Boggabri Coal Operations Pty Ltd

Boggabri Coal Mine
Biodiversity Offset Strategy

4 August 2017

PARSONS BRINCKERHOFF

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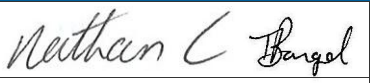
Prepared by:	Nathan Cooper, Tanya Bangel	Date: 04/08/2017	Signature: 
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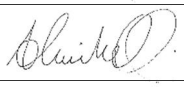
Approved by:	Alex Cockerill	Date: 16/06/2016	Signature: 

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Glossary

BioBanking	Refers to the NSW Biodiversity Banking and Offsets Scheme.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: ▪ Genetic diversity — the variety of genes (or units of heredity) in any population ▪ Species diversity — the variety of species ▪ Ecosystem diversity — the variety of communities or ecosystems.
Bioregion (region)	A bioregion defined in a national system of bioregionalisation. For this study this is the NSW Brigalow Belt South bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).
Biodiversity Offset Area (BOA)	Refers to the property or properties acquired by Boggabri Coal to offset project related impacts to native vegetation and fauna habitats.
Box Gum Woodland	Refers collectively to White Box Yellow Box Blakely's Red Gum and Derived Native Grassland community as listed as endangered under the TSC Act and critically endangered under the EPBC Act
CoA	Conditions of Approval.
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 both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* and both the State (Department of Environment and Climate Change) and Commonwealth (Department of the Environment, Water, Heritage and the Arts) Directors-General 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.
Department of the Environment (DoE)	A most recent former name of the Commonwealth Department of Environment and Energy (DoEE).
Department of the Environment and Energy (DoEE)	The Commonwealth Department of the Environment and Energy (DoEE), formerly the DoE, SEWPAC and DEWHA. The department develops and implements national policy, programs and legislation to protect and conserve Australia's natural environment and cultural heritage and administers the *Environment Protection and Biodiversity Conservation Act 1999.*
Department of Environment, Climate Change and Water (DECCW)	The most recent former name for the NSW Office of Environment and Heritage (OEH).

Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)	A former name of the Commonwealth Department of Environment and Energy (DoEE).
Department of the Environment, Water, Heritage and the Arts (DEWHA)	A former name of the Commonwealth Department of Environment and Energy (DoEE).
Ecological community	An assemblage of species occupying a particular area.
Environmental weed	Any plant that is not native to a local area that has invaded native vegetation.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic components.
Likely	Taken to be a real chance or possibility (Department of Environment and Conservation 2004).
Local population	The population that occurs within the study area, 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 NSW National Parks and Wildlife Service 1996).
Subject site	The area to be directly impacted by the construction and/or operation of the proposal.
Project boundary	The subject site and an additional area of investigation around the study site that could potentially be affected by the project indirectly.
Locality	The area within a 10 km of the study area.
Significant	Important, weighty or more than ordinary (as defined by NSW National Parks and Wildlife Service 1996) (Department of Environment and Climate Change 2007).
Threatened biodiversity	Threatened species, populations or ecological communities, or their habitats as listed under either the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999*.
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 *Threatened Species Conservation Act 1995, Fisheries Management Act 1994* or the *Environment Protection and Biodiversity Conservation Act 1999*. Capitalisation of the terms 'Threatened', 'Vulnerable', 'Endangered' or 'Critically Endangered' in this report refers listing under the relevant State and/or Commonwealth legislation.

1. Introduction

This revised biodiversity offset strategy (BOS) has been developed for the Boggabri Coal project (the project) on behalf of Boggabri Coal Operations Pty Ltd (Boggabri Coal), a joint owned subsidiary of Idemitsu Australia Resources Pty Limited (80%), Chugoku Electric Power Australia Resources Pty. Ltd (10%) and NS Boggabri Pty Limited (10%).

This report addresses Schedule 3 Condition 43 of the project's state conditions of approval which requires Boggabri Coal to prepare and implement a revised BOS. Under Condition 43, the revised BOS must satisfy a set of requirements including the incorporation of an additional 1000 ha and additional project modification offset requirements as identified in Table 15 of Condition 39. Full details regarding these conditions are provided in Section 3.2.

The revised BOS has been prepared in accordance with the project's approved environmental assessment including the Boggabri Coal BOS which was approved by the Director-General.

Furthermore, this revised BOS has been prepared with reference to the Leard State Forest regional biodiversity Stage 1 – Scoping report and recent changes to the NSW Biodiversity offset policy's and guidelines including the Office of Environment and Heritage's (OEH) principles for the use of biodiversity offsets in New South Wales (NSW), Plant Community Types (PCTs) for classifying vegetation and the NSW Biodiversity Offsets Policy for major projects – Framework Biodiversity Assessment (FBA) methodology.

1.1 Project background

The project comprises an open cut coal mine located approximately 15 km north-east of the township of Boggabri in north-western NSW. Exploration and development studies commenced in the vicinity of the Boggabri Coal Mine in 1976. Approval for mining operations was initially granted on 22 August 1989 under Part 4 of the EP&A Act. Major development of the site began in the mid 2000's, with coal mining commencing in 2006 using truck and shovel methods. Infrastructure constructed for the mine before production of coal included:

- 17 km bitumen sealed private coal haul road from the mine to the Boggabri Coal Terminal (BCT) rail
- loading facility, including bridges over the Namoi River and Kamilaroi Highway
- ROM and product coal stockpiles
- coal crushing plant
- conveyor and truck load out facility
- 3 km rail loop and turnout
- mine infrastructure area (MIA) including workshop and offices.

In 2009, BCPL lodged a major project application under the now-repealed Part 3A of EP&A Act. This continuation is known as the Boggabri Coal Project and it includes:

- production of up to seven Million tonnes per annum (Mtpa) product coal
- construction of an additional CHPP
- a 17 km rail spur line and rail load-out facility running from the main line to the CHPP
- upgraded mining fleet, including use of a dragline
- upgrades of other ancillary infrastructure.

The Boggabri Coal Project was approved under project approval 09_0182 (the project approval), which was awarded on 18 July 2012. Impacts associated with the Boggabri Coal Project were assessed through the *Continuation of Boggabri Coal Mine Environmental Assessment December 2010* (Hansen Bailey 2010a) (the 2010 EA).

BCPL subsequently applied for modifications (MODs) of the project approval, to modify the project's approval boundary for additional activities and ancillary infrastructure. Environmental assessments and associated approvals in accordance with the EP&A Act have been completed for modification 3, 4 and 5. In addition to the projects modifications, Boggabri Coal has made commitments to provide additional offsets for impacts associated with the Goonbri Road Upgrade assessed under Part 5 of the EP&A Act and non-approved clearing of understory vegetation outside of the approved project boundary as detailed in the letter to Department of Planning and Environment (DP&E) dated 29 May 2015. A description of the activities associated with each of the additional offsets commitments is provided below in Sections 1.1.1 - 1.1.3, Section 3.1 and Appendix A.

1.1.1 Modifications to project approval

In addition to the project's impacts approved for the Boggabri Coal Mine extension there have been a number of modifications to the project boundary. These modifications have included:

- **Modification 3 –** construction of permanent mine access from the Kamilaroi Highway, temporary storage of processed mine over burden material at existing rock quarry and reuse of material for construction of the rail spur embankments and reuse of the Daisymede laydown compound.
- **Modification 4 –** adjustment of project boundary, alterations to existing infrastructure, construction of security fence and the use of addition portable fuel storages within operational areas.
- **Modification 5 –** construction and operation of production bores and associated infrastructure on the Heathcliffe, Cooboobindi, Roma, Belleview and Victoria Park properties including 11 kV power lines, above and below ground pipelines and access tracks.

A summary of the specific impacts on biodiversity associated with each of the modifications is provided in Appendix A. Specific commitments for additional offsets associated with each modification is provided in Table A1.4 of Appendix A. Figures depicting biodiversity to be impacted for each modification are provided in Appendix A (Figure A1.2, Figure A1.3, Figure A1.4, Figure A1.5, Figure A1.6).

1.1.2 Commitments to offsets Goonbri Road Upgrade

Leard State Forest Road was the only road that passed from the south-west to the north-east through Leard State Forest. Given the location of approved future mining operations and other site rail infrastructure for the Boggabri Coal project, Leard State Forest Road has been decommissioned and replaced by the Goonbri Road Upgrade (Idemitsu Boggabri Coal 2013). Although the Goonbri Road Upgrade does not fall within the Boggabri Coal project boundary the realignment does pass through the Wirrilah biodiversity offset area approved in the BOS. An overview of the location of the Goonbri Road Upgrade in relation to the biodiversity offsets and vegetation communities within the disturbance area associated with this project are provided in Figure A1.7 of Appendix A.

A summary of the impacts on biodiversity associated with the Goonbri Road Upgrade are provided in Table 1.1 below.

Table 1.1 Potential loss of vegetation within the Goonbri Road study area

Vegetation community/fauna habitat	Extent within study area (ha)	Vegetation clearing within study area (ha)
Pilliga Box – Poplar Box – White Cypress Pine grassy woodland	5.8	2.6
White Box-Narrow-leaved Ironbark Grassy Woodland[1]	2.1	0.7
Red Gum Grassy Woodland [1, 2]	4.3	1.2
Derived Native Grassland with scattered native trees[1]	25.6	4.1
Modified Grassland with scattered native trees	87.7	25.0
Total area	**125.5**	**33.6**
Total area of native vegetation	**37.8**	**8.6**
Total area of TSC Act Endangered Ecological Community[1]	**32**	**6.0**
Total area of EPBC Act Critically Endangered Ecological Community[2]	**4.3**	**1.2**

(1) Endangered Ecological community, White Box Yellow Box Blakely's Red Gum Woodland (TSC Act)
(2) Critically Endangered Ecological community, White Box Yellow Box Blakely's Red Gum grassy woodlands and derived native grassland as listed on the EPBC Act.

The condition of approval for the Goonbri Road Upgrade (dated 28 March 2014) relevant to the revised BOS states;

Condition 9; *Biodiversity offsets for the impacts from the Goonbri Road Upgrade shall include a minimum of 40.4 ha of native vegetation and threatened species habitat, selected based on the principles outlined in the approved Boggabri Coal Expansion Project Biodiversity offset Strategy.*

This revised BOS has been developed to incorporate these additional commitments to offset areas.

1.1.3 Commitments to provide offsets for clearing outside project boundary

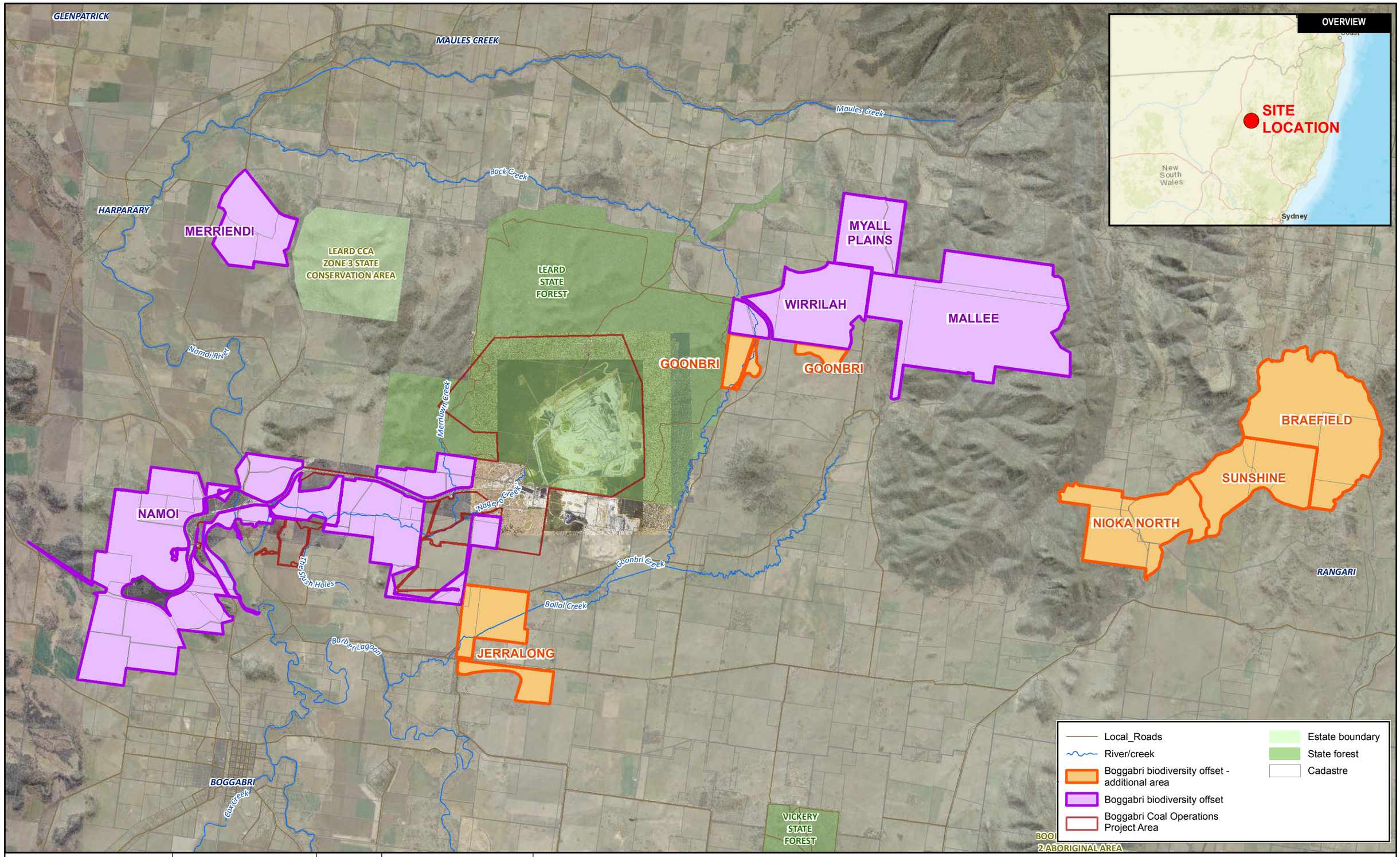
An oversight of a small area of understorey clearing outside of the mine disturbance limit (Boggabri extension) but inside the project boundary, has occurred during the clearing works in 2014. The clearing included the understorey clearing of 7.7 ha of White Box – Narrow-leaved ironbark – White Cypress Pine shrubby open forest. The Department of Planning was informed of this incident who issued mitigation measures. Part of these mitigation measures (No. 6) included an additional offset area to be incorporated into the revised BOS to offset the non-compliance clearing which occurred outside the mine disturbance limit at a ratio of 2.5:1 (Idemitsu Boggabri Coal 2015). Boggabri Coal has committed to provide an offset area of at 19.3 ha of 'Like to Like' remnant vegetation which has been set aside from the recently purchased offset properties.

1.1.4 Changes in biodiversity offset vegetation mapping

In accordance with Condition 9 of the project's EPBC approval an independent audit of the approved BOS (Parsons Brinckerhoff 2010a) was undertaken to '*validate the quantity, quality and ecological characteristics of the offset areas in line with the requirements of the department's Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012*'.

Results of the independent audit in December 2013 made changes to the vegetation community/habitat extents within the Biodiversity Offset Areas (BOAs) (Niche Environment and Heritage 2014).The verified vegetation community mapping undertaken as part of the independent audit have been adopted in this revised BOS. The revised vegetation mapping is presented in Appendix A.

As part of this independent audit, large areas of exotic grasslands which formed part of the 626 ha of additional land within the within the Namoi Offset Area, Eastern Offset Area and Crown Reserve Land to be managed as corridor enhancement were reclassified as derived native grasslands. Subsequently, due to the vegetation reclassification, the corresponding management zones for the majority of these areas were changed from Corridor Enhancement to Habitat Restoration.



Map: 2267037B_GIS_BOS017_A1	Author: SuansriR		
Date: 21/06/2017	Approved by: - CooperN		

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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BIODIVERSITY OFFSET STRATEGY

Figure 1.1
Locality plan

1.2 Aims of the revised BOS

The overall objective of this revised Boggabri Coal BOS is to detail the ecological values that will result from the project and how these impacts will be offset. Specifically, the BOS aims to:

- prepare a BOS in accordance within the projects CoA and consideration of the relevant NSW policy's and guidelines
- consult with the community and regulators to provide input into the development of the Boggabri Coal BOS
- prepare a BOS that enhances connectivity within the Regional East-West Wildlife Corridor
- provide information on the biodiversity values of the BOAs that have been acquired by Boggabri Coal as offsets
- recommend potential BOA management areas for management, restoration and rehabilitation within land owned by Boggabri Coal and land acquisitions
- determine the management and monitoring requirements for biodiversity offset measures proposed to ensure outcomes of the package are achieved
- determine whether the current BOAs adequately compensate the projects impacts on local biodiversity
- determine the appropriate conservation mechanisms to secure the BOAs in perpetuity.

2. Biodiversity offset policies and guidelines

The former Department of Planning (now Department of Planning and Environment) established a Biodiversity Offset Working Group for the Boggabri project to assist in developing an appropriate level of biodiversity offsets to mitigate the impacts of the project. The Biodiversity Offset Working Group included representatives from the former Department of Planning (now Department of Planning and Environment), the former Department of Environment, Climate Change and Water (now Office of Environment and Heritage), the former Department of Sustainability, Environment, Water, Population and Communities (now Department of Environment and Energy), the former Department of Industry and Investment (now Department of Industry), the former Forestry NSW (now Forestry Corporation) and Boggabri Coal. It was determined and agreed through the above committee that the Biodiversity Offset requirements for the project and the Boggabri Coal BOS approved by the Director-General (Parsons Brinckerhoff 2010b) would be developed on a principles based approach with an emphasis and consideration of:

- The use of rehabilitation/restoration of existing lands for biodiversity.
- The regional context of the strategy and potential for restoration of Regional East-West Wildlife Corridor.
- Purchase of high value biodiversity lands.
- The provision for 'broad regional benefits' to biodiversity.
- Compensatory lands for forest production.
- More generally that the strategy meets the principles of Ecological Sustainable Development and State and Federal biodiversity offsets guidelines, including;
  - NSW Native Vegetation Act 2003
  - the Department of Environment Climate Change and Water (DECCW) (now OEH) offsetting principles
  - NSW BioBanking Scheme and BioBanking Assessment Tool
  - the Department of the Environment, Water, Heritage and the Arts (DEWHA) Draft Offset Policy (2007)
  - Brigalow and Nandewar Western Regional Assessment (BNWRA)
  - Brigalow and Nandewar Community Conservation Area Agreement (BNC Agreement).

The revised BOS has also been developed with reference to:

- Leard State Forest regional biodiversity Stage 1 – Scoping report (Umwelt Environmental Consultants 2015).
- the NSW OEH *Principles for the use of biodiversity offsets in NSW* (2014d)
- the NSW OEH *BioBanking Assessment Methodology* (BBAM) and Plant Community Types (PCTs) classification of vegetation type boundaries (2014a)
- the *NSW Biodiversity Offsets Policy for Major Projects - Framework Biodiversity Assessment* (FBA) methodology (Office of Environment and Heritage 2014c).

2.1 Principles for the use of biodiversity offsets in NSW

The original project approval and BOS was based on the principles based approach, using the previous offsetting principles (Department of Environment Climate Change and Water (DECCW) now OEH (2008)) and guidelines. However subsequent modifications considered the principles from a revised offset policy as described below.

The OEH have provided guidelines for developing biodiversity offsets to achieve conservation outcomes, particularly for projects where there will be an unavoidable loss of biodiversity (Office of Environment and Heritage 2014d). Although not a defined requirement under legislation, these guidelines provide a list of 13 principles to be followed when developing biodiversity offsets:

- impacts must be avoided first by using prevention and mitigation measures
- all regulatory requirements must be met
- offsets must never reward ongoing poor performance
- offsets will complement other government programs
- offsets must be underpinned by sound ecological principles
- offsets should aim to result in a net improvement in biodiversity over time
- offsets must be enduring - they must offset the impact of the development for the period that the impact occurs
- offsets should be agreed prior to the impact occurring
- offsets must be quantifiable - the impacts and benefits must be reliably estimated
- offsets must be targeted
- offsets must be located appropriately
- offsets must be supplementary
- offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

2.2 NSW Biodiversity Offsets Policy for major projects

In October 2014, the NSW Biodiversity Offsets Policy for Major Projects (Offsets Policy 2014) was implemented and became mandatory for all state significant development (SSD) and state significant infrastructure (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 in accordance with its current BOS approved under previous offset policy, consideration to the principles outlined in the recent NSW (Offset Policy 2014) policy is also 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 project have been 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 offsets 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.
- Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.
  - The offsets have been 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 and/or adjoining 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 offsets are in accordance with 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 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 project will be direct land based and not require supplementary measures.

2.3 Consultation of revised biodiversity offset strategy

The Boggabri Coal BOS approved as part of the environmental assessment and this revised BOS has been developed in consultation with DP&E, OEH, DP&I-Lands and Namoi Catchment Management Authority (CMA) (now North West Local Land Services (NWLLS). A summary of the consultation to date includes:

- On 18 July 2012 Idemitsu and Parsons Brinckerhoff met with David Kitto from DP&I to discuss the projects approval conditions specifically in relation to the BOS previously prepared for the modification.
- On 20 November 2013 Idemitsu and Parsons Brinckerhoff met with OEH (Peter Christie and Sonya Ardill) to discuss the development of the BOS in particular the acquisition of identified additional offset properties.
- On 20 November 2013 Idemitsu and Parsons Brinckerhoff met with David Kitto and Mike Young from DP&I to discuss the development of the BOS in particular the acquisition of identified additional offset properties.
- DP&I identified that while the regional strategy was still in development and uncertainty remained on the timing of the Stage 1 and Stage 2, DP&I would be supportive of Idemitsu moving forward with the development of a revised BOS incorporating the additional 1000 ha of Box Gum Woodland.
- On 21 April 2015 Idemitsu and Parsons Brinckerhoff met with Peter Christie from OEH to present the revised BOS properties and implementation plans for threatened biodiversity.
- OEH identified that the revised BOS should include the species-specific outcomes in regards to habitat provided within the biodiversity offsets, ratios and a split between the remnant and proposed restoration of derived grassland.
- OEH requested that the vegetation types within the biodiversity offset areas be linked to the state-wide classification of vegetation (PCTs).

- On 23 April 2015 Idemitsu and Parsons Brinckerhoff met with Dennis Boschma from North West Local Land Services (NWLLS) to present and discuss the BOS additional properties and implementation plans for TS.
- On 4 June 2015 Boggabri Coal and Parsons Brinckerhoff met with Steve O'Donoghue from DP&E and Terry Mazzer from OEH and inspected the Nioka North and Sunshine Offsets.
- Detailed ecological reports on the biodiversity offset properties were also provided to DP&E in June 2015.
- The BMP and BOS has been sent to DoE for comment it has been received by DoE. No further comments were provided.
- DP&E provided comments on the BOS in correspondence dated 28 October 2015. These comments have been incorporated and addressed in the revised BOS. The BOS was discussed in the CCC meeting on the 15th of November 2015 no comments at the meeting. No further comments were provided.
- OEH provided comments on the BOS in correspondence provided on the 18 January 2016. These comments have been considered and addressed in the revised BOS.
- The BMP and BOS has been sent to the CCC on the 16th of February 2016, and was discussed at the CCC on the 3rd of March. No further comments were provided.
- Boggabri Coal have undertaken ongoing consultation with the DPI-Lands (letter date 18th February 2016 and meeting with Danny Young on the 23 February 2016), regarding the proposed purchase and /or land management of these remaining Crown Land parcels (approximately 330.7 ha) previously identified within the BOS. In a letter dated 11 March 2016, DPI-Lands have advised Boggabri Coal that they are unlikely to be in a position to sell and/or agree to the management for conservation of the majority of the remaining land parcels. Given the unlikely suitability of these land parcels and associated timeframes identified by DPI-Lands of any potential sale, the revised BOS has been prepared in accordance with Condition 43, which will *identify substitute areas that would provide an equivalent increase in biodiversity values* to the residual 298.9 ha of land.
- November 2016, Boggabri Coal and WSP | Parsons Brinckerhoff met with Steve O'Donoghue from DP&E and Steve Cox from OEH and inspected the additional offset properties Braefield, Goonbri and Jerralong.
- OEH provided comments on the BOS in correspondence provided on 15 May 2017. These comments have been considered and addressed in the revised BOS.
- On 1 June 2017 Boggabri Coal and WSP met with OEH to present and discuss the revised BOS, specifically regarding OEH recommendations for the BOS - August 2016 version.

3. Biodiversity offset required for the project

3.1 Project related impacts to vegetation and habitat

The majority of the works for the project will be located within vegetated or relatively undisturbed areas and will require clearing of native vegetation. The development of a Boggabri Coal BOS has been specifically targeted at addressing the projects residual impacts. Despite the project's mitigation measures, it will still have a number of residual impacts on biodiversity including:

- clearing of vegetation and habitat disturbance
- removal of dead wood and trees
- fragmentation and edge effects
- noise and other human disturbance
- soil erosion and compaction
- fauna injury
- increased weed invasion.

The most significant impact of the project will be loss of native vegetation and associated habitats. The projects cumulative impacts (incorporating the project approval, modification 3, modification 4, modification 5, Goonbri Road Upgrade, and the clearing outside of the Project boundary) will result in the loss of native vegetation within the subject site including up to 1,458.5 ha of native vegetation which includes up to 637.8 ha of threatened ecological communities (including Box-Gum Woodland, Weeping Myall Woodlands, Plains Grassland, Aquatic ecological community in the natural drainage system of the Lowland Catchment of the Darling River and Plains Grassland) and associated habitat for threatened flora and fauna species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, NSW *Threatened Species Conservation Act 1995* and *Fisheries Management Act 1994* (Parsons Brinckerhoff 2010b).

A summary of the extent of each vegetation community and associated fauna habitat to be impacted by the project and the subsequent biodiversity offsets required to offset impacts are provided in Table 3.1.

Table 3.1 Potential loss of vegetation and habitat associated with the project

Vegetation communities[1]	Plant community types[2]	Boggabri continuation EA impacts	Mod 3 impact area	Mod 4 impact area	Goonbri Road impact area	Mod 5 impact area	Illegal clearing	Total project disturbance (ha)[8]
Threatened ecological communities								
Box Gum Woodland CEEC[3,4]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions and PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	623.6	2.6	1.2	1.9			629.3
Box Gum Woodland CEEC[3,4]– derived native grassland				0.7	4.1			4.8
Plains Grassland CEEC[5]	PCT102 / BVT NA181: Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion	0.4				0.1		0.5
Weeping Myall Woodland EEC[6]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	0.3				0.1		0.4
Natural Drainage System of the Lowland Catchment of the Darling River EEC[7]	PCT78 / BVT NA193: River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	0.6		0.9		1.3		2.8
Subtotal threatened ecological communities		**624.9**	**2.6**	**2.8**	**6.0**	**1.5**	**0**	**637.8**
Other vegetation communities								
Dwyer's Red Gum woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	0.3	0.0	0.0	0.0	0.0	0.0	0.3

Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest	PCT1380 / BVT NA163: Narrow-leaved Ironbark - pine - Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion	14.8	0.0	0.0	0.0	0.0	0.0	14.8
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	175.1	0.0	1.2	0.0	0.0	7.7	184
Pilliga Box – Poplar Box – White Cypress Pine grassy open woodland	PCT 88 / BVT NA 179 Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion	10.3	10.7	17.2	2.6	6.1	0.0	46.9
Pilliga Box – Poplar Box – White Cypress Pine grassy open woodland – derived native grassland		26.1	0.0	0.8	0.0	11.2	0.0	38.1
White Box – Melaleuca riverine forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	0.6	0.0	0.0	0.0	0.0	0.0	0.6
Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	528.8	0.0	3.5	0.0	0.0	0.0	532.3
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion	3.7	0.0	0.0	0.0	0.0	0.0	3.7
Myrtle Shrubland (+- White Pine/Tumbledown Red Gum)	PCT427 / BVT NA410: Cypress pine – Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White Pine/Narrow Leaved Ironbark Shrub/Grass Open	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Forest – derived native grassland								
Other – derived native grassland	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other – remnant and derived native grassland		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal other vegetation		**759.7**	**10.7**	**22.7**	**2.6**	**17.3**	**7.7**	**820.7**
Total vegetation		**1,384.6**	**13.3**	**25.5**	**8.6**	**18.8**	**7.7**	**1,458.5**
Fauna habitats for threatened species (excluding exotic grassland)								
Grassy Woodland on fertile soils		634.2	13.3	19.3	4.5	6.2		676.6
Shrubby Woodlands/Open Forest on skeletal soils		722.7		4.7			7.7	733.9
Riverine Woodland		1.2				1.3		2.5
Grassland		26.5		1.5	4.1	11.3		42.7
Total fauna habitat		**1,384.6**	**13.3**	**25.5**	**8.6**	**18.8**	**7.7**	**1,458.5**

(1) Continuation of Boggabri Coal Mine Environmental Assessment (Hansen Bailey 2010).
(2) Plant Community Type classification is maintained in the Vegetation Information System classification database (Office of Environment and Heritage 2017).
(3) Critically Endangered Ecological Community, White Box -Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the EPBC Act.
(4) Endangered Ecological Community, White Box – Yellow Box – Blakely's Red Gum Woodland Endangered Ecological Community listed under the TSC Act.
(5) Critically Endangered Ecological Community, Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland.
(6) Endangered Ecological Community, Weeping Myall Woodlands.
(7) Endangered Ecological Community, Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River FM Act.
(8) Disturbance areas include the continuation of Boggabri Coal Mine EA, Modification 3, Modification 4, Modification 5, Goonbri Road Upgrade and non-approved understorey clearing area.

3.2 Project Conditions of Approval (Biodiversity)

Under Condition 39 of the Project Approval, Boggabri Coal were required to implement the BOS described in the Environmental Assessment, which is summarised in Table 3.2. In addition, under Condition 43 of the Project Approval, Boggabri Coal are required to offset an additional 1,000 ha including the protection of 650 ha of Box Gum Woodland ecological community and the restoration of 350 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community listed under the TSC Act. Boggabri Coal were also required to provide additional offsets for the impacts associated with project modifications (3, 4 and 5), non-approved clearing outside the project boundary and the Goonbri Road Upgrade outlined in Section 1.1.

Table 3.2 Summary of the Boggabri Biodiversity Offset Strategy

Area	Offset Type	Minimum area (hectares)
Condition 39 requirements		
Merriendi Offset Area	Existing native vegetation to be protected and enhanced and additional native vegetation to be established with the restoration of at least 170.1 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	541
Namoi Offset Area	Existing native vegetation to be protected and enhanced and additional native vegetation to be established with restoration of at least 491 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	2,427
Eastern Offsets (Wirrilah/ Myall Plains/ Mallee)	Existing native vegetation to be protected and enhanced and additional native vegetation to be established with restoration of at least 430 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	3,247
Additional Offset Area (location subject to final approval as part of the revised Biodiversity Strategy to be prepared by Boggabri Coal)	Proposal for 650ha of existing Box Gum Woodland EEC to be enhanced and restoration of an additional 350 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	1,000
Additional land within Namoi Offset Area, Eastern Offset Area and Crown Reserve Land managed for Corridor Enhancement	Located on poor condition (for biodiversity conservation) land but managed to improve connectivity in offset corridors.	626[1]
Rehabilitation Area	Except for the area of the minimised final void, pre-mining native vegetation communities are to be re-established for a biodiversity conservation land use objective, with the area subject to finalisation of the rehabilitation management plan as required under this approval.	1,508[2]
	Sub-total	**7,215[3]**
Condition 43 requirements		
Additional modification offset area (Modification 3) (Note: Location subject to final approval as part of revised Biodiversity Strategy to be prepared by Boggabri Coal)	Existing native vegetation to be protected and enhanced including at least 63 ha of Pilliga Box Woodland and 16 ha of Box Gum Woodland EEC as listed under the TSC Act.	103

Area	Offset Type	Minimum area (hectares)
Additional modification offset area (Modification 4) (Note: Location subject to final approval as part of revised Biodiversity Strategy to be prepared by Boggabri Coal)	Existing native vegetation to be protected and enhanced including at least: ■ 8 ha of Box Gum Woodland EEC as listed under the TSC Act; ■ 103 ha of Pilliga Box Grassy Open Forest or open grassy vegetation community of higher conservation status; ■ 21 ha of Narrow leaved ironbark shrubby open forest or shrubby open forest of higher conservation status; ■ 1 ha of River Red Gum Riparian Woodlands and Forest or riparian woodland/ forest of higher conservation status (note: due to a deficit of remnant River Red Gum woodland, 2.4 ha of River Red Gum Derived Native Grassland required for offset).	133[4]
Additional modification offset area (Modification 5) (Note: Location subject to final approval as part of revised Biodiversity Strategy to be prepared by Boggabri Coal)	Existing native vegetation to be protected and enhanced including at least: ■ 1 ha of Weeping Myall Woodland EEC as listed under the TSC Act; ■ 1 ha of Plains Grassland or grassland of higher conservation value; ■ 7 ha of River Red Gum Riparian Woodlands and Forest or riparian woodland/ forest of higher conservation status (note: due to a deficit of remnant River Red Gum woodland, 24.7 ha River Red Gum Derived Native Grassland required for offset); ■ 34 ha of Pilliga Box Grassy Open Forest or open grassy vegetation community of higher conservation status.	106[4]
Crown Reserve Land within Namoi Offset Area	Additional funding /management agreement with DPI towards management of Special Lease/Crown Reserve land.	441
	Sub-total	**783**
Goonbri Road Upgrade	40.4 ha of native vegetation and threatened species habitat, including: ■ 3.3 ha of Box Gum woodland ■ 19.3 ha Box Gum Woodland Derived Native Grassland	40.4
Un-approved clearing	19.3 ha of White Box – Narrow-leaved Ironbark White Cypress Pine shrubby open forest	19.3
	Sub-total	**59.7**
	Total[5]	**8,057.7[5]**

(1) The sub-total for condition 39 excludes the 626 ha of additional land within the Namoi Offset Area, Eastern Offset Area and Crown Reserve Land identified for corridor enhancement. Areas of corridor enhancement were identified as poor condition land for biodiversity conservation and were excluded from the total 'like for like' offset area committed by the project.

(2) The sub-total for Condition 39 excludes the 1,508 ha associated with the mine rehabilitation area as it does not form part of the revised BOS.

(3) The sub-total for Condition 39 excludes the 626 ha of additional land identified for corridor enhancement and 1,508 ha of mine rehabilitation area.

(4) Due to an 8 ha deficit in remnant River Red Gum riparian woodland, a total offset of 135.4 ha and 130.7 ha is required to offset Modification 4 and Modification 5 respectively.

(5) Due to an 8 ha deficit in remnant River Red Gum riparian woodlands associated with Modification 4 and Modification 5, the OEH recommended a suitable replacement offset of restoring 27.1 ha of River Red Gum Derived Native Grassland. Consequently, the total offset area committed in this revised BOS totals 8,076.8 ha.

4. Biodiversity offset strategy

The Boggabri Coal BOS has been developed to ensure the long-term conservation of the local biodiversity and that the project will 'improve or maintain' the biodiversity value of the region.

Significantly the Boggabri Coal BOS will result in the dedication and enhancement of significant areas of habitats for locally occurring threatened species and communities to be impacted by the project. It also provides for targeted restoration and management of threatened ecological communities, particularly Box Gum Woodland.

The key measures for the Boggabri Coal BOS include:

- restoration and establishment of a network of regional and local wildlife corridors, providing linkages between important large isolated remnants within the region
- establishment of long-term biodiversity offsets and management areas for conservation of existing vegetation habitats for locally occurring threatened species and ecological communities, particularly Box Gum Woodland
- targeted restoration and revegetation of the Leard State Forest disturbance area to natural vegetation communities under joint management for biodiversity conservation and forestry, particularly areas of Box Gum Woodland and provision for establishing a eucalypt plantation forest
- a consolidated ecological management program across biodiversity offsets and network of wildlife corridors.

4.1 Leard Forest mining precinct regional biodiversity strategy

Schedule 3 Condition 43 of the project's approval outline that the revised Boggabri Coal BOS is to be consistent with the recommendations and objectives of the Leard Forest mining precinct regional biodiversity strategy (the regional strategy).

Due to delays in preparing the Stage 2 regional strategy and additional modifications to the project boundary, Boggabri Coal have progressed and finalised this revised BOS in accordance with the Leard State Forest regional biodiversity Stage 1 – Scoping report.

The locations of BOAs acquired by Boggabri Coal have been selected given their location within the proposed geographic extent of the Leard State Forest regional biodiversity Stage 1 – Scoping report (Umwelt Environmental Consultants 2015).

4.2 Connectivity

Connectivity of habitats is essential to the long-term survival of many species because it facilitates movement on a local scale, for foraging and sheltering, as well as on a regional scale as a wildlife corridor, for dispersal and migration. Remnants with habitat linkages are more likely to maintain their biodiversity in the long-term because wildlife corridors:

- provide increased foraging areas for wide-ranging species
- provide cover for movement between habitat patches, particularly for cover-dependant species and species with poor dispersal ability and enhancing the movement of animals through sub-optimal habitats

- reduce genetic isolation
- facilitate access to a mix of habitats and successional stages to those species which require them for different activities (for example foraging and breeding)
- provide refuge for disturbances such as fire
- provide habitat in itself
- link wildlife populations and maintain immigration and re-colonisation between otherwise isolated patches. This in turn may help reduce the risk of population extinction (Wilson & Lindenmayer 1995).

Connectivity of habitats creates larger remnants that are likely to be of a higher quality and support higher biodiversity. Offsets are likely to be of greater biodiversity value where they are located adjacent to remnant vegetation creating a larger remnant or where they provide linkages within otherwise fragmented landscapes. As a result, the revised Boggabri Coal BOS has been developed in the intention of enhancing existing corridors including the re-establishment of the Regional East-West Wildlife Corridor to link Leard State Forest to the Nandewar Range, Namoi River, Leard State Conservation Area and other large remnants.

4.2.1 Regional East-West Wildlife Corridor

A history of intensive agriculture land use comprising primarily sheep and wheat activities dominates the project locality. These activities resulted in the isolation of the Leard State Forest remnant from other isolated remnants within locality and region. Historically, the Nandewar Range, Leard State Forest and Namoi River floodplain were once linked by a contiguous corridor of native vegetation. The Boggabri Coal BOS has been developed with the intention of recreating habitat linkages within this important environmental corridor, linking existing remnant patches of native vegetation and increasing the overall biodiversity value of the area. The re-establishment of the Regional East-West Wildlife Corridor will facilitate the movement of threatened species throughout the region and provide for the conservation and restoration of large areas of threatened ecological communities, including Box Gum Woodland.

Boggabri Coal have acquired a number of BOAs for inclusion into the revised BOS to recreate linkages within the Regional East-West Wildlife Corridor. These properties have been selected based on their conservations values (commensurate with the impacts of the project) and their location within the Regional East-West Wildlife Corridor. The BOAs located within the Regional East-West Wildlife Corridor are illustrated in Figure 4.1.

The Regional East-West Wildlife Corridor complements existing offsets strategies in the region and will provide an opportunity for future offsets to build upon. Locally the Boggabri Coal revised BOS links with the Tarrawonga Mine and Maules Creek Mine biodiversity offsets by further facilitating through rehabilitation the link between the Leard State Forest and Nandewar Range, Namoi River and Leard State Conservation Area. From a regional perspective, the Boggabri Coal BOS provides for the establishment of linkages to the Nandewar Range and the Whitehaven regional biodiversity offsets site adjoining the Kelvin State Forest to the south.

4.3 Original Biodiversity Offset Areas

Five regionally significant BOAs were secured as part of the original Boggabri Coal BOS. These offsets comprised:

- Merriendi BOA – 547 ha
- Namoi BOA – 3,336.5 ha
- Wirrilah BOA – 873.1 ha
- Myall Plains BOA – 480.4 ha
- Mallee BOA – 2,066.2 ha.

Each of these BOAs are incorporated and built on, in the revised BOS. They contain large patches of remnant vegetation and retain high quality habitats that adjoin existing vegetated lands and will facilitate the creation of a broad Regional East-West Wildlife Corridor linking the Namoi River with the Nandewar Range.

The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement. Figure A1.8 in Appendix A illustrates the full extent of the Namoi BOA that is subject to the joint venture.

A comprehensive description of the biodiversity values within each of the properties is provided in the Appendix B.

4.4 Additional Biodiversity Offset Areas

To meet the projects residual offset requirements under Condition 43, Boggabri Coal have acquired five additional BOAs. Each of the additional BOAs are within the study area of the Leard State Forest Regional Biodiversity Stage 1 – Scoping Report and will further contribute to and extend the Regional East-West Wildlife Corridor. These additional BOAs include:

- Sunshine – 738.1 ha
- Nioka North – 867.9 ha
- Goonbri – 223.4 ha
- Jerralong – 570.1 ha
- Braefield – 1,400.7 ha.

A general summary of each of the BOAs acquired for inclusion within the revised BOS is provided in Table 4.1 below and the vegetation communities/ PCT's they contain is provided in Table 4.2 and illustrated in Figure 4.1.

A comprehensive description of the biodiversity values within each of the BOAs is provided in Appendix B. Field survey reports validating the vegetation communities, habitats and species present within each of the additional BOAs are provided in Appendix C (Jerralong and Goonbri BOAs), Appendix D (Nioka North and Sunshine BOAs) and Appendix E (Braefield BOA).

Table 4.1 Summary of biodiversity values within Boggabri Coal Biodiversity Offset Areas

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
Original BOAs							
Merriendi	Grassland Grassy Woodland on fertile soils Shrubby Woodlands /Open Forest on Skeletal soils	216.2 180.2 150.6	The majority of the Merriendi BOA comprises woodland habitats considered to be of high quality. These are characterised by native grasses, fallen timber, leaf litter and loose rock. Many of the box trees host hollows suitable for small birds, arboreal mammals and reptiles, tree frogs and microbats.	 Derrived Grassland on southern lower slope Shrubby Woodand on steep central ridge	Brown Treecreeper Diamond Firetail *Digitaria porrecta* Eastern Cave Bat Grey-crowned babbler Hooded Robin Speckled Warbler Dusky Woodswallow Masked Owl	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Barking Owl, Spotted Harrier, Square-tailed Kite and Little Lorikeet, Superb Parrot, Black Falcon) **Microbats** (Eastern Bent-wing Bat, Yellow-bellied Sheathtail-Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Spotted-tailed -Quoll, Koala, Squirrel Glider) **Herpetofauna** (Border Thick-tailed Gecko, Sloane's Froglet) **Flora** (*Pomaderris queenslandica, Diuris tricolor*)	Box Gum Woodland State 1 (Woodland) 177.4 ha State 2 (Derived Native Grasslands) 194.9 ha Weeping Myall Woodland (EPBC Act and TSC Act) 2.8 ha

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
Namoi	Grassland Grassy Woodland on fertile soils Riverine Woodland Shrubby Woodlands /Open Forest on skeletal soils Other land (intensive agriculture and farm dams)	1,431.5 609.5 100.5 944.2 250.8	The western portion of the Namoi BOA contains significant areas of grassy and shrubby woodland with relatively few disturbances. Importantly this offset contains significant areas of floodplain vegetation including numerous natural soaks and 7 km of the Namoi River.	 Centre of the "Rocklea" property Shrubby White Box River Red Gum Woodland along the Banks of Namoi after flooding.	Brown Treecreeper Black-chinned Honeyeater Diamond Firetail Painted Honeyeater Dusky Woodswallow Grey-crowned Babbler Koala Little Lorikeet Little Pied Bat Masked Owl Speckled Warbler Spotted Harrier Varied Sittella Yellow-bellied Sheathtail Bat Turquoise Parrot Corben's Long-eared Bat Eastern Bent-wing Bat Eastern Cave Bat	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Hooded Robin, Pied Honeyeater, Square-tailed Kite, Superb Parrot, Black Falcon) **Microbats** (Eastern False Pipistrelle, and Large-eared Pied Bat) **Other mammals** (Spotted-tailed Quoll) **Herpetofauna** (Border Thick-tailed Gecko, Sloane's Froglet) **Flora** (*Pomaderris queenslandica, Digitaria porrecta* and *Diuris tricolor*)	Box Gum Woodland State 1 (Woodland) 343 ha State 2 (Derived Native Grasslands) 629.6 ha Weeping Myall Woodland (EPBC Act and TSC Act) 30.1 ha woodland and 2.3 ha Derived Native Grasslands Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern NSW and Southern QLD (EPBC Act and TSC Act) 20.7 ha Aquatic Ecological Community in the Natural Drainage

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
							System of the Lowland Catchment of the Darling River (FM Act) 85 ha woodland 106.5 ha Derived Native Grasslands
Wirrilah	Grassland Grassy Woodlands on fertile soils Shrubby Woodlands /Open Forest on skeletal soils Riverine Woodland Other land (intensive agriculture and farm dams)	355.1 145.8 183.3 12.6 176.3	Much of the woodland within the Wirrilah BOA is in relatively good condition. Regeneration is present on many parts of the main ridge, particularly on the lower slopes. A small cliff-line traverses the southern side of the main east-west range which may provide roosting and maternity opportunities for microbats.	 Grassy Woodland on eastern property boundary Shrubby Woodland within the centre of the property	Barking Owl Brown Treecreeper Grey-crowned Babbler Speckled Warbler Turquoise Parrot Varied Sittella Black Falcon Painted Honeyeater Swift Parrot (recorded by call during 2012 BOA inspections)	**Nomadic species** (Regent Honeyeater) **Birds** (Hooded Robin, Black-chinned Honeyeater, Pied Honeyeater, Diamond Firetail, Masked Owl, Spotted Harrier, Square-tailed Kite, Little Lorikeet, Superb Parrot, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Spotted-tailed Quoll, Squirrel Glider) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Digitaria porrecta* and *Diuris tricolor*)	Box Gum Woodland State 1 (Woodlands) 145.8 ha State 2 (Derived Native Grasslands) 506.7 ha

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
Myall Plains	Grassland Grassy Woodlands on fertile soils Shrubby Woodlands /Open Forests on skeletal soils Other land (intensive agriculture and farm dams)	62.9 66.7 306.9 43.9	The Myall Plans BOA comprises woodland habitats in relatively good condition. The central portion hosts a large number of trees of varying ages. Some small areas of rock outcropping of a conglomerate origin are scattered across the BOA.	 Grassy Woodland along northern boundary Central ridge of Myall Plains	Brown Treecreeper Hooded Robin Little Eagle Little Lorikeet Speckled Warbler Turquoise Parrot Grey-crowned Babbler Varied Sittella Barking Owl Corben's Long-eared Bat Eastern Cave Bat Yellow-bellied Sheathtail-bat Koala	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Diamond Firetail, Masked Owl, Spotted Harrier, Square-tailed Kite and, Superb Parrot, Black Falcon) **Microbats** (Eastern Bent-wing Bat, Little Pied Bat, Eastern False Pipistrelle, Large-eared Pied Bat) **Other mammals** (Spotted-tailed Quoll, Squirrel Glider) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Digitaria porrecta* and *Diuris tricolor*)	Box Gum Woodland State 1 (Woodland) 66.7 ha State 2 (Derived Native Grasslands) 43.9 ha
Mallee	Grassland Grassy Woodlands on fertile soils Riverine Woodland	40.3 14.2 18.9	The majority of the Mallee BOA site supports woodland habitats of good quality with very few edge effects. A diverse shrub layer is present. Large areas of rocky outcrops and cliff lines are likely to		Brown Treecreeper Diamond Firetail Grey-crowned Babbler Hooded Robin Little Eagle Little Lorikeet	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Masked Owl, Barking Owl, Spotted Harrier, Square-tailed Kite, Superb Parrot, Black Falcon)	Box Gum Woodland State 1 (Woodland) 14.2 ha

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
	Shrubby Woodlands / Open Forests on skeletal soils	1992.8	provide significant roosting and potential maternity sites for microchiropteran bats (microbats). A dam and the "Dripping Rock" water hole in the central and southern areas of the Mallee BOA are likely to provide a significant watering point for local fauna.	"Dripping Rock" adjacent to southern Mallee boundary Central cliff line in the Mallee BOA	Speckled Warbler Turquoise Parrot Varied Sittella Dusky Woodswallow	**Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, and Large-eared Pied Bat) **Other mammals** (Brush-tailed Rock Wallaby, Spotted-tailed Quoll, and Koala) **Herpetofauna** (Border Thick-tailed Gecko) **Flora** (*Pomaderris queenslandica, Digitaria porrecta* and *Diuris tricolor*)	
Additional BOAs							
Goonbri	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby woodlands open forest on skeletal soils	85.1 0 67.9 55.3	This property contains areas of box gum woodland and remnant Box Gum Woodland (derived native grassland). This property adjoins the Wirrilah BOS and extends and enhances the biodiversity offset corridor. Habitat within the property includes grassy woodland,	 Scrubby woodland within eastern side.	Little Lorikeet Grey-crowned Babbler	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Brown Treecreeper, Speckled Warbler, Turquoise Parrot, Varied sittella, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Diamond Firetail, Little Eagle, Spotted Harrier, Square-tailed Kite, Black Falcon, Superb Parrot, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-	Box Gum Woodland State 1 (Woodland): 67.9 ha State 2 (Native Pastures): 85.1 ha

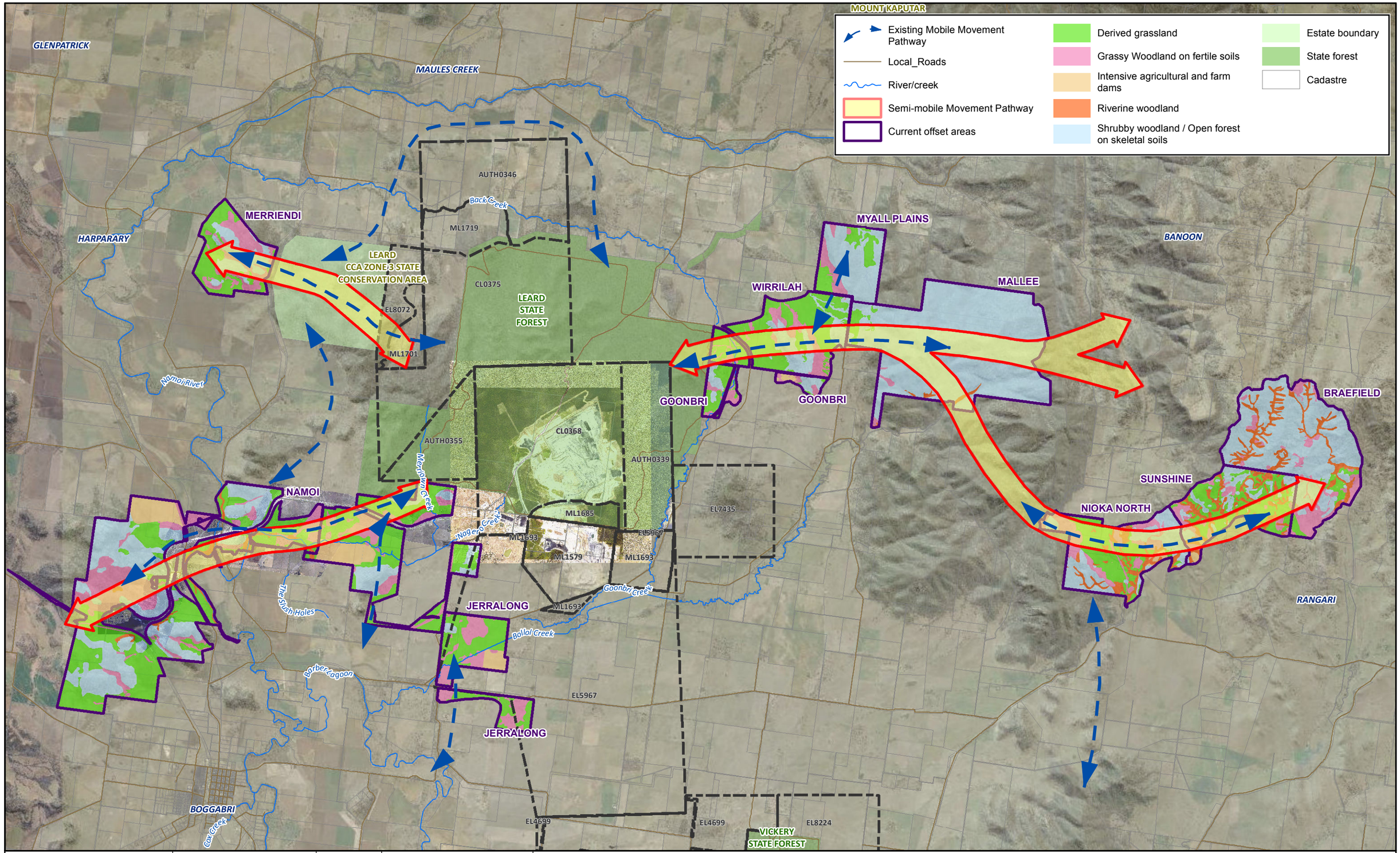
Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
	Other land (intensive agriculture and farm dams)	15.1	shrubby woodlands and grassland. These areas provided habitat for a range of threatened flora and fauna.	Good Condition White Box Grassy Woodland		bellied Sheathtail Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll, Grey-headed Flying Fox) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*)	
Jerralong	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby woodlands open forest	300.8 0 209 13.4	This property contains large areas of Pilliga Box – Popular Box grassy woodland which is required for the offsets. It adjoins the Namoi Offsets to the north west extending the proposed regional corridor. Large areas of derived grassland which are likely to respond well to	Narrow-leaved Ironbark Open Forest	Yellow-bellied Sheathtail-bat	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Brown Treecreeper, Little Lorikeet, Speckled Warbler, Turquoise Parrot, Varied sittella, Hooded Robin, Grey-crowned Babbler, Black-chinned Honeyeater, Painted Honeyeater, Diamond Firetail, Little Eagle, Spotted Harrier, Square-tailed Kite, Black Falcon, Superb Parrot, Dusky Woodswallow)	NA

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
	on skeletal soils Other land (intensive agriculture and farm dams)	 46.9	restoration are also present. A small area of riparian woodland is present and this provides habitat for threatened herpetofauna and foraging habitat for a number of threatened owls. The grassy woodlands provide habitat for a number of threatened flora and fauna species that are known to occur within the area.	 Pilliga Box – Poplar Box Woodland		**Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll, Grey-headed Flying-fox) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*)	
Nioka North	Grassland Riverine Woodland Grassy Woodland on fertile soils	275 117.1 178.8	This property contains good condition of areas of both grassy and shrubby woodland. These occur along the eastern and western boundaries of the property. The ridgelines within the property contain conglomerate		Brown Treecreeper Grey-crowned Babbler Speckled Warbler Little Lorikeet Turquoise Parrot Black-chinned Honeyeater Diamond Firetail	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Spotted Harrier, Square-tailed Kite, Barking Owl, Masked Owl, Hooded Robin, Pied Honeyeater, Painted Honeyeater, Superb Parrot, Black Falcon, Dusky Woodswallow)	Box Gum Woodland State 1 (Woodland): 295.9 ha State 2 (Native Pastures): 270.2 ha

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
	Shrubby Woodlands /Open Forest on skeletal soils Other land (intensive agriculture and farm dams)	279.2 17.8	outcropping providing habitat for a range of herpetofauna. The property contains a large number of White box trees which contain hollows suitable for birds, tree frogs, arboreal mammals and hollow-dwelling microbats.	Yellow Box Grassy Woodland in the north west Shrubby woodland in the centre of Nioka North	Varied Sittella Squirrel Glider	**Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail-bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Spotted-tailed Quoll) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Digitaria porrecta, Diuris tricolor, Tylophora linearis, Pomaderris queenslandica*)	
Sunshine	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby Woodlands /Open Forest on skeletal soils	248.9 171.5 81.2 151.8	The northern edges of Sunshine contain areas of grassy and shrubby woodland with a dense understorey. There are areas of riparian grassy woodland vegetation throughout, which has good restoration potential. Along the western boundary of the property a rare community which	 Grassy Woodland in the north of the property	Brown Treecreeper Little Lorikeet Speckled Warbler Turquoise Parrot Grey-crowned Babbler	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Hooded Robin, Black-chinned Honeyeater, Pied Honeyeater, Painted Honeyeater, Diamond Firetail, Varied Sittella, Little Eagle, Spotted Harrier, Square-tailed Kite, Superb Parrot, Black Falcon, Dusky Woodswallow) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail-bat, Little Pied Bat, Eastern False Pipistrelle,	Box Gum Woodland State 1 (Woodland): 240.5 ha State 2 (Native Pastures): 248.9 ha

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
	Other land (intensive agriculture and farm dams)	84.7	occurs on anderistie geology. This vegetation contains rare plants and grass trees which is likely to be regionally significant vegetation.	Grass Trees in rare vegetation on Western boundary		Corben's Long-eared Bat, Large-eared Pied Bat) **Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Digitaria porrecta, Diuris tricolor, Pomaderris queenslandica, Tylophora linearis*)	
Braefield	Grassland Riverine Woodland Grassy Woodland on fertile soils Shrubby woodlands open forest	55.4 197.1 165.1 982.7	The northern portion of this property contains a large area of intact good condition native bushland which has a variety of habitats. This area contains a large bluff with cliff lines and caves suitable for threatened microbats. This area of intact bushland also contains large hollow-bearing trees and dense understorey and ephemeral creeklines which provides significant habitat for a number of	Bluff and Shrubby Woodland in the north of the property	Brown Treecreeper Little Lorikeet Speckled Warbler Turquoise Parrot Varied Sittella Hooded Robin Grey-crowned Babbler Diamond Firetail Dusky Woodswallow	**Nomadic species** (Regent Honeyeater, Swift Parrot) **Birds** (Barking Owl, Masked Owl, Black-chinned Honeyeater, Painted Honeyeater, Little Eagle, Spotted Harrier, Square-tailed Kite, Black Falcon, Superb Parrot) **Microbats** (Eastern Cave Bat, Eastern Bent-wing Bat, Yellow-bellied Sheathtail-bat, Little Pied Bat, Eastern False Pipistrelle, Corben's Long-eared Bat, Large-eared Pied Bat)	Box Gum Woodland State 1 (Woodland): 194.3 ha State 2 (Native Pastures): 55.4 ha

Property	Fauna habitat	Area (ha)	Description	Photos	Threatened species recorded	Threatened species with potential habitat	Threatened ecological communities
	on skeletal soils Other land (intensive agriculture and farm dams)	 0.4	woodland birds, mammals and herpetofauna. The southern portion of this BOS contains large areas of good condition white box grassy woodland and native grassland areas. Along the southern boundary the property contains an area of extensive agriculture and to the south west contains an area of remnant white box woodland which would respond well to regeneration.	 Good Condition Grassy White Box Woodland		**Other mammals** (Koala, Squirrel Glider, Spotted-tailed Quoll, Grey-headed Flying-fox) **Herpetofauna** (Border Thick-tailed Gecko, Pale-headed Snake) **Flora** (*Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*)	



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Date: 16/06/2017	Approved by: - CooperN		

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
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BIODIVERSITY OFFSET STRATEGY

Figure 4.1
Biodiversity Offset Area and regional east-west wildlife corridor

4.5 Vegetation communities associated with biodiversity offset properties

Ten biodiversity offset properties were acquired by Boggabri Coal to offset project related impacts to native vegetation and habitat. In total, these properties retain approximately 10,687.7 ha of native vegetation, of which 8,076.8 ha will be committed as biodiversity offset to meet the project's Conditions of Approval (Table 3.2, Table 4.2). In addition, 138 ha of Miscellaneous Ecosystem (highly disturbed areas with no or little native vegetation) and 1.0 ha of Miscellaneous Ecosystem (water bodies, rivers, lakes and streams (not wetlands)) will be managed for corridor enhancement as part of the BOS commitment to re-establish a Regional East-West Wildlife Corridor (refer section 4.9.1.3). Vegetation communities, their corresponding PCT and area available within each BOA are detailed in Table 4.2.

Table 4.2 Summary of vegetation communities within Biodiversity Offset Areas acquired by Boggabri Coal

Vegetation community	Plant Community Type[1]	Threatened Ecological Community	Total project disturbance (ha)[2]	Area of vegetation within offsets committed under revised BOS		Surplus vegetation within offsets not required by current approvals
				Offset property	Area (ha)	
White Box Grassy Woodland	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland[3,4]	626.1	Merriendi	177.4	0
				Namoi	324.8	0
				Goonbri	38.7	0
				Wirrilah	145.8	0
				Myall Plains	66.7	0
				Mallee	9.2	0
				Nioka North	118.3	0
				Sunshine	81.2	0
				Braefield	152.3	114.6
				Total	**1,114.4**	**114.6**
	Derived Native Grassland		4.1	Merriendi	194.9	0
				Namoi	600.4	58.0
				Goonbri	51.6	0
				Wirrilah	506.7	0
				Myall Plains	43.9	43.9
				Nioka North	270.2	5.3
				Sunshine	245.9	245.9

Vegetation community	Plant Community Type[1]	Threatened Ecological Community	Total project disturbance (ha)[2]	Area of vegetation within offsets committed under revised BOS		Surplus vegetation within offsets not required by current approvals
				Offset property	Area (ha)	
				Braefield	55.4	55.4
				Total	**1,969.0**	**408.5**
Yellow Box - Blakely's Red Gum grassy woodland	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (NA 237, PCT 1329)		3.2	Namoi	18.2	0
				Goonbri	29.2	0
				Mallee	5	0
				Nioka North	60.5	0
				Braefield	12.8	0
				Total	**125.7**	**0**
	Derived Native Grassland		0.0	Namoi	29.2	0
				Goonbri	33.5	0
				Total	**62.7**	**0**
White Box Blakely's Red Gum Rough-barked Apple riparian woodland	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (grassy variant) (NA 197, PCT 1118)		0.0	Nioka North	117.1	0
				Sunshine	159.3	0
				Braefield	29.2	0
				Total	**305.6**	**0**
	Derived Native Grassland		0.0	Sunshine	3	3
				Total	**3**	**3**
Weeping Myall Woodland	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (NA 219, PCT 027)	Weeping Myall Woodland[5,6]	0.4	Merriendi	2.8	0
				Namoi	30.1	28.2
				Total	**32.9**	**28.2**
	Derived Native Grassland		0.0	Namoi	2.3	2.3
				Total	**2.3**	**2.3**
River Red Gum Riparian woodland and forest	River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 193, PCT 078)	Natural Drainage System of the Lowland Catchment of the Darling River (River Red Gum Riverine Woodlands)[7]	2.8	Namoi	85[10]	0
				Total	**85[10]**	**0**
			0.0	Namoi	106.5	0

Vegetation community	Plant Community Type[1]	Threatened Ecological Community	Total project disturbance (ha)[2]	Area of vegetation within offsets committed under revised BOS		Surplus vegetation within offsets not required by current approvals
				Offset property	Area (ha)	
	Derived Native Grassland			**Total**	**106.5**	**27.1**
Plains Grassland	Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion (NA 181, PCT 102)	Plains Grassland[8,9]	0.5	Namoi	20.7	3.6
				Total	**20.7**	**3.6**
Sub-total Threatened Ecological Communities					**3,827.8**	**560.2**
Pilliga Box - Poplar Box - White Cypress Pine grassy open woodland	Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (NA 179, PCT 88)	NA	46.9	Namoi	227.9	0
				Jerralong	209	0
				Total	**436.9**	**0**
	Derived Native Grassland	NA	38.1	Namoi	546.1	20.8
				Merriendi	10.2	0
				Jerralong	300.8	300.8
				Total	**857.1**	**321.6**
Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest	Narrow-leaved Ironbark – pine Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion (NA 163, PCT 1380)	NA	14.8	NA[11]	NA[11]	NA[11]
Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313)	NA	532.3	Namoi	169.0	0
				Jerralong	13.4	13.4
				Goonbri	37.2	13.2
				Wirrilah	76.9	0
				Myall Plains	200.1	0
				Mallee	1,727.6	107.8
				Total	**2,224.2**	**134.4**
	Derived Native Grassland	NA	0.0	Namoi	23.7	0
				Jerralong	0	0
				Myall Plains	19.8	0

Vegetation community	Plant Community Type[1]	Threatened Ecological Community	Total project disturbance (ha)[2]	Area of vegetation within offsets committed under revised BOS		Surplus vegetation within offsets not required by current approvals
				Offset property	Area (ha)	
				Mallee	4	0
				Total	**47.5**	**0**
White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (shiny bush) Regrowth – White Cypress Pine	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)	NA	182.8	Merriendi	20.4	0
				Namoi	443.5	0
				Goonbri	3.6	3.6
				Wirrilah	106.4	0
				Myall Plains	100.7	0
				Mallee	30.9	0
				Nioka North	263.2	263.2
				Sunshine	138.6	138.6
				Braefield	37.1	37.1
				Total	**1,144.4**	**442.5**
	Derived Native Grassland	NA	0.0	Namoi	7.0	0
				Wirrilah	24.7	0
				Myall Plains	43.1	0
				Mallee	36.3	0
				Total	**111.1**	**0**
Belah alluvial woodlands	Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region (NA 102, PCT 055)	NA	0.0	Namoi	8.5	0
				Total	**8.5**	**0**
	Derived Native Grassland	NA	0.0	Namoi	64.4	0
				Merriendi	11.1	0
				Total	**75.5**	**0**
Silver-leaved Ironbark heathy woodland	White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (NA 224, PCT 1307)	NA	3.7	Namoi	206.1	0
				Goonbri	14.5	14.5
				Myall Plains	6.1	0
				Sunshine	6.8	6.8
				Total	**233.5**	**21.3**
		NA	0.0	Namoi	4.6	0

Vegetation community	Plant Community Type[1]	Threatened Ecological Community	Total project disturbance (ha)[2]	Area of vegetation within offsets committed under revised BOS		Surplus vegetation within offsets not required by current approvals
				Offset property	Area (ha)	
	Derived Native Grassland			Nioka North	4.8	4.8
				Total	**9.4**	**4.8**
Dwyer's Red Gum Woodland	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (NA 245, PCT 610)	NA	0.3	Namoi	125.6	0
				Merriendi	130.2	0
				Mallee	91.4	0
				Nioka North	4.3	4.3
				Sunshine	1.3	1.3
				Braefield	38.0	38.0
				Total	**390.8**	**43.6**
	Derived Native Grassland	NA	0.0	Namoi	29.6	0
				Total	**29.6**	**0**
White Box – White Cypress Pine shrubby open forest (including White Cypress Pine regrowth and Shiny Bush)	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA 225, PCT 1308)	NA	0.0	Nioka North	11.7	9
				Sunshine	5.1	5.1
				Braefield	879.9	860.6
				Total	**896.7**	**874.7**
Rough-barked Apple Riparian Forb/Grass Open Forest	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (NA 197, PCT 1118)	NA	0.0	Namoi	7.9	0
				Mallee	16.8	0
				Sunshine	12.2	12.2
				Braefield	150.9	150.9
				Total	**187.8**	**163.1**
River Oak Riparian Open Forest	River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions (NA 191, PCT 84)	NA	0.0	Namoi	4.6	0
				Wirrilah	12.6	0
				Mallee	2.1	0
				Braefield	17.0	17.0
				Total	**36.3**	**17.0**
Tumbledown Red Gum	Cypress pine - Tumbledown Red Gum low open	NA	0.0	Mallee	142.9	0
				Braefield	26.4	26.4

Vegetation community	Plant Community Type[1]	Threatened Ecological Community	Total project disturbance (ha)[2]	Area of vegetation within offsets committed under revised BOS		Surplus vegetation within offsets not required by current approvals
				Offset property	Area (ha)	
grassy woodland Myrtle Shrubland (+/- White Pine/Tumbledown Red Gum)	woodland to grassland on rocky benches, mainly in the Nandewar Bioregion (NA 410, PCT 427)			**Total**	**169.3**	**26.4**
New England Blackbutt Rough-barked Apple shrubby open forest	Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion (NA 162, PCT 542)	NA	0.0	Braefield	1.3	1.3
				Total	**1.3**	**1.3**
Intensive Agriculture Exotic Grassland	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation[12]	NA	0.0	Namoi	21	0
				Goonbri	15.1	0
				Nioka North	17.6	0
				Sunshine	84.3	0
				Total	**138.0**	**0**
Farm dams	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)[12]	NA	0.0	Nioka North	0.2	0
				Sunshine	0.4	0
				Braefield	0.4	0
				Total	**1**	**0**
Sub-total other vegetation					**6,998.9**	**2,050.7**
Total area					**10,826.7**	**2,610.9**

(1) Plant Community Type is a NSW classification established to provide unambiguous master community-level classification for use in vegetation mapping programs, BioMetric-based regulatory decisions, and as a standard typology for other planning and data gathering programs.

(2) Total Project disturbance includes impacts associated with the Continuation of Boggabri Coal Environmental Assessment, Modification 3, Modification4, Modification 5, inadvertent clearing outside Project Boundary and Goonbri Road Upgrade.

(3) Critically Endangered Ecological Community White Box – Yellow Box – Blakey's Red Gum Woodland and Derived Native Grassland listed under the EPBC Act.

(4) Endangered Ecological Community White Box – Yellow Box – Blakely's Red Gum Woodland listed under the TSC Act.

(5) Endangered Ecological Community Weeping Myall Woodlands listed under the EPBC Act.

(6) Endangered Ecological Community Myall Woodland in the Darling Riverine Plains, Brigalow belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes Bioregions listed under the TSC Act.

(7) Endangered Ecological Community Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River listed under the FM Act.

(8) Critically Endangered Ecological Community Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland.

(9) Endangered Ecological Community Native Vegetation on Cracking Clay Soils of the Liverpool Plains listed under the TSC Act.

(10) A deficit of 8.0 ha is associated with River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA193, PCT78). This is fulfilled by surplus credits from River Red Gum riparian tall woodland/ open forest wetland (Derived Native Grassland) in the Namoi BOA (refer Table 4.3).

(11) The deficit for Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion (NA 163, PCT 1380) is accounted for in the 2,178.1 ha of proposed offset area associated with White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313).

(12) Identified for corridor enhancement (intensive management).

4.6 Plant Community Types in deficit

While the revised BOS delivers a significant overall surplus of vegetation against the projects CoA, changes in the vegetation classification to PCTs, and changes in area of the Namoi offset boundary have resulted in two PCTs in the revised BOS having relatively minor deficits against the projects committed offsets within the CoA. Each of these two PCT are described below in Table 4.3 along with justification supporting commitment to alternative PCT fulfilling the deficit in Table 4.4.

Table 4.3 PCTs with minor deficit against the projects CoA

PCT	NSW Vegetation formation	Percent cleared in Namoi CMA	Area of offsets required by project[1]	Area of offsets available within revised BOS	Residual area of PCT required by project	Surplus of PCT of suitable replacement available within existing BOAs[1]	Fulfilment of project credit requirements
PCT 78 / BVT NA193: River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	Forested Wetlands	75	93.0	85.0 ha within Namoi BOA	8.0 ha	Surplus of 27.1 ha of 'Forested Wetland' credits (Derived Native Grassland)[2]	**Offset requirement fulfilled**
PCT 1380 / BVT NA 163: Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	30	14.8	0 ha	14.8 ha	Surplus of 134.4 ha of 'Western Slopes Dry Sclerophyll Forests' credits available (remnant)[3]	**Offset requirement fulfilled**

(1) As determined by the Project Approval (09_0182) under section 75J of the Environmental Planning and Assessment Act 1979.

(2) In consultation with the OEH, 'Forested Wetlands' replacement offsets are comprised of PCT 78 / BVT NA193 River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland) sourced from the Namoi BOA.

(3) 'Western Slopes Dry Sclerophyll Forest' replacement offsets are comprised of PCT 1313 / BVT NA 228 White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion. A surplus of 134.4 ha for PCT 1313 still remains, as the 14.8 ha deficit for PCT 1380 was accounted for in the 2,089.8 ha included as a proposed offset in Table 4.2.

Table 4.4 Comparison of offset PCTs required by the project and replacement 'like for like' PCT from surplus offsets

PCT credit required	Replacement 'like for like' PCT from same vegetation formation	NSW Vegetation formation	Percent cleared within Namoi CMA	Justification as a suitable replacement
PCT 78 / BVT NA193: River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	PCT 78 / BVT NA 193: River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Forested Wetlands	75	While the revised BOS results in a minor deficit for PCT 78 against the CoA, the Project will still provide an offset to impact ratio of 34:1 for this PCT. In accordance with the OEH recommendation, suitable replacement offset consists of Derived Native Grassland River Red Gum riparian tall woodland/ open forest wetland to fulfil the broad objective of the BOS by contributing and restoring the regional East-West Wildlife Corridor and connectivity across the landscape.
PCT 1380 / BVT NA 163: Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion	PCT 1313 / BVT NA 228 White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	55	The deficit in PCT 1380 is due to the reclassification of the PCT 1380 to PCT1313 by the independent BOS audit and not due to a reduction in offset area or increased impact to this PCT under the Projects Modifications. This PCT would have also been reclassified to PCT 1313 within the original Project disturbance area. The proposed alternative vegetation PCT 1313 forms part of the same NSW vegetation formation, is of greater extent cleared in the region and provides similar or better habitat, to PCT 1380.

4.7 Plant Community Types in surplus

The acquisition of 10 BOAs has resulted in a surplus of native vegetation, which is not currently required for the project's Conditions of Approval. In total, 2,610.9 ha of native vegetation has been identified in surplus, as described in Table 4.5. If required, native vegetation in surplus would be available for future offset requirements.

Table 4.5 Surplus breakdown per Biodiversity Offset Area

Offset property	Plant Community Type	Threatened Ecological Community	Surplus area (ha)
Namoi BOA[1]	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383) (Derived Native Grassland)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	58.0
	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (NA 219, PCT 027)	Weeping Myall Woodland	28.2
	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (NA 219, PCT 027) (Derived Native Grassland)	Weeping Myall Woodland	2.3
	Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion (NA 181, PCT 102)	Plains Grassland	3.6
	Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / BVT NA 179) (Derived Native Grassland)	-	20.8
		Sub-total	**112.9**
Jerralong BOA	Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / BVT NA 179) (Derived Native Grassland)	-	300.8
	White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313) (Derived Native Grassland)	-	13.4
		Sub-total	**314.2**
Goonbri BOA	White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (NA 224, PCT 1307)	-	14.5
	White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313)	-	13.2
	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)		3.6
		Sub-total	**31.3**
Myall Plains BOA	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	43.9
		Sub-total	**43.9**

Mallee BOA	White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313)	-	107.8
		Sub-total	**107.8**
Nioka North BOA	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383) (Derived Native Grassland)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	5.3
	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)	-	263.2
	White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (NA 224, PCT 1307) (Derived Native Grassland)	-	4.8
	White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA 225, PCT 1308)	-	9.0
	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (NA 245, PCT 610)	-	4.3
		Sub-total	**286.6**
Sunshine BOA	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383) (Derived Native Grassland)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	245.9
	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (NA 197, PCT 1118) (Derived Native Grassland)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	3.0
	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)	-	138.6
	White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (NA 224, PCT 1307)	-	6.8
	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (NA 245, PCT 610)	-	1.3
	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA225, PCT1308)	-	5.1
	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (NA197, PCT1118)	-	12.2
		Sub-total	**412.9**
Braefield BOA	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	114.6
	White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383) (Derived Native Grassland)	White Box – Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland	55.4
	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA165, PCT1381)	-	37.1
	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (NA245, PCT610)	-	38.0

	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (NA225, PCT1308)	-	860.6
	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (NA197, PCT1118)	-	150.9
	River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions (NA191, PCT84)	-	17.0
	Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion (NA410, PCT427)	-	26.4
	Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion (NA162, PCT542)	-	1.3
		Sub-total	**1,301.3**
		Total	**2,610.9**

(1) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.

4.8 Summary of fauna habitats in Biodiversity Offset Areas

Five fauna habitat types have been described in the revised BOS, including grassy woodland, shrubby woodland, riverine woodland, grassland and intensive agriculture/ farms dams. The extent of each of these fauna habitat types is detailed in Table 4.6.

Table 4.6 Summary of fauna habitats contained on offset properties

Offset property	Fauna habitat					Total
	Grassy woodland	Shrubby woodland	Riverine woodland	Grassland	Intensive agriculture and farm dams[1]	
Merriendi	180.2	150.6	0	216.2	0	547.0
Namoi[2]	609.5	944.2	100.5	1,431.5	250.8	3,336.5
Jerralong	209	13.4	0	300.8	46.9	570.1
Goonbri	67.9	55.3	0	85.1	15.1	223.4
Wirrilah	145.8	183.3	12.6	355.1	176.3	873.1
Myall Plains	66.7	306.9	0	62.9	43.9	480.4
Mallee	14.2	1,992.8	18.9	40.3	0	2,066.2
Nioka North	178.8	279.2	117.1	275.0	17.8	867.9
Sunshine	81.2	151.8	171.5	248.9	84.7	738.1
Braefield	165.1	982.7	197.1	55.4	0.4	1,400.7
Total	**1,718.4**	**5,060.2**	**617.7**	**3,071.2**	**635.9**	**11,103.4**

(1) Includes 276.7 ha identified as other land for agriculture and 359.2 ha identified for corridor enhancement.

(2) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.

4.9 Summary of threatened species habitat in Biodiversity Offset Areas

Table 4.7 details 'like for like' habitat for threatened fauna species in the BOAs.

Table 4.7 Fauna habitat biodiversity offset summary

Threatened species	Total project disturbance (ha)	'Like for Like' offset
		Area in offsets (ha)
Raptors (Little Eagle, Square-tailed Kite)	1,456.4	10,826.7
Owls (Barking Owl, Masked Owl)	1,439.1	7,414.0
Cave-dependant microbats (Large-eared Pied Bat, Eastern Bent-wing Bat, Eastern Cave Bat, Little Pied Bat)	1,439.1	7,414.0

Hollow-dependant microbats (Corben's Long-eared Bat, Eastern False Pipistrelle, Yellow-bellied Sheathtail-bat)	1,439.1	7,414.0
Turquoise Parrot	1,439.1	7,414.0
Woodland birds (Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Varied Sittella, Pied Honeyeater)	1,439.1	7,414.0
Little Lorikeet	1,439.1	7,414.0
Swift Parrot	1,439.1	7,414.0
Spotted Harrier	1,456.4	10,826.7
Black-necked Stork	2	192.5
Superb Parrot	1,439.1	7,414.0
Regent Honeyeater	1,439.1	7,414.0
Spotted-tailed Quoll	1,439.1	7,414.0
Squirrel Glider	1,439.1	7,414.0
Koala	1,439.1	7,414.0
Pale-headed Snake	1,439.1	7,414.0

4.10 Summary of Box Gum Woodland EEC within Biodiversity Offset Areas

The Biodiversity Offset Areas contain approximately 3,580.4 ha of Box Gum Woodland which is listed under the TSC Act and/ or EPBC Act listed White Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Table 4.8). In accordance with the State and Transition model for Box Gum Grassy Woodlands, the condition of Box Gum Woodland remnants is provided in Table 4.8.

Table 4.8 Summary of Box Gum Woodland EEC within Biodiversity Offset Areas

Biodiversity Offset Area	State of Box Gum Woodland	
	State 1 – Woodland (ha)	State 2 – Native Pastures (ha)
Merriendi	177.4	194.9
Namoi	343.0	629.6
Jerralong	0.0	0.0
Goonbri	67.9	85.1
Wirrilah	145.8	506.7
Myall Plains	66.7	43.9
Mallee	14.2	0.0
Nioka North	295.9	270.2
Sunshine	240.5	248.9
Braefield	194.3	55.4
Total	**1,545.7**	**2,034.7**

GLENPATRICK
MAULES CREEK
Maules Creek
Back Creek
HARPARARY
MERRIENDI
LEARD CCA ZONE 3 STATE CONSERVATION AREA
LEARD STATE FOREST
MYALL PLAINS
BANOON
WIRRILAH
MALLEE
GOONBRI
GOONBRI
BRAEFIELD
Namoi River
Merrtown Creek
NAMOI
Nagero Creek
NIOKA NORTH
SUNSHINE
Three Mile Holes
JERRALONG
Goonbri Creek
RANGARI
Bollol Creek
Burbers Lagoon
JERRALONG
BOGGABRI
Cox Creek
2 ABORIGINAL AREA

- Local_Roads
- River/creek
- Current offset areas
- Boggabri Coal Operations Project Area
- Estate boundary
- State forest
- Cadastre

Box Gum Woodlands

- Box Gum Woodland (State 1: Woodland) - EPBC Act)
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act

Other Threatened Ecological Communities

- Weeping Myall Woodland (TSC Act and EPBC Act)
- Plains Grassland
- Aquatic ecological community in the natural drainage system of the Darling River

Map: 2267037B_GIS_BOS016_A1	Author: SuansriR
Date: 22/06/2017	Approved by: - CooperN

0 1,500 3,000 Meters

1:115,000

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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BIODIVERSITY OFFSET STRATEGY

Figure 4.2
Box-Gum Woodland EEC within the Biodiversity Offset Areas

4.11 Proposed conservation mechanisms

Boggabri Coal is committed to establishing an offsets strategy that will provide ongoing conservation of land beyond the 21-year approval period for the benefit of future generations. Offsets must be enduring and must offset the impact of the development for the period that the impact occurs. The security of land tenure and ongoing management of offsets is critical to the long-term viability of offsets and must be carefully considered.

To ensure the conservation of lands in-perpetuity the Boggabri Coal BOS will require the dedication of the identified offsets under a secure conservation arrangement. To further ensure the Boggabri Coal BOS will not be compromised by potential future mining projects, the offsets have been located outside of currently known mining tenements or lease area.

4.11.1 Options for long-term security

The long-term objective of the Boggabri Coal BOS is to provide conservation of the area in-perpetuity. There are a number of options available to secure land under permanent conservation agreements. Boggabri Coal is committed to exploring and identifying the most suitable conservation arrangement for land in consultation with the relevant stakeholders. Potential options may include:

1. BioBanking
2. land acquisition and in perpetuity management under a Voluntary Conservation Agreement.
3. land acquisition and dedication to National Parks reserve estate

It should be recognised that a number of different conservation strategies to provide for the ongoing protection of offsets may be required and one strategy may not be suitable for all land tenures. Boggabri Coal is committed to establishing suitable conservation agreements for offsets to meet the objectives of the Boggabri Coal BOS and provide a regional approach to biodiversity conservation.

Boggabri Coal is currently considering which of the options listed above will most appropriately meet the objectives. A summary of each option is provided below.

4.11.1.1 NSW BioBanking Scheme

The NSW government has developed a biodiversity banking and offsets scheme (BioBanking) to help address the loss of biodiversity values, including threatened species. This scheme was established under Part 7A of the TSC Act and uses offsets (where appropriate) to assist in addressing the cumulative effects of development in NSW and in particular, to help meet the goal of maintaining or improving biodiversity. This approach is intended to allow development to occur in a sustainable way without placing extra stress on the environment (Department of Environment and Conservation 2006). BioBanking offsets are established through the establishment of BioBanking agreements.

A BioBanking agreement is an agreement between a landowner and the NSW Minister for the Environment that establishes and determines the management actions to be undertaken on a BioBank site to conserve and improve biodiversity values and thereby create biodiversity credits under the scheme. BioBanking agreements are largely prescribed by legislation and have effect in perpetuity. The agreement is registered onto the land title which binds future landowners if the property is sold. Establishing and protecting a BioBanking site in perpetuity ensures that the offset provides for development impacts into the future (Office of Environment and Heritage 2012).

Mining companies are able to voluntarily use the BioBanking Scheme to generate biodiversity credits and provide secure conservation agreements for lands under their control, as well as using credits to offset development impacts (Office of Environment and Heritage 2015).

4.11.1.2 Land acquisition and in perpetuity management under a voluntary conservation agreement

A conservation agreement is a joint agreement between landholders and the NSW Minister for the Environment and is managed by OEH. Conservation agreements were introduced in 1987 in Section 69A and 69KA of the *National Parks and Wildlife Act 1974* and in NSW are administered by the NSW OEH. It is a voluntary agreement that provides permanent protection of the land in title. The area under the agreement is registered on the title of the land, ensuring that, of the land is sold, the agreement and management requirements remain in place.

A conservation agreement provides the ability for land to be permanently conserved for current and all future ownership. When entering into a conservation agreement, the landholder continues to undertake responsibility for the management of the land. OEH may provide assistance to the landholder in the form of property management planning advice, biodiversity surveying and assessment assistance, information and practical advice about conservation management strategies etc.

Conservation agreements can apply to part or all of a property and different terms and conditions can apply to specific 'zones' within the area covered by the agreement. The key goal of conservation agreements is to ensure the land is managed to maintain and improve its conservation values, which may vary across the property.

4.11.1.3 Land acquisition and dedication to National Parks reserve estate.

This involves the dedication of offset properties to National Parks reserve estate. It requires approval by the National Parks and Wildlife Service that the properties contribute the national parks estate, conservation priorities and are approximately located for combining with existing management responsibilities. Depending on the timing of the hand over, it is likely to require financial contributions for the in-perpetuity management of the lands to be dedicated.

4.12 Proposed management of offset areas

The management of each BOA is directed by the specific management plans that have been developed in Appendix E of the Boggabri Coal BMP (January 2012). In addition Appendix F of the BMP contains implementation plans for threatened biodiversity which provide specific measures to manage the Box Gum Grassy Woodland ecological community and threatened species known or predicted to occur within the project boundary and/or BOAs (Parsons Brinckerhoff 2015). The approved BMP is currently being revised to incorporate the additional offset properties in accordance with Condition 43.

4.12.1 Offset management zones

Boggabri Coal's BOAs are managed in accordance with the approved BMP (January 2012). Four distinct management zones are recognised within the BOAs. These zones are classified according to environmental condition and the distinct suite of management measures required maintaining, enhancing or restoring biodiversity values within these areas.

A brief description of each management zone is provided in the following sections and a breakdown of the extent of each zone within the BOAs is provided in Table 4.9. The management zones within each of the additional BOAs are mapped in Appendix E of the revised BMP.

Table 4.9 Extent of offset management zones within each BOA

BOA	Management zones (ha)				Total (ha)
	Habitat management	Habitat restoration	Corridor enhancement[1]	Other lands for agriculture	
Merriendi	329.5	211.7	5.8		547
Namoi[2]	1,626.0	1,459.7	21.0	229.8	3,336.5
Jerralong	222.4	300.8	-	46.9	570.1
Goonbri	123.2	85.1	15.1	-	223.4
Wirrilah	326.5	370.3	176.3	-	873.1
Myall Plains	373.6	62.9	43.9	-	480.4
Mallee	2,025.9	40.3	-	-	2,066.2
Nioka North	527.5	322.6	17.8	-	867.9
Sunshine	353.2	300.2	84.7	-	738.1
Braefield	1,283.2	117.1	0.4	-	1,400.7
Total	**7,191.0**	**3,270.7**	**365.0**	**276.7**	**11,103.4**

(1) In addition to the 139 ha of miscellaneous ecosystems (exotic grassland/ intensive agriculture/ farm dams) described in Table 4.2, corridor enhancement identifies those areas of the BOAs that may require specific management measures, such as canopy plantings.

(2) The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement.

4.12.1.1 Habitat management zone

The habitat management zone is associated with remnant native woodland vegetation in good condition, with limited disturbances and exotic species present. This zone requires some active pest and weed management activities, fencing of areas adjoining lands not managed for biodiversity conservation and the exclusion of livestock grazing. These areas are generally considered to not require any assisted revegetation and provide existing high quality fauna habitats.

4.12.1.2 Habitat restoration zone

The habitat restoration zone incorporates those areas of good condition native grassland communities with only moderate exotic species present and an existing soil seed bank with the potential for natural revegetation.

Management activities required within this zone involve fencing, targeted pest and weed management and supplementary canopy planting to facilitate enhanced revegetation of the canopy layer. This zone will also incorporate the provision of supplementary habitat features to further encourage use by local fauna species.

4.12.1.3 Corridor enhancement zone

The corridor enhancement zone incorporates those areas of non-native grasslands and/or areas that have been significantly disturbed by past land use practices, including clearing, cropping, pasture improvement and heavy grazing. This zone incorporates supplementary canopy planting and some targeted weed and pest management activities to increase woody canopy cover and build on adjoining existing wildlife corridors. This zone is likely to further encourage the use of the proposed wildlife corridors by semi mobile fauna species in the medium to long-term.

4.12.1.4 Other lands for agriculture zone

The other lands for agriculture zone incorporates highly productive agricultural land previously identified as containing pasture improvement, cropping or other intensive agricultural activities. These areas are considered to provide only limited potential for revegetation and are not considered critical to the establishment of the proposed wildlife corridors or habitat areas within the BOAs.

With adequate fencing, targeted weed management and monitoring of potential edge effects these areas are potentially available for continued agricultural use and are not incorporated in the BOS. Under certain circumstances Boggabri Coal owned agricultural land (other lands for agriculture zone) adjoining high quality remnants may be enhanced or restored to provide an adequate buffer between degraded land and high quality vegetation

4.12.2 Proposed monitoring

Monitoring of BOAs is being undertaken to assess the positive and negative outcomes of management measures employed by Boggabri Coal and measure progress towards, and achievement of, the completion criteria.

Monitoring within BOA monitoring sites and corresponding analogue sites comprises the survey of flora and vertebrates. Monitoring sites within the BOAs are representative of each vegetation community in each treatment offset management zone (habitat restoration and corridor enhancement zones). Where possible, data derived from BOA monitoring sites will be compared with existing analogue sites established for the rehabilitation monitoring component.

A total of 54 replicate monitoring sites have been identified across the BOAs, including:

- Merriendi BOA (6 sites)
- Namoi BOA (11 sites)
- Jerralong BOA (3 sites)
- Goonbri BOA (0 sites)
- Wirrilah BOA (6 sites)
- Myall Plains BOA (6 sites)
- Mallee BOA (5 sites)
- Nioka North BOA (6 sites)
- Sunshine BOA (5 sites)
- Braefield BOA (6 sites).

To date, four sessions of monitoring have been undertaken on the original five BOAs (Merriendi, Namoi, Myall Plains, Wirrilah and Mallee BOAs) (Parsons Brinckerhoff 2015). Four of the additional five BOAs (Jerralong, Nioka North, Sunshine and Braefield) have been monitored annually since 2015.

4.12.3 Rehabilitation management and monitoring

The rehabilitation of mine disturbance areas will be further directed by the RMP which will outline all management associated with rehabilitation areas. The previous RMP is currently being revised to address the recent project approval (D143/12) CoA for the continuation of mining until 2032 as approved by a delegate for the NSW Minister for Planning and Infrastructure on 18 July 2012.

At the time of updating this BOS, the monitoring of rehabilitation sites has commenced. Preliminary benchmark data for rehabilitation monitoring has been developed from flora and fauna surveys completed throughout Leard State Forest for the project EA (Parsons Brinckerhoff 2010c). The benchmark table will be updated once revised baseline data from all three analogue locations is available.

5. Summary

Under Condition 39 of the Project Approval, Boggabri Coal were required to implement the BOS described in the Environmental Assessment, which is summarised in Table 3.2. In addition, under Condition 43 of the project's state Conditions of Approval, Boggabri Coal is required to prepare and implement a revised BOS incorporating:

- an additional 1,000 ha offset that includes the protection of 650 ha of existing Box Gum Woodland EEC and the restoration of 350 ha of derived native grassland (Box Gum Woodland EEC) as listed under the TSC Act.
- additional offsets for impacts associated with project modifications (3, 4 and 5)
- substitute offsets for Crown Land parcels excluded from the Namoi BOA.

Boggabri Coal were also required to provide additional offsets for non-approved clearing outside the project boundary and the Goonbri Road Upgrade.

To meet these additional offset requirements the project will require a minimum of 8,057.7 ha of 'Like for Like' offsets.

This revised BOS has been prepared with reference to the NSW OEH *Principles for the use of biodiversity offsets in NSW* (2014d), OEH's Plant Community Types (PCTs) classification of vegetation (Office of Environment and Heritage 2017) and the previous Boggabri Coal BOS approved by the Director-General (Parsons Brinckerhoff 2010b).

The offset approach adopted by the project, was to identify and acquire BOAs, specifically targeted for their conservational value, for the presence of vegetation types representative of those being impacted by the project and their location within the Regional East-West Wildlife Corridor.

The Regional East-West Wildlife Corridor is an important ecological corridor that historically linked Leard State Forest with the Nandewar Range, Namoi River and large vegetation remnants to the west of the Namoi River. The original BOS and this revised BOS have been developed with the intention of recreating habitat linkages within this corridor and increasing the overall biodiversity values of the area. The re-establishment of the Regional East-West Wildlife Corridor will facilitate the movement of threatened species throughout the region and provide for the conservation and restoration of large areas of threatened ecological communities including Box Gum Woodland.

To date, Boggabri Coal has acquired 10 BOAs, totalling 11,103.4 ha, which includes 10,687.7 ha of native vegetation.

Five regionally significant BOAs were secured as part of the original Boggabri Coal BOS, comprising:

- Merriendi BOA – 547 ha
- Namoi BOA – 3,336.5 ha
- Wirrilah BOA – 873.1 ha
- Myall Plains BOA – 480.4 ha
- Mallee BOA – 2,066.2 ha.

To meet the project's residual offset requirements under Condition 43, Boggabri Coal acquired five additional BOAs. Each of the additional BOAs contribute to the Regional East-West Wildlife Corridor and include:

- Sunshine – 738.1 ha
- Nioka North – 867.9 ha
- Goonbri – 223.4 ha
- Jerralong – 570.1 ha
- Braefield – 1,400.7 ha.

A summary of the project's BOAs described within this revised BOS against the project's offset requirements detailed in Table 15 of Condition 39 is provided below in Table 5.1.

Table 5.1 Summary of BOS requirements and current BOAs acquired by Boggabri Coal

Area	Offset type[1]	Minimum required offset area[1] (ha)	Current offset area within revised BOS (ha)[2]	Reason for change in offset area/ provision of additional offset requirements	Offset type within revised BOS
Merriendi offset area	Existing native vegetation to be protected and enhanced and additional native vegetation to be established with the restoration of at least 170.1 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	541	547.0	Vegetation audit – Niche mapping change from exotic grassland to derived native grassland state (Figure A1.1).	Includes restoration of at least 194.9 ha of derived native grassland Box Gum Woodland EEC.
Namoi offset area	Existing native vegetation to be protected and enhanced and additional native vegetation to be established with restoration of at least 491 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	2,427	3,336.5	Vegetation audit – Niche mapping change from exotic grassland to derived native grassland state. Addition of 13.2 ha of Cooboobindi Property into the Namoi BOA. Current offset area within revised BOS includes removal of: ■ 298.9 ha of Crown Land ■ 13.3 ha of Project Modification 3 ■ 4.5 ha of Project Modification 4 ■ 7.7 ha of Project Modification 5.	Includes restoration of at least 629.6 ha of derived native grassland Box Gum woodland EEC.
Eastern offsets (Myall Plains/Wirrilah/ Mallee)	Existing native vegetation to be protected and enhanced and additional native vegetation to be established with restoration of at least 430 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	3,247	3,419.7	Vegetation audit – Niche mapping change from exotic grassland to derived native grassland state. Current Offset area within revised BOS includes: ■ Modification to original Wirrilah BOA boundary for agricultural land swap ■ Excision of Goonbri Road upgrade from Wirrilah BOA boundary.	Includes restoration of at least 550.6 ha of derived native grassland Box Gum woodland EEC.

Area	Offset type[1]	Minimum required offset area[1] (ha)	Current offset area within revised BOS (ha)[2]	Reason for change in offset area/ provision of additional offset requirements	Offset type within revised BOS
Additional offset area note: Location subject to final approval as part of revised biodiversity strategy to be prepared by Proponent	Proposal for 650 ha of existing Box Gum Woodland EEC to be enhanced and restoration of an additional 350 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	1,000	3,800.2 ha of native vegetation associated with five additional offset areas. Jerralong 570.1 Goonbri 223.4 Nioka North 867.9 Sunshine 738.1 Braefield 1,400.7	Includes: 801.6 ha of remnant Box Gum Woodland EEC as listed under the TSC Act; 728.6 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act.	The five additional offset properties provide 3,635.3 ha of native vegetation incorporating at least: 798.6 ha of remnant Box Gum Woodland EEC as listed under the TSC Act; 659.6 ha of derived native grassland Box Gum Woodland EEC as listed under the TSC Act; 209 ha of remnant Pilliga Box – White Cypress Pine Buloke shrubby woodland in the Brigalow Belt South Bioregion; 300.8 ha of Pilliga Box – White Cypress Pine Buloke shrubby woodland in the Brigalow Belt South Bioregion (Derived Native Grassland); 442.5 ha of remnant Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion; All surplus areas of vegetation within BOAs additional to offset requirements in Condition 43 and 39 Table 15 will be available for future requirements.
Additional modification offset area (modification 3)	Existing native vegetation to be protected and enhanced including at least 63 ha of Pilliga Box Woodland and 16 ha of Box Gum Woodland EEC as listed under the TSC Act	103		Provision of additional offsets for Project Modification 3 impacts, including impact to original Namoi BOA.	
Additional modification area (modification 4) Note: location subject to final approval as part of revised biodiversity strategy to be prepared by the Proponent	Existing native vegetation to be protected and enhanced including at least: 8 ha of Box Gum Woodland EEC as listed under the TSC Act; 103 ha of Pilliga Box Grassy Open Forest or open grassy vegetation community of higher conservation status; 21 ha of Narrow leaved ironbark shrubby open forest or shrubby open forest of higher conservation status; 1 ha of River Red Gum Riparian Woodlands and Forest or riparian woodland/forest of higher conservation status.	133		Provision of additional offsets for Project Modification 4 impacts, including impact to original Namoi BOA.	
Additional modification area (modification 5) Note: location subject to final approval as part of revised biodiversity strategy to	Existing native vegetation to be protected and enhanced including at least:	106		Provision of additional offsets for Project Modification 5 impacts, including impact to original Namoi BOA.	

Area	Offset type[1]	Minimum required offset area[1] (ha)	Current offset area within revised BOS (ha)[2]	Reason for change in offset area/ provision of additional offset requirements	Offset type within revised BOS
be prepared by the Proponent					
Goonbri Road upgrade	Goonbri Road realignment requires 40.2 ha of native vegetation of which 8.9 ha is Box Gum Woodland and 19.3 Derived Native Grasslands EEC 12 ha of Pilliga Box Grassy Open Forest	40.4		Provision of additional offsets for Goonbri Road upgrade, including impact to original Wirrilah BOA.	
Understorey clearing outside of Boggabri existing boundary	Understorey clearing outside of Boggabri existing boundary includes 19.3 ha of native vegetation.	19.3		Provision of additional offsets to ameliorate impacts associated with understorey clearing outside Boggabri	
Total offset area requirements and owned, under option by Proponent		7,616.7	11,103.4 ha, of which 10,687.7 ha is native vegetation	NA	NA
Crown Reserve Land within Namoi offset area	Additional funding/management agreement with DPI Catchments and Lands towards management of special lease/Crown Reserve land.	441	142.1	Boggabri Coal have undertaken consultation with the DPI-Lands regarding the proposed purchase or land management of these remaining Crown Land parcels (approximately 298.9 ha). DPI-Lands have subsequently advised Boggabri Coal that they are unlikely to be in a position to sell or agree to the management for conservation of the majority of the remaining land parcels due to the incompatibility of current land-use purposes with the proposed management for in perpetuity conservation outlined in the BOS.	Boggabri Coal has purchased 142.1 ha of the 441 ha of Crown Land committed to in the original BOS. The remaining 298.9 ha of Crown Land are not likely to be managed for conservation and consequently removed from this revised BOS. However, the 298.9 ha shortfall associated with the exclusion of Crown Land is accounted for by the Namoi BOA, which exceeded the existing requirements by 658.7 ha prior to its reduction by the Crown Land shortfall, project modifications and Goonbri Road Upgrade.

Area	Offset type[1]	Minimum required offset area[1] (ha)	Current offset area within revised BOS (ha)[2]	Reason for change in offset area/ provision of additional offset requirements	Offset type within revised BOS
Additional land within Namoi offset area, Eastern offset area and Crown Reserve Land managed for corridor enhancement	Located on poor condition (for biodiversity conservation) land but managed to improve connectivity in offset corridors.	626	139	NA	605 ha of the Namoi offset area and Eastern offset area identified as exotic grassland for corridor enhancement in the previous BOS has been reclassified as derived native grassland for restoration by the Commonwealths independent audit. These areas are now included in the revised surplus commitment for Namoi offset area calculations. The additional 118 ha of corridor enhancement are associated with the additional BOAs (Goonbri, Nioka North, Sunshine and Braefield).
Rehabilitation area	Except for the area of the minimised final void, pre-mining native vegetation communities are to be re-established for a biodiversity conservation land use objective, with the area subject to finalisation of the RMP as required under this approval. Note: the final mix and area of native vegetation communities is subject to the approved BMP and RMP.	1,508	TBC with reference to current MOP and revised RMP.		TBC with reference to current MOP and revised RMP.

(1) In accordance with Schedule 3, Condition 43 and Condition 39 Table 15 of the CoA.

(2) Namoi offset area has increased in vegetation extent despite reduction in offset area due changes in the vegetation mapping by the independent review identifying greater areas of remnant and derived grassland vegetation. Details are provided in Section 1.3.1.

The revised BOS meets the projects offset requirements of 8,057.7 ha with the provision of 8,076.8 ha of 'Like for Like' vegetation and habitat.

The BOS also incorporates 2,610.9 ha of surplus native vegetation and habitat, additional to its current offset requirements, which will be continually managed to benefit biodiversity conservation within the region but also left available for future offset requirements. The surplus areas of native vegetation and habitat are largely associated with the Namoi, Jerralong, Goonbri, Mallee, Nioka North, Sunshine and Braefield BOAs.

The revised BOS will provide for the conservation of up to 10,826.7 ha of land, including biodiversity conservation areas and land identified for corridor enhancement. This land consists of approximately 10,687.7 ha of 'Like for Like' native vegetation offsets, to those being impacted by the project, including 7,414.0 ha of remnant vegetation/habitats and the restoration of 3,273.7 ha of derived native grasslands over the medium to long term. The outstanding 139 ha of land subject to intensive agriculture and farm dams will be managed as corridor enhancement to provide infilling of canopy within and immediately adjacent existing offset properties to increase connectivity in the region. These corridor enhancement zones will provide an overall improved outcome and support biodiversity conservation areas.

Boggabri Coal are committed to managing the entire offset area (10,826.7 ha) under the Boggabri Coal BMP including the identified surplus native vegetation and habitat, which are of good condition remnant native vegetation with minimal maintenance requirements. The 2,610.9 ha of surplus native vegetation and habitat will be identified as excess areas available for future offsets requirements if required.

Two PCTs in the revised BOS, including River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 193, PCT 78) and Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion (NA 163, PCT 1380), have credit deficits that required suitable replacement credits available within the existing BOAs. The deficits are directly related to changes in vegetation classification from the original approved BOS, subsequent independent vegetation verification (Niche 2013), exclusion of offset parcels associated with Crown Land and modifications to project boundaries.

River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 193, PCT 078) has a credit deficit of 8 ha. In accordance with the OEH recommendation, suitable replacement offsets comprised of River Red Gum riparian tall woodland/ open forest wetland (Derived Native Grassland) sourced from the Namoi BOA. This offset replacement was considered suitable to fulfil the broad objective of the BOS by contributing and restoring the regional East-West Wildlife Corridor and connectivity across the landscape.

Narrow-leaved Ironbark – pine – Brown Bloodwood shrub/grass open forest in the north west of the Nandewar Bioregion (NA 163, PCT 1380) has a credit deficit of 14.8 ha (Table 3.1). This PCT occurs in the 'Western Slopes Dry Sclerophyll Forests' vegetation formation. Replacement offsets comprised of White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313), which occurs in the 'Western Slopes Dry Sclerophyll Forests' vegetation formation and occurs in surplus in the Jerralong, Goonbri and Mallee BOAs. The 134.4 ha surplus of White Cypress – Pine Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (NA 228, PCT 1313) detailed in Table 4.2 still remains, as this deficit was accounted for in the 2,089.8 ha committed under this revised BOS.

6. References

Debus, SJS 1995, 'Surveys of large forest owls in Northern New South Wales: methodology, calling behaviour and owls responses', *Corella*, vol. 19, no. 2, pp. 38-50.

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 2008, *BioBanking Assessment Methodology*, 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 2006, *BioBanking – A Biodiversity Offsets and Banking Scheme. Conserving and restoring biodiversity in NSW, working paper*, Department of environment and Conservation,, Sydney.

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

Department of the Environment and Water Resources 2007, *Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment and Water Resources, Canberra.

Hansen Bailey 2010, *Continuation of Boggabri Coal Mine Environmental Assessment*, Prepared for Boggabri Coal Pty Limited.

Idemitsu Boggabri Coal 2013, *Leard State Forest Road Closure Strategy - BEP-RPT-Z-003*, Boggabri.

Idemitsu Boggabri Coal 2015, *Boggabri Coal Mine (MP 09_0182): Native Vegetation Clearing - Mitigation and Offset Commitments*, Boggabri.

Kavanagh, RP & Debus, SJS 1994, 'The Powerful Owl *Ninox strenua* in New South Wales', *Australian Birds* vol. 28, supplement 21-38.

Niche Environment and Heritage 2014, *Boggabri Coal Mine - Biodiversity Offsets Audit*, Prepared for Boggabri Coal Pty Ltd Limited.

NSW National Parks and Wildlife Service 1996, *Threatened species assessment under the Environment Planning and Assessment Act: The '8 part test' of significance. Information circular No. 2*, NSW National Parks and Wildlife Service, Hurstville.

Office of Environment and Heritage 2012, *BioBanking review: Discussion paper* Sydney.

Office of Environment and Heritage 2014a, *BioBanking Assessment Methodology*, Sydney.

Office of Environment and Heritage 2014b, *BioBanking Assessment Methodology 2014*, Sydney.

Office of Environment and Heritage 2014c, *Framework for Biodiversity Assessment - NSW Biodiveristy Offsets Policy for Major Projects*, Office of Environment and Heritage for the NSW Government, Sydney.

Office of Environment and Heritage 2014d, *Principles for the use of biodiversity offsets in NSW* viewed 15 July 2014, <http://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm>.

Office of Environment and Heritage 2015, *Refinements to the development and implementation of the Biodiversity Banking Bill after stakeholder consultation*, <http://www.environment.nsw.gov.au/biobanking/billrefine.htm>.

Office of Environment and Heritage 2017, *Vegetation Information System (VIS) Classification 2.1*, Office of Environment and Heritage,, 2017, <http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx>.

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

Parsons Brinckerhoff 2010b, *Continuation of Boggabri Coal Mine - Biodiversity Offset Strategy*, prepared for Hansen Bailey Pty Ltd Sydney.

Parsons Brinckerhoff 2010c, *Continuation of Boggabri Coal Mine – Biodiversity Impact Assessment*.

Parsons Brinckerhoff 2015, *Biodiversity Management Plan - Boggabri Coal*, prepared for Idemitsu Boggabri Coal Newcastle.

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

Umwelt Environmental Consultants 2015, *Leard State Forest Biodiversity Strategy Stage 1 - Scoping Report*.

Wilson, A & Lindenmayer, DB 1995, *Wildlife Corridors and the Conservation of Biodiversity: A Review.*, National Corridors of Green Program, Green Australia Ltd., Canberra.

Appendix A

Previously approved Biodiversity Offset Strategy

A1. Original Biodiversity Offset Strategy Summary

A1.1 Previously approved biodiversity offset strategy and projects conditions of approval

The continuation of Boggabri Coal Mine BOS (Parsons Brinckerhoff 2010a) developed in the environmental assessment was approved by the Director-General of the DP&I, subject to a number of conditions of approval (CoA), under Schedule 3 of the *Environmental Planning and Assessment Act 1979.* Specifically, the approved BOS was comprised of the following offsets:

- **Merriendi biodiversity offset areas (BOAs): 541 ha -** including the restoration of at least 170.1 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community as listed under the TSC Act.
- **Namoi BOA: 2,469 ha** - including the restoration of at least 491 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community as listed under the TSC Act.
- **Myall Plains, Wirrilah, Mallee BOAs: 3,247 ha -** including the restoration of at least 430 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community as listed under the TSC Act.
- **Additional BOA: 1,000 ha -** including the protection of 650 ha of Box Gum Grassy Woodland ecological community and the restoration of 350 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community as listed under the TSC Act.
- **Crown Reserve Land within Namoi offset area: 441 ha -** Additional funding/management agreement with DPI Catchments and Lands towards management of special lease/Crown Reserve land.
- **Additional land within Namoi offset area, Eastern offset area (Myall Plains, Wirrilah, Mallee) and Crown Reserve Land managed for corridor enhancement:** 626 ha - Located on poor condition (for biodiversity conservation) land but managed to improve connectivity in offset corridors.
- **Rehabilitation area: 1,508 ha -** Except for the area of the minimised final void, pre-mining native vegetation communities are to be re-established for a biodiversity conservation land use objective, with the area subject to finalisation of the rehabilitation management plan (RMP) as required under this approval.

A1.2 Revisions to the biodiversity offset strategy

A revision to the approved BOS (Parsons Brinckerhoff 2010a) is required for the project to address:

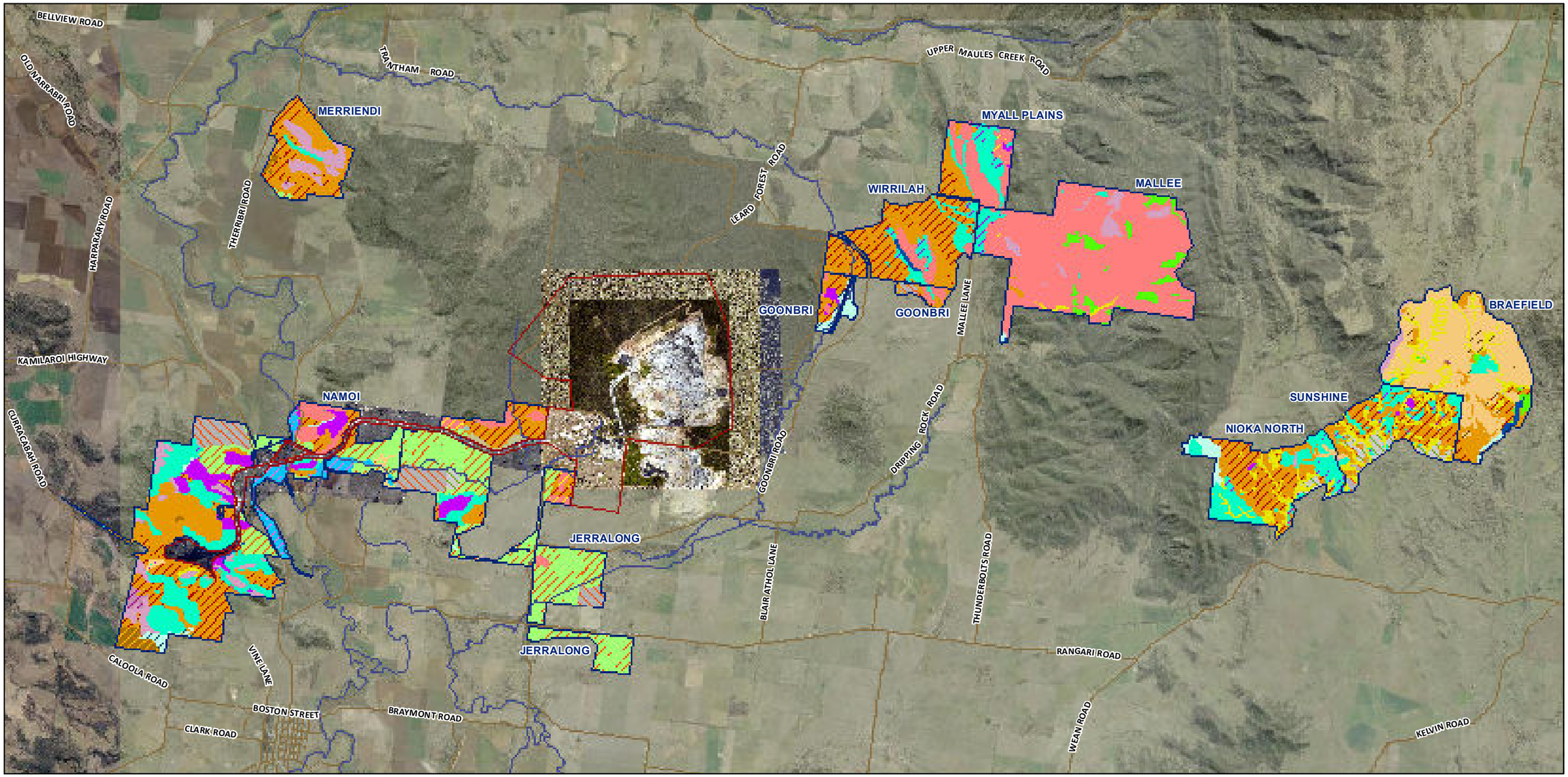
- changes to the type and extent of vegetation/habitats within identified offsets resulting from the independent verification under Condition 9 of the project's EPBC approval.
- minor modifications to the project boundary and the relocation of Goonbri road within the previously identified biodiversity offsets
- suitable alternative offset areas to the residual Crown Lands areas excluded from offsets
- additional offset areas required under Condition 43 (incorporating the additional 1000 ha offset) and for understorey clearing outside of Boggabri existing boundary

A description of each of these changes is provided below in Sections A1.2.1 – A1.2.4.

A1.2.1 Changes in biodiversity offset vegetation mapping

In accordance with Condition 9 of the project's EPBC approval an independent audit of the approved BOS (Parsons Brinckerhoff 2010a) was undertaken to '*validate the quantity, quality and ecological characteristics of the offset areas in line with the requirements of the department's* Environment Protection and Biodiversity Conservation Act 1999 *Environmental Offsets Policy October 2012'*.

Results of the independent audit conducted by Niche in December 2013 made changes to the vegetation community/habitat extents within the Biodiversity Offset Areas (Niche Environment and Heritage 2014).The verified vegetation community mapping undertaken as part of the independent audit have been adopted in this revised BOS. The revised vegetation mapping is presented below in Figure A1.1.



Offset area

Boggabri Project Approval Area

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region [PCT55/NA102]

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region - Derived Native Grassland [PCT55/NA102]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range - Derived Native Grassland [PCT610/NA245]

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [PCT427/NA410]

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [PCT102/NA181]

Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion

Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion [PCT530/NA309]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT78/NA193]

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT78/NA193]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion - Derived grassland [PCT1118/NA197]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [PCT27/NA219]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT27/NA219]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions - Derived Grassland [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1384/NA227]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1384/NA227]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion - Derived Native Grassland [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion - Derived Native Grassland [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

Map: 2267037B_GIS_BOS013_A1	Author: SuansriR
Date: 2/08/2017	Approved by: - CooperN

Data source: © Land and Property Information 2015

0 1,600 3,200 Meters

1:120,000

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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BIODIVERSITY OFFSET STRATEGY

Figure A1.1
Revised Biodiversity Offset Area vegetation mapping

A1.2.2 Changes resulting from minor modifications to the project boundary and the relocation of Goonbri Road within the previously identified biodiversity offsets

As described in Section A1.2 Boggabri Coal have undertaken a number of minor modifications to the project approval boundaries. These Modification have included some minor changes to the areas of Biodiversity offsets committed to in the approved BOS. For each of these Modification approvals commitments to provide alternative offsets of similar condition are included in project approvals. These alternative offsets are in addition to the offset requirements for each of the modifications specific impacts. A Summary of the change to the approved offsets areas resulting from the modifications and Goonbri Road Upgrade are provided below in Table A1.1below and shown in Figure A1.2 to Figure A1.5.

Table A1.1 Areas to be removed from previously approved Biodiversity Offset Area following project modifications and Goonbri Road Upgrade

Vegetation community (PCT)	Modification 3[1]	Modification 4[1]	Modification 5[1]	Goonbri Road Upgrade[2]	Total
Derived Grassland	-	-	2.9	5.7	8.6
Remnant vegetation					
Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / VT NA 179)	10.7	1.7	3.4	-	**15.8**
White Box White Cypress Pine grassy woodland (White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 1383 / BVT NA 226))	2.6	0.7	-	-	**3.3**
River Red Gum riparian woodlands and forests (River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 78 / BVT NA 193))	-	0.9	1.3	-	**2.2**
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (PCT 1381 / BVT NA 165))	-	1.2	-	-	**1.2**
Plains Grassland (Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South	-	-	0.1	-	**0.1**

Vegetation community (PCT)	Modification 3[1]	Modification 4[1]	Modification 5[1]	Goonbri Road Upgrade[2]	Total
Bioregion (PCT 102 / BVT NA 181))					
Exotic vegetation (Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation)	24.1	8.4	1.0	-	**33.5**
Total Native vegetation	**13.3**	**4.5**	**7.7**	**5.7**	**31.2**
Total Box Gum Woodland TEC	**2.6**	**0.7**	**-**	**-**	**3.3**

1 Modification 3, Modification 4 and Modification 5 occur within and adjacent to the Namoi BOA. Impacts associated with these modifications described in Table A1.1 relate to the portion of vegetation/ PCT occurring within the Namoi BOA.
2 A portion of the Goonbri Road Upgrade was associated with the Wirrilah BOA. Impacts associated with the Goonbri Road Upgrade described in Table A1.1 relate to the portion of vegetation/ PCT occurring within the Wirrilah BOA.

Following approval of Modification 4 the Namoi BOA was reduced by 12.9 ha, comprising 4.5 ha of native vegetation and 8.4 ha of exotic vegetation.

Modification 3 boundary

Cadastre

Boggabri Project Approval Area

Offset boundary

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [PCT102/NA181]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT78/NA193]

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT78/NA193]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1384/NA227]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

KAMILAROI HIGHWAY

THERRIBRI ROAD

OVERVIEW

Map: 2267037B_GIS_BOS007_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 160 320 Meters

1:12,500

Coordinate system: GDA 1994 MGA Zone 56
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BIODIVERSITY OFFSET STRATEGY

Figure A1.2
Modification 3 - vegetation in disturbance area

Modification 3 boundary

Cadastre

Boggabri Project Approval Area

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT78/NA193]

River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT78/NA193]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

KAMILAROI HIGHWAY

THERRIBRI ROAD

OVERVIEW

Map: 2267037B_GIS_BOS008_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

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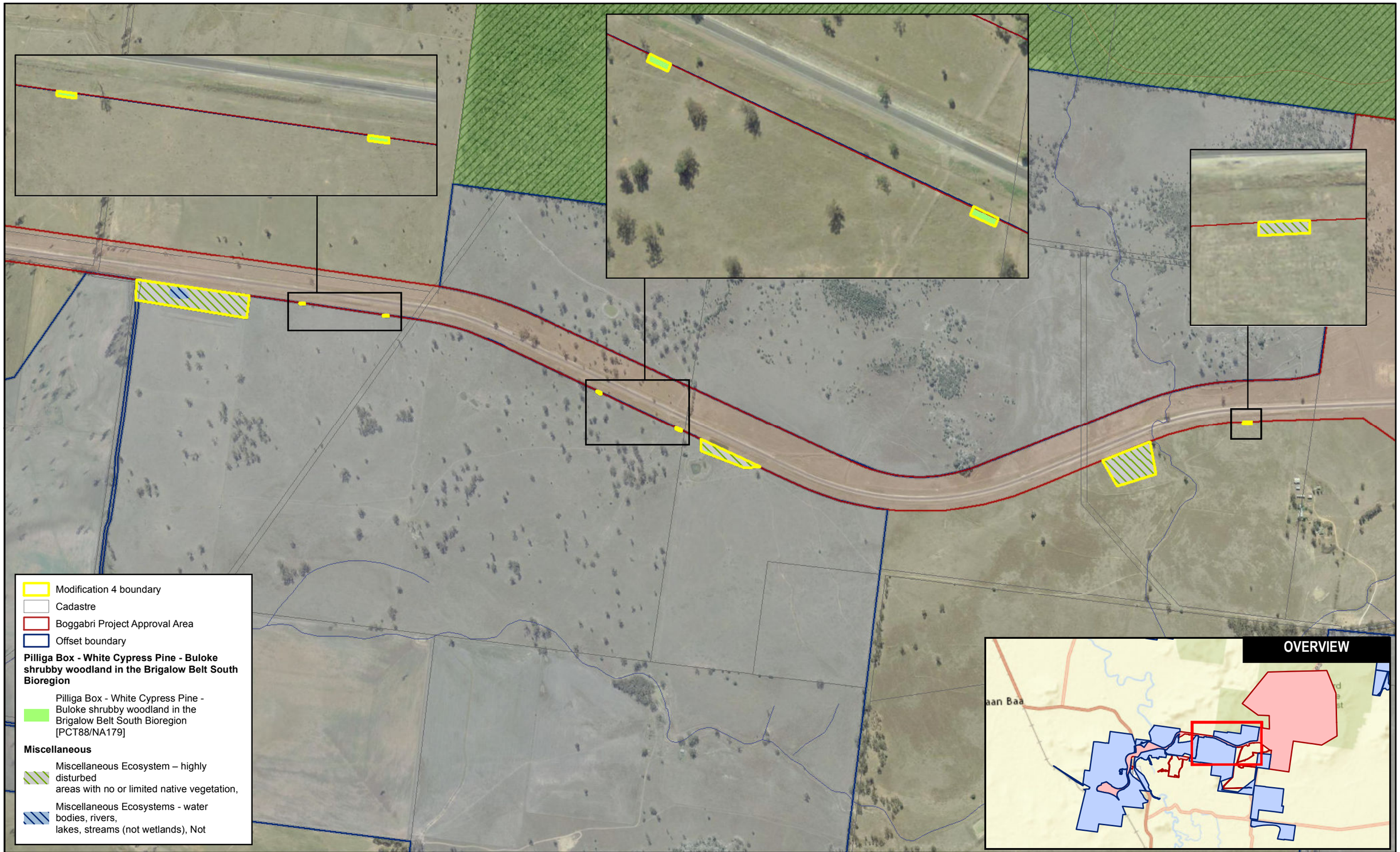
BIODIVERSITY OFFSET STRATEGY

Figure A1.3
Modification 4 - vegetation in disturbance area



Map: 2267037B_GIS_BOS009_A1	Author: SuansriR		0 160 320 Meters 1:12,500 Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3
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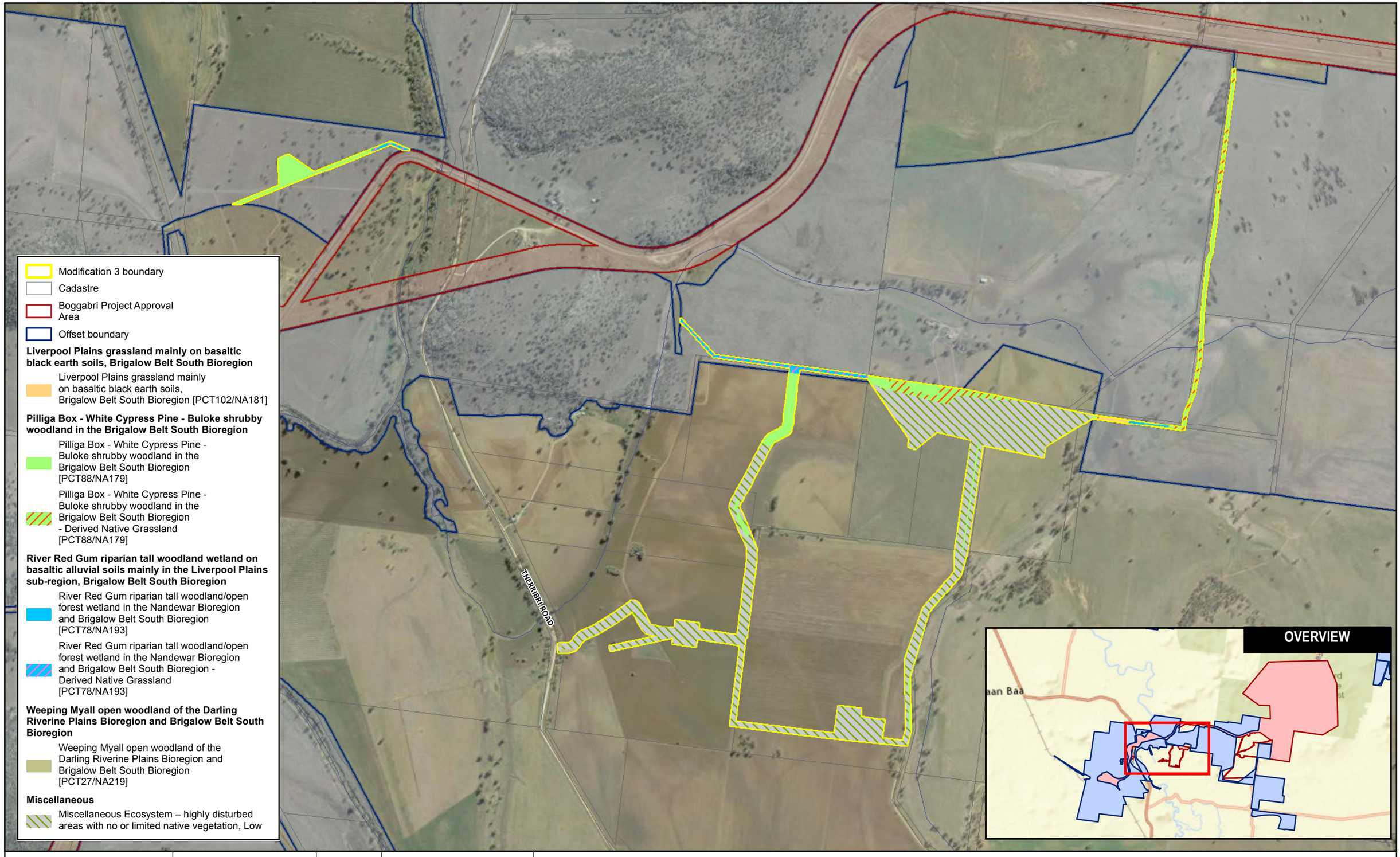
BIODIVERSITY OFFSET STRATEGY

Figure A1.4
Modification 4 - vegetation in disturbance area



Map: 2267037B_GIS_BOS010_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

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BIODIVERSITY OFFSET STRATEGY

Figure A1.5
Modification 5 - vegetation in disturbance area

Modification 3 boundary
Cadastre
Boggabri Project Approval Area
Offset boundary

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

LEARD FOREST ROAD

OVERVIEW

Map: 2267037B_GIS_BOS011_A1	Author: SuansriR		0 200 400 Meters 1:15,000 Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3
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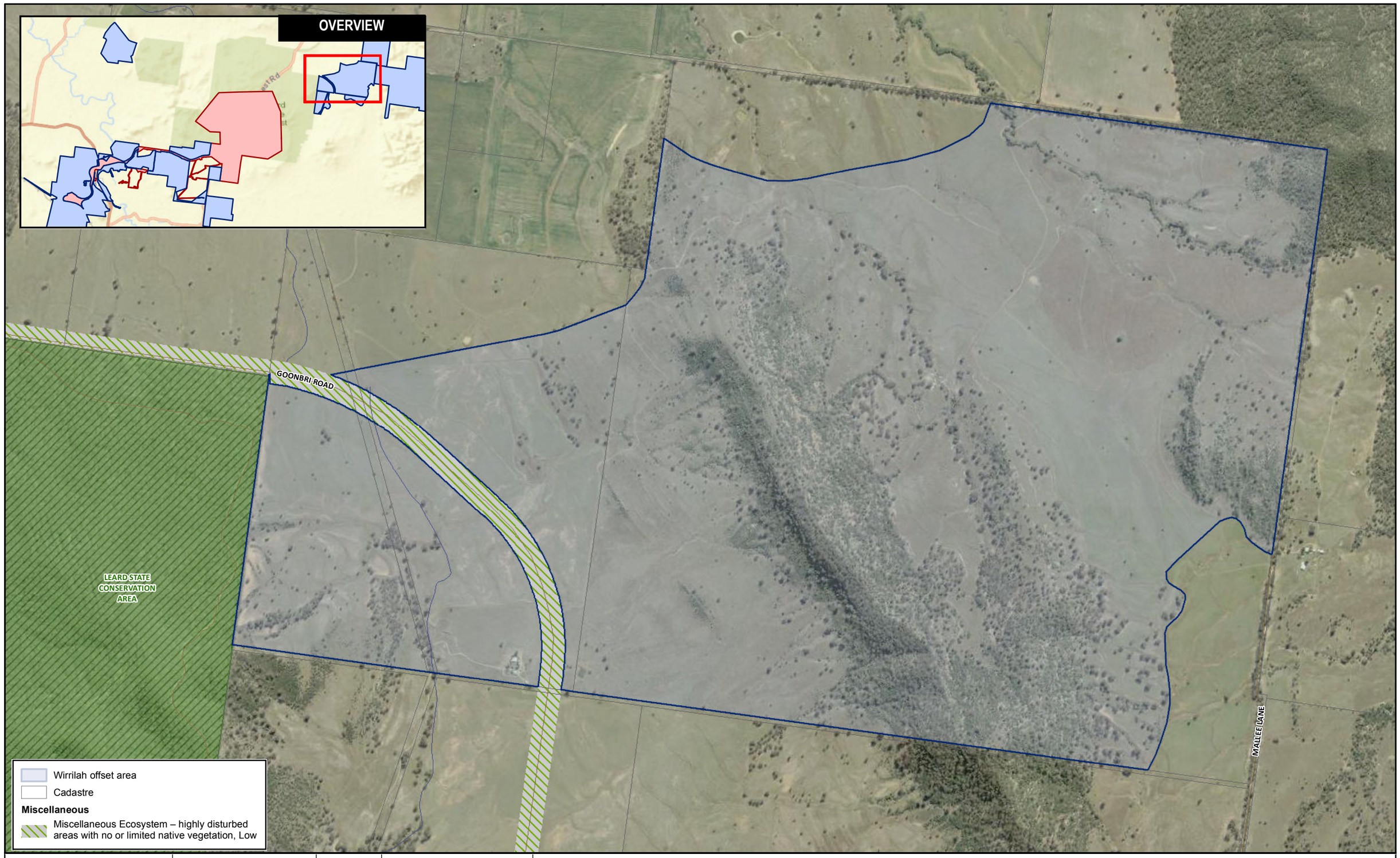
BIODIVERSITY OFFSET STRATEGY

Figure A1.6
Modification 5 - vegetation in disturbance area



Map: 2267037B_GIS_BOS012_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

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BIODIVERSITY OFFSET STRATEGY

Figure A1.7
Goonbri Road - vegetation in disturbance area

A1.2.3 Changes to offset areas following exclusion of Crown Land

Under Condition 43 of the Boggabri Coal Project Approval (PA 09_0182) Boggabri Coal are required to incorporate a number of parcels of Crown Reserve land within and/ or adjoining the proposed "Namoi Offset Area". Specifically, this condition requires Boggabri Coal to:

- Identify the special lease/Crown Reserve land subject to a funding/ management agreement with DPI Catchments and Lands, and if this land area is less than the identified 441 ha, then the Proponent must identify substitute areas that would provide an equivalent increase in biodiversity values.

To date Boggabri Coal have purchased a number of the committed land parcels from DPI-Lands, however of the 441 ha committed to in the BOS, a shortfall of approximately 298.9 ha associated with the following parcels remain:

- Lot 160 and Lot 171 DP 755475 – Reserve 93765 for Future Public Requirements
- Lot 263 DP1193634 – Reserve 83990 for Travelling Stock
- Lot 7001 DP 1052587 – Reserve 28354 for Camping and Travelling Stock
- Lot 87 and 89 DP 755475 – Reserve 82995 for Public Recreation and Trigonometrical Purposes
- Lot 7015 DP 1051978, Lot 145 DP 755475 and Lot 1 DP 1197060 – Reserve 52313 for Camping and Water.

Boggabri Coal have undertaken ongoing consultation with the DPI-Lands, regarding the proposed purchase and/ or land management of these remaining Crown Land parcels (approximately 298.9 ha). DPI-Lands have subsequently advised Boggabri Coal that they are unlikely to be in a position to sell and/ or agree to the management for conservation of the majority of the remaining land parcels. For the majority of these parcels the current land-use purposes, including traveling stock reserves, public recreation with right of public access are considered to be incompatible with the proposed management for in perpetuity conservation outlined in the BOS.

While DPI - Lands identified two parcels Lot 160 and Lot 171 DP 755475 – Reserve 93765 for Future Public Requirements) as potentially unconstrained from Aboriginal land claim, right of public access or management as traveling stock reserves, these parcels would still require consideration of native title and competitive process. DPI Lands have identified that it is likely that consideration of these issues would have extended timeframes outside of the proposed submission timeframes of the revised BOS and associated CoA timeframes for finalised offsets security.

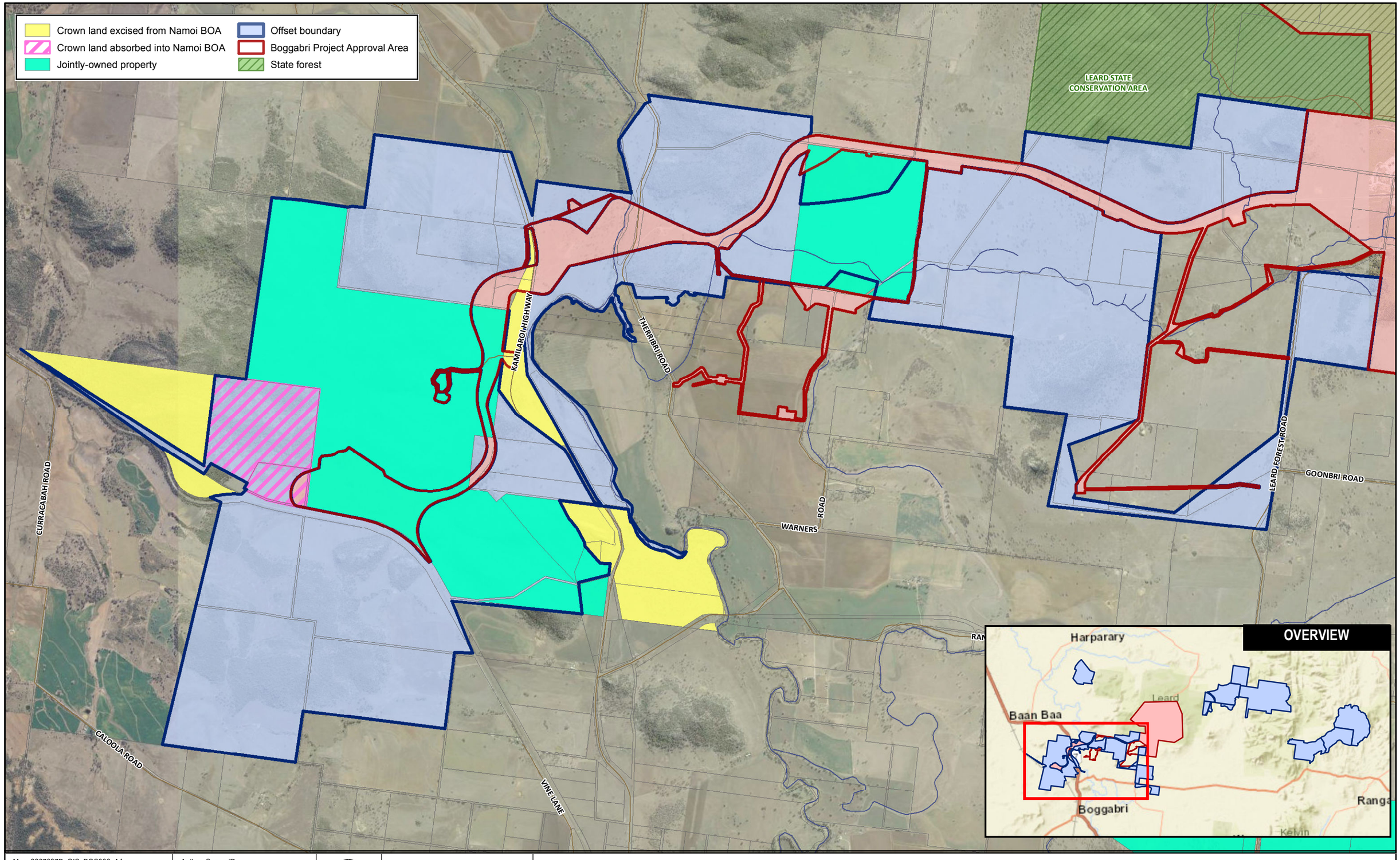
Given the improbable suitability of these land parcels and associated timeframes identified by DPI-Lands for any further acquisition, Boggabri Coal will provide a revised BOS in accordance with Condition 43, which will *identify substitute areas that would provide an equivalent increase in biodiversity* to the residual 298.9 ha of Land.

Boggabri Coal notes that the obligation to manage the additional 298.9 ha of Crown Land is currently met under the revised Namoi BOA, which exceeded the existing requirements by 658.7 ha (prior to Crown Land and modifications being accounted for) (refer to Table 5.1).

A summary of biodiversity within the proposed areas of Crown Land to be excluded from the BOS are provided below in Table A1.2 and presented in Figure A1.8. Areas of Crown Land excluded from the BOS are in association with the Namoi BOA (Figure A1.8).

Table A1.2 Summary of biodiversity within Crown Land exclusions

Vegetation communities	Area
Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (NA 2415, PCT 610)	17.0
River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 193, PCT 78)	54.0
River Red Gum riparian tall woodland/ open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 193, PCT 78) (derived grassland)	19.9
Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (NA 165, PCT 1381)	26.3
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383)	76.7
White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (NA 226, PCT 1383) (derived grassland)	4.6
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (NA 219, PCT 27)	0.6
Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region (NA 102, PCT 55)	20.6
Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / BVT NA 179)	78.1
Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (PCT 88 / BVT NA 179) (derived grassland)	35.6
Total	**333.4**



Map: 2267037B_GIS_BOS006_A1	Author: SuansriR		0 0.5 1 Kilometres 1:40,000 Coordinate system: GDA 1994 MGA Zone 56 Scale ratio correct when printed at A3
Date: 16/06/2017	Approved by: - CooperN		

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BIODIVERSITY OFFSET STRATEGY

Figure A1.8
Changes to Biodiversity Offset Areas following exclusion and absorption of Crown Lands, location of Joint-venture properties

A1.2.4 Additional offset areas under Condition 43

Under Condition 43 of the projects CoA, Boggabri Coal are required to provide a revised BOS as outlined in Table A1.3.

Table A1.3 Condition 43 requirements for the revised BOS

Requirement of biodiversity offset strategy	Section addressed in revised biodiversity offset strategy
Not reduce the size or quality of the proposed offset areas.	Section 4 and 5
Be consistent (as far as is possible) with the recommendations and objectives of the Leard Forest Mining Precinct Regional Biodiversity Strategy.	Section 4.1
Be prepared in consultation with OEH, Namoi CMA, CCC, DPI Catchments and Lands and DoEE (previously SEWPAC).	Section 2.3
Identify the land to be acquired for the additional offset area of 1,000 ha.	Section 4 and 5
Identify land to be acquired for the additional modification offset area (modification 3) of 103 ha and the additional modification offset area (modification 4) of 132 ha.	Section 4 and 5
Identify the special lease/Crown reserve land subject to a funding/management agreement with DPI Catchments and Lands, and if this land area is less than the identified 441 ha, then the Proponent must identify substitute areas that would provide an equivalent increase in biodiversity values.	Appendix A

A1.2.4.1 Details of the additional offset requirements

The additional offset requirements include:

- 1,000 ha of Box Gum Woodland EEC (including 650 ha of remnant and 350 ha of derived grassland)
- modification 3 minimum offset requirements are 103 ha of native vegetation, including at least 63 ha of Pilliga Box Woodland and 16 ha is Box Gum Woodland EEC as listed under TSC Act
- modification 4 minimum offset requirements are 133 ha of native vegetation of which 8 ha is Box Gum woodland EEC, 103 ha of Pilliga Box Woodland, 21 ha of Narrow Leaved ironbark shrubby open forest and 1 ha of River Red Gum Riparian Woodlands.
- modification 5 minimum offset requirements are 106 ha of native vegetation of which 1 ha is Plains Grassland, 1 ha is Weeping Myall Woodland, 7.0 ha is River Red Gum Riparian Woodlands and 34 ha is Pilliga Box grassy woodland.
- Goonbri Road Upgrade requires 40.4 ha of native vegetation of which 3.3 ha is Box Gum Woodland and 19.3 Derived Native Grasslands EEC
- understorey clearing outside of Boggabri existing clearing boundary includes 19.3 ha of native vegetation, none of this vegetation is commensurate with Box Gum Woodland
- An additional area of 298.9 ha for replacement of the Crown Lands excluded from the approved offset area.

The specific commitments for additional offset requirements associated with biodiversity impacts of each modification is detailed in Table A1.4.

Table A1.4 Additional biodiversity offset commitments associated with project modifications

Modification Vegetation community	Impact (ha)	Offset commitment (ha)
Modification 3		
Pilliga Box – Poplar Box – White Cypress grassy woodland	10.7	63
White Box – White Cypress Pine grassy woodland	2.6	16
Native vegetation community	–	24
	Sub-total	**103**
Modification 4		
Pilliga Box – Poplar Box – White Cypress Pine grassy woodland	17.2	103
Yellow Box – Blakely's Red Gum grassy woodland	1.2	8.0
Narrow-leaved Ironbark – White-Cypress Pine shrubby open forest	3.5	21
River Red Gum riparian woodlands and forests	0.9	1.0
	Sub-total	**133**
Modification 5		
Derived native grassland: Pilliga Box – Poplar Box – White Cypress Pine grassy woodland	11.2	63.0
Pilliga Box – Poplar Box – White Cypress Pine grassy woodland	6.1	34.0
Plains Grassland	0.1	1.0
Weeping Myall woodland	0.1	1.0
River Red Gum riparian woodlands and forests	1.3	7.0
	Sub-total	**106**
Goonbri Road Upgrade		
Derived native grassland: White Box – Yellow Box – Blakely's Red Gum woodland[1]	4.1	19.3
Red Gum grassy woodland[2]	1.2	5.6
White Box – Narrow-leaved Ironbark grassy woodland[2]	0.7	3.3
Pilliga Box – Poplar Box – White Cypress Pine grassy woodland	2.6	12.2
	Sub-total	**40.4**
Illegal clearing		
White Box – Narrow-leaved Ironbark White Cypress Pine shrubby open forest	7.7	19.3
	Sub-total	**19.3**
Total	**71.1**	**401.7**

1 Consistent with PCT 1383 / BVT NA 226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland).

2 Consistent with PCT 1383 / BVT NA 1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion.

To meet the projects residual offset requirements under Condition 43, Boggabri Coal have acquired five additional BOAs. Each of the additional BOAs are within the study area of the Leard State Forest Regional Biodiversity Stage 1 – Scoping Report and contribute to the Regional East-West Wildlife Corridor. These additional BOAs include:

- Sunshine – 738.1 ha
- Nioka North – 867.9 ha
- Goonbri – 223.4 ha
- Jerralong – 570.1 ha
- Braefield – 1,400.7 ha.

A general summary of each of the BOAs acquired for inclusion within the revised BOS is provided in Section 4. Detailed ecological investigation for each of these offset properties and the biodiversity values they contain are presented in Appendix B. Field survey reports validating the vegetation communities, habitats and species present within each of the additional BOAs are provided in Appendix C (Jerralong and Goonbri BOAs), Appendix D (Nioka North and Sunshine BOAs) and Appendix E (Braefield BOA).

Appendix B

Biodiversity Offset Areas

B1. Biodiversity survey methods for BOAs

B1.1 Biodiversity monitoring survey methods

Outlined below are details of field methods used to undertake biodiversity monitoring across Boggabri Coal Mine Biodiversity Offset Areas (BOA). BOA monitoring surveys were generally conducted annually, during springtime, so that year to year results would be subject to the same seasonal conditions. Targeted surveys for specialist fauna species were also conducted, but seasonal survey timings were during contexts most favourable for the ecological requirements of individual specialist species.

BOA surveys undertaken were designed to determine the condition and extent of vegetation communities, the potential habitat those communities represent for threatened flora and fauna species, and to record the suite of flora and fauna species using the BOAs.

B1.2 Flora Survey

The flora monitoring employed quantitative transect/plot surveys as outlined in the methodology contained within BioBanking Assessment Methodology (Department of Environment and Climate Change 2008) (Table B1.1 and Figure B1.1). Transects/plots were surveyed at each of the monitoring sites that represent each vegetation type and each management zone where practicable.

Table B1.1 Attributed measures in each transect/plot

Variable	Attribute	Plot or transect type	Description
Canopy	Species richness	20 x 20 m plot	A count of the total number of canopy species.
	Percentage canopy cover	Measured at 10 points along 50 m line transect (i.e. every 5 m)	An estimate of percent foliage cover for the canopy.
	Number of trees with hollows	50 x 20 m plot	A count of the total number of living and dead trees with at least one hollow.
	Regeneration	50 x 20 m plot	The proportion of canopy species regenerating (i.e. seedlings/saplings).
Midstorey	Species richness	20 x 20 m plot	A count of the total number of midstorey species.
	Percentage Midstorey cover	Measured at 10 points along 50 m line transect (i.e. every 5 m)	An estimate of percent foliage cover for the midstorey.
Ground layer	Species richness	20 x 20 m plot	A count of the total number of ground cover species.
	Percentage native ground cover (grasses)	Measured at 50 points along a 50 m line transect (i.e. every 1 m)	Records of whether native grass intersects defined points along the transect to derive percentage cover.
	Percentage native ground cover (shrubs)		Records of whether native shrubs intersects defined points along the transect to derive percentage cover.

Variable	Attribute	Plot or transect type	Description
	Percentage native ground cover (other)		Records of whether native other (forbs, ferns, etc.) intersects defined points along the transect to derive percentage cover.
	Coarse woody debris (fallen logs)	50 x 20 m plot	Total number and combined length of all sections of dead fallen timber ≥ 10 cm diameter, ≥ 0.5 m in length, and completely detached from living or dead standing trees.
Weed species	Species richness	20 x 20 m plot	Total number of weed species.
	percentage cover	Measured at 50 points along a 50 m line transect (i.e. every 1 m)	An estimate of percent foliage cover for weed species in the canopy and midstorey. Records of whether ground cover weeds intersect defined points along the transect to derive percentage cover.

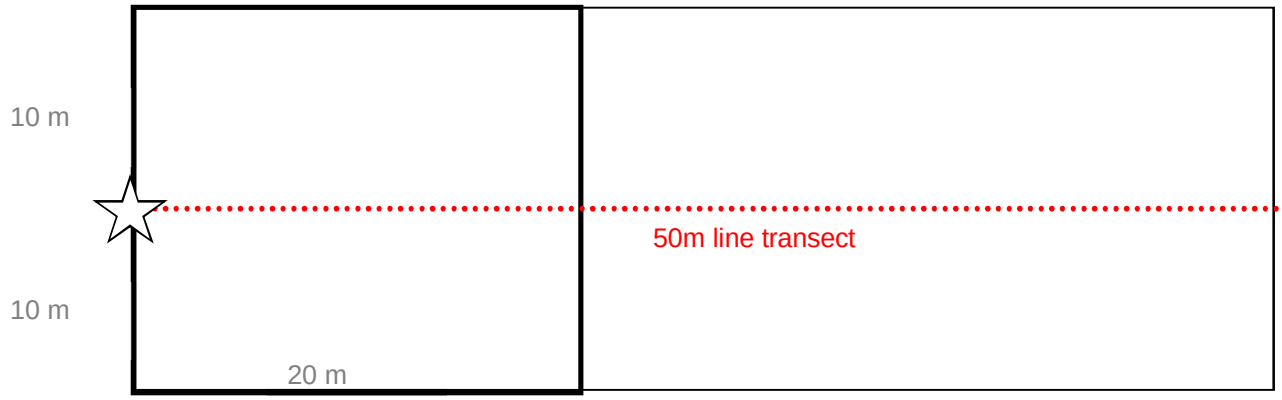


Figure B1.1 Transect/plot design

A key element of the monitoring within the BOAs was to determine the condition of White Box Woodland remnants in accordance with the State and Transition model for box gum grassy woodlands. The box gum woodland vegetation within the BOAs was delineated into States as follows:

- State 1: Grassy woodland
- State 2: Native pastures and woodland
- State 3: Fertilised pastures
- State 4: Crops and sown pastures
- State 5: Revegetated areas.

The State and Transition model was used during the monitoring of the BOAs to develop a baseline for box gum woodland patches to enable any transition from a state to be detected in the future after management actions have begun. The indicators outlined in Table B1.2 were used to determine the current state of the vegetation within the BOAs (for States 1–3) and will be used to determine any transition between states as monitoring progresses. The current states of box gum woodland within each BOA is mapped in Section 3 to Section 6 for each BOA.

Table B1.2 Indicator species to be used for State 1 – 3 within BOAs

Variable	Indicators

	State 1	State 2	State 3
Canopy	A range of ages, from mature trees with hollows to seedlings.	The dominant canopy species are present, with a good representation of tree ages (excludes derived grasslands).	Canopy species are still present in woodlands though there are few young trees and seedlings.
Shrubs	Many of the leguminous (pod-bearing) shrubs are found only in State 1. Due to their high nutritional value, young plants are quickly grazed out in other states. Examples include Wattles (*Acacia* spp.), Indigos (*Indigofera* spp.), Common fringe-myrtle (*Calytrix tetragona*), Bush-peas (e.g. *Pultenaea* spp., *Daviesia* spp., *Dillwynia* spp.), and Cryptandras (*Cryptandra* spp.).	While many shrubs are still present in State 2, they are likely to be mostly the colonising species like Cassinias. Grazing-sensitive shrubs such as most of the wattles, the indigos and cryptandras are probably no longer present unless protected. Examples include some heaths, such as urn heath (*Melichrus urceolatus*) and peach heath (*Lissanthe strigosa*) persist where protected, and Grey Guinea-flower (*Hibbertia obtusifolia*).	Most shrubs in State 3 will be exotic. Native shrubs that persist in State 3 are those that are highly unpalatable due to thorns or other features. Examples include Blackthorn (*Bursaria spinosa*), and Cassinias, Chinese shrub, sifton bush, etc. (*Cassinia* spp.).
Groundcover – forbs (wildflowers)	Plants with tall, flowering stems which are sensitive to grazing may only be found in State 1 including many lilies, orchids and daisies. Examples include Native flax (*Linum marginale*), Donkey orchids *(Diuris spp*.) and sun orchids (*Thelymitra spp*.), and Yam daisy/murrnong (*Microseris lanceolata*).	Forbs are transitional in form, between the tall, fleshy plants found in State 1 and those of shorter stature that are often found in State 3. State 2 forbs will often have persistent root stock, tough, rough or hairy leaves, which makes them more resistant to grazing. Examples include Sedges (*Carex spp*.), Mat-rushes (*Lomandra spp.),* Early Nancy (*Wurmbea dioica*), Chocolate lilies (*Dichopogon spp*.), Common buttons (*Chrysocephalum apiculatum*), Native plantains (*Plantago spp*.), Common raspwort (*Gonocarpus tetragynus*).	In general, the groundcover in State 3 will have traits adapted to elevated nutrients, competition and grazing. These plants will be annuals (a), short-lived perennials (spp.), short-flowering (sf), rosette forming (r) or stoloniferous (st). Examples include Bluebells (*Wahlenbergia spp*.) (spp.), New Holland daisies (*Vittadinia spp*.), Austral sunray (*Triptilodiscus pygmaeus*) (a), Blue heron's-bill (*Erodium crinitum*) (a), Austral bear's-ear (*Cymbonotus lawsonianus*) (r), Solenogynes (*Solenogyne spp*.) (r), Kidneyweed (*Dichondra repens*) (st).
Groundcover — grasses	Grasses that are typically sensitive to grazing will only persist in State 1. These include Kangaroo grass, Barbed-wire grass (*Cymbopogon refractus*), Wild sorghum (*Sorghum leiocladum*).	Many of the warm-season and highly grazing sensitive grasses found in State 1 are no longer present in State 2. Common State 2 grasses include Nine-awn grass (*Enneapogon nigricans*), Plume-grasses (*Dichelachne spp.*) and Common wheat-grass (*Elymus scaber*).	There are many native grasses that become more common with grazing. In State 3, these species will move towards co-dominance with the exotics that are present. Some examples include Weeping grass (*Microlaena stipoides*), Red grass (*Bothriochloa macra* or *B. decipiens*), Wallaby grasses (*Austrodanthonia spp*.), Purple wire-grass (*Aristida ramosa*).
Exotic species	Occasional woody weeds from seeds carried in bird droppings.	Shrubs including Blackberry (*Rubus fruticosus*), Briar rose (*Rosa rubiginosa*), and African box-thorn (*Lycium ferocissimum*). Groundcovers including Paterson's curse (*Echium*	Exotic species commonly found in State 3 are similar to those in State 2 but more abundant.

		plantagineum), Capeweed (*Arctotheca calendula*), Fescues (*Vulpia spp*.), Bromes (*Bromus spp*.), Coolatai grass (*Hyparrhenia hirta*), African love-grass (*Eragrostis curvula*), and Thistles (various species).	

B1.3 Fauna survey methods

Fauna surveys undertaken within the BOAs include a combination of diurnal bird surveys, call-play back, spotlighting, Anabats and camera trapping as described below.

Table B1.3 Variables measured during fauna monitoring

Species/group	Methods	Effort per site	Frequency	Season
Diurnal birds	Point bird census	20 minutes each for two mornings/afternoons per monitoring site	Annually	Spring – Summer
Nocturnal birds	Call playback	5minutes 5 minutes of call broadcast, 10 minutes listening in habitat management zone per BOA	Annually	Spring – Summer
Microchiropteran bats	Anabat- Ultrasonic call detection	2 consecutive nights of passive recording per monitoring site	Annually	Spring – Summer
Nocturnal Mammals	Spotlighting	20 min in habitat management zones per BOA	Bi-Annually	Spring – Summer
Targeted Regent Honeyeater and Swift Parrot survey	Area searches targeting *Eucalyptus albens* blossom	Refer Section 2.2.4.5	Annually	Winter
Targeted Corben's Long-eared Bat survey	Harp trapping	2 harp trap nights per site	Annually	Summer

B1.3.1 Diurnal bird surveys

Daytime area bird surveys were undertaken within 100 m of the flora quadrats completed at BOAs. Designated surveys were completed during periods of high bird activity, predominately early morning or late afternoon. Surveys were completed at each sample site twice on separate days per monitoring event by two experienced ecologists. Opportunistic records were collected within each BOA concurrently during other surveys.

B1.3.2 Nocturnal surveys

Call playback

Call playback was used to survey for the Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider and Koala using the methods of Kavanagh and Debus (1994) and Debus (1995). Call playback surveys involved broadcasting recordings of the vocalisations of animals to elicit a response, either vocal or behavioural. At each call playback site an initial ten minute listening period was undertaken followed by a five minute call broadcast and then a five minute listening and spotlighting period. For each additional species, the 2 x 5 minute periods were repeated. A final listening period of ten minutes was undertaken after call broadcasting

was concluded. Calls were broadcast using a portable MP3 player and amplified through a megaphone. Call playback was completed in conjunction with spotlighting surveys by Ecologists.

Spotlighting

Spotlighting was completed at Quadrats on foot by two Ecologists, targeting arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. Spotlighting was also completed informally during call playback with animals heard or observed recorded.

B1.3.3 Anabat survey for Microchiropteran bats

Passive Ultrasonic Anabat Bat detection (Anabat SD1/SD2 or Anabat Express unit – Titley Scientific) were used to record and identify the echolocation calls of microchiropteran foraging at certain monitoring locations within the BOAs Passive monitoring of survey sites was achieved by setting Anabat bat detectors to record throughout the night over two consecutive nights at each site.

B1.3.4 Remote camera traps

Remote motion sensing infra-red cameras are positioned at each nine of the 10 BOAs to gain an understanding of terrestrial mammals and vertebrate pests, to aid management strategies. Camera traps were set with chicken necks, and left out for three nights at each site.

B1.3.5 Opportunistic surveys

Opportunistic sightings of animals were recorded including diurnal birds and reptiles. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provides indirect information on animal presence and activity and captured occurrences of threatened fauna species outside of formal surveys limited by scientific time constrained methodologies.

B1.3.6 Targeted Swift Parrot and Regent Honeyeater surveys

Blossom nomads, such as the Swift Parrot and Regent Honeyeater do not reside in discrete areas, because their home range encompasses all the resources they require to survive, which for these species includes large areas of NSW and adjacent States. Due to variations in the distribution of blossom from year to year their distribution may shift from the NSW western slopes to the coast or tablelands with different areas in each of these regions used as the blossoming interval of different tree species cycle.

Both the Regent Honeyeater and Swift Parrot are relatively cryptic species; with Swift Parrots blending all too easily into canopy foliage and Regent Honeyeaters characterised by relatively quiet dispositions and so not easily detectable for bird surveyors to pick up.

Therefore, survey methodologies for these species, rely heavily on observing the distribution of blossom resources and other associated indicators, such as the occurrence of high nectarivorous bird density and diversity.

With the ecology of the birds and associated nectarivorous species in mind, surveys conducted within the BOA's concentrate on patches of tree species, which the birds are likely to use. During the winter period when Swift Parrots are present on the mainland, the key nectar producing tree species in the Boggabri area is *Eucalyptus albens* (White Box).

Therefore, surveys involve checking White Box patches throughout the BOAs for the presence of blossom and nectarivorous bird activity to determine the likelihood that Swift Parrots and Regent Honeyeaters might be present locally. Subsequently, targeted surveys for Regent Honeyeaters and Swift Parrots where undertaken over two sessions in July and August.

Where blossom and nectarivorous bird densities were elevated opportunistic surveys in combination with formal 20 minute surveys were conducted to detect the potential presence of Swift Parrots or Regent Honeyeaters. During each season surveys were conducted to roughly coincide with annual survey dates set by Birdlife Australia in May and August, so that possible variations in blossom timings might be captured within survey effort.

B1.3.7 Targeted Corben's Long-eared Bat surveys

Like other Long-eared Bat species Corben's Long-eared Bat (*Nyctophilus corbeni*) uses understorey strata for foraging and they roost in hollow-bearing trees.

Although many microchiropteran bat species are detectable through use of Anabat call detection methodologies, the vocal differences between *Nyctophilus* spp. are too subtle to reliably differentiate between the various species occurring in the locality of the BOAs. Therefore, surveys for Corben's Long-eared Bat needed to be conducted with a methodology that enabled bats to be identified in the hand.

Harp traps are excellent for capture and release of microchiropteran bats and they are well suited to the capture of *Nyctophilus* spp. due to their propensity to use lower forest strata for their foraging habits.

Site selection for the setting of harp traps included a number of rationale, such as, targeting of those areas where *Nyctophilus* sp. had been previously detected during other monitoring programs, woodland habitats in areas where hollow-bearing trees provide potential roosting sites and where suitable flyways were detected in forest and woodland areas.

Harp traps were set at each location over a two-consecutive night period during the warmer months (surveys best conducted between October and April).

Captured bats were identified to species level, sexed, measured and weighed. Bats were released immediately after processing if during dark conditions or held in a cool, dark and quiet location until release in the dark was possible.

B1.4 Survey history

The survey history of each of the BOA areas is presented below through Appendix B chapters B2-B11. All BOAs have undergone baseline surveys, and are now surveyed as part of the annual BOA monitoring program.

B2. Merriendi BOA

The Merriendi property encompasses an area of 547 ha and is located approximately 8.3 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Merriendi property is provided in Table B2.1.

Table B2.1 Summary of Merriendi BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Liverpool Plains sub-catchment
Botanical Subdivision	Bordering the North Western Slopes (NWS) and North Western Plains (NWP) subdivisions
Mitchell landscapes	Bugaldie Uplands Liverpool Alluvial Plains
Noxious weed control area	Narrabri

B2.1 Merriendi biodiversity survey effort

Presented below is a summary of biodiversity survey works completed for the Merriendi BOA.

B2.1.1 Flora survey

Table B2.2 Summary of Merriendi BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline surveys	Niche	Biodiversity Offset Monitoring			
						2012	2014	2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	11 Plots	Independent audit of BOA	6 Plots	6 Plots	6 Plots	6 Plots
Threatened flora targeted surveys	Stratified random meander and plot based surveys		Targeted seasonal contexts	10 Days (2009-2011)		6 Plots Opp. Survey	6 Plots Opp. Survey	6 Plots Opp. Survey	6 Plots Opp. Survey
Vegetation community delineation	Plot-based quadrats survey and quaternary			10 days (2009-2011) 11 plots					

	rapid plot assessments								

B2.1.2 Fauna Survey

Table B2.3 is a summary of survey effort completed at the BOA since baselines surveys.

Table B2.3 Summary of Merriendi BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Merriendi fauna surveys				
				2012	2013	2014	2015	2016
Diurnal birds	Annually	Spring – Summer	8 hrs	6 sites		6 sites	6 sites	6 sites
Herpetofauna Searches	NA Baseline biodiversity survey	Spring – Summer	2 person hrs	-	-	-	-	-
Koala spot surveys	NA Baseline biodiversity survey	Spring – Summer	3 x 5 min surveys					
Nocturnal birds	Annually	Spring – Summer	1 hr	6 sites		6 sites	2 sites	2 sites
Elliot A Traps	NA Baseline biodiversity survey	Spring – Summer	100 nights					
Elliot B Traps	NA Baseline biodiversity survey	Spring – Summer	24 nights					
Pitfall Traps	NA Baseline biodiversity survey	Spring – Summer	8 nights					
Funnel Traps	NA Baseline biodiversity survey	Spring – Summer	24 nights					
Microchiropteran bats Anabat	Annually	Spring – Summer	1 night	6 sites		6 sites	6 sites	6 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	1 hr	6 sites		6 sites	6 sites	6 sites
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	8 hrs			July	May/Aug surveys	Apr/Jul surveys
Targeted Corben's Long-eared Bat survey	Annually	Summer	2 nights			1 site	1 site	1 site
Habitat Assessment	NA Baseline biodiversity survey	Spring – Summer	1 hr					

B2.2 Baseline condition

B2.2.1 Vegetation

The Merriendi property forms the north-west corner of the Regional East-West Wildlife Corridor. The north-east boundary of the property adjoins approximately 1.7 km the Leard State Conservation Area, which was gazetted in 2005 under the BNCCA Act.

The Merriendi property supports large areas of high quality woodland habitats characterised by native grasses, fallen timber, leaf litter and loose rock. The vegetation and fauna habitat types present are illustrated in Figure B2.1 and a breakdown is provided in Table B2.4.

Table B2.4 Summary of Merriendi BOA vegetation communities

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Merriendi BOA (ha)
Belah alluvial woodlands – (Derived Native Grasslands)	PCT55 / BVT NA102: Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region	Brigalow Clay Plain Woodlands	Grassy Woodlands	Not Listed	11.1
Dwyer's Red Gum Woodland (includes regrowth White Cypress Pine)	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not Listed	130.2
Pilliga Box – Poplar Box – white cypress pine grassy open forest (Low Condition)	PCT88 / BVT NA179 Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (Derived Native Grassland)	Pilliga Outwash Dry Sclerophyll Forest	Dry Sclerophyll Forests (shrub/ grass sub-formation)	Not Listed	10.2
White Box – White Cypress Pine grassy woodland[1]	PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	177.4
White Box – White Cypress Pine grassy woodland (Low Condition)[2]	PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	194.9
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not Listed	20.4
Weeping Myall Woodland[3]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy	Weeping Myall Woodlands (TSC Act EPBC Act)	2.8

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Merriendi BOA (ha)
			sub-formation)		
				Total	**547**

1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland TSC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland,
3 Equivalent to Weeping Myall Woodlands listed on both the TSC Act and EPBC Act.

B2.2.2 Fauna habitats

A relatively low diversity of fauna habitat types has been recorded across the Merriendi BOA, however relatively large areas of grassy box woodland habitats were suitable for a range of threatened woodland birds (Table B2.5 and Figure B2.1).

Table B2.5 Fauna habitat types in the Merriendi BOA

Fauna habitat	Area (ha)
Grassland	216.2
Grassy woodland on fertile soils	180.2
Shrubby Woodlands/Open forest on skeletal soils	150.6
Total	**547**

B2.2.3 Threatened species and ecological communities

Table B2.6 summarises the threatened species recorded or predicted to occur within the Merriendi property. Threatened species and ecological communities recorded within the Merriendi property are illustrated in Figure B2.2.

Table B2.6 Threatened species recorded or with potential habitat in the Merriendi BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Weeping Myall Woodlands	E	E	
Flora			
Digitaria porrecta	E	E1	Recorded on site with an estimated population exceeding 250 plants
Pomaderris queenslandica		E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Brown Treecreeper		V	Presence confirmed

Diamond Firetail		V	
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Lorikeet		V	
Masked Owl		V	
Speckled Warbler		V	
Turquoise Parrot		V	
Barking Owl		V	Potential habitat
Black-chinned Honeyeater		V	
Little Eagle		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Mammals			
Eastern Cave Bat		V	Presence confirmed
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Yellow-bellied Sheathtail-bat		V	
Corben's Long-eared Bat	V	V	Potential habitat
Koala		V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Spotted-tailed Quoll	E	V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Amphibians			
Sloane's Froglet		V	Potential habitat

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B2.3 Baseline habitat conditions for matters of National Environmental Significance

The Merriendi BOA contains approximately 177.4 ha of the EPBC Act listed White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 194.9 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the TSC Act listing for this community. This ecological community is situated throughout the Merriendi BOA on lower slopes and flatter land. The Merriendi BOA also contains 2.8 ha of Weeping Myall Woodland.

The Merriendi BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot and Corben's Long-eared Bat.

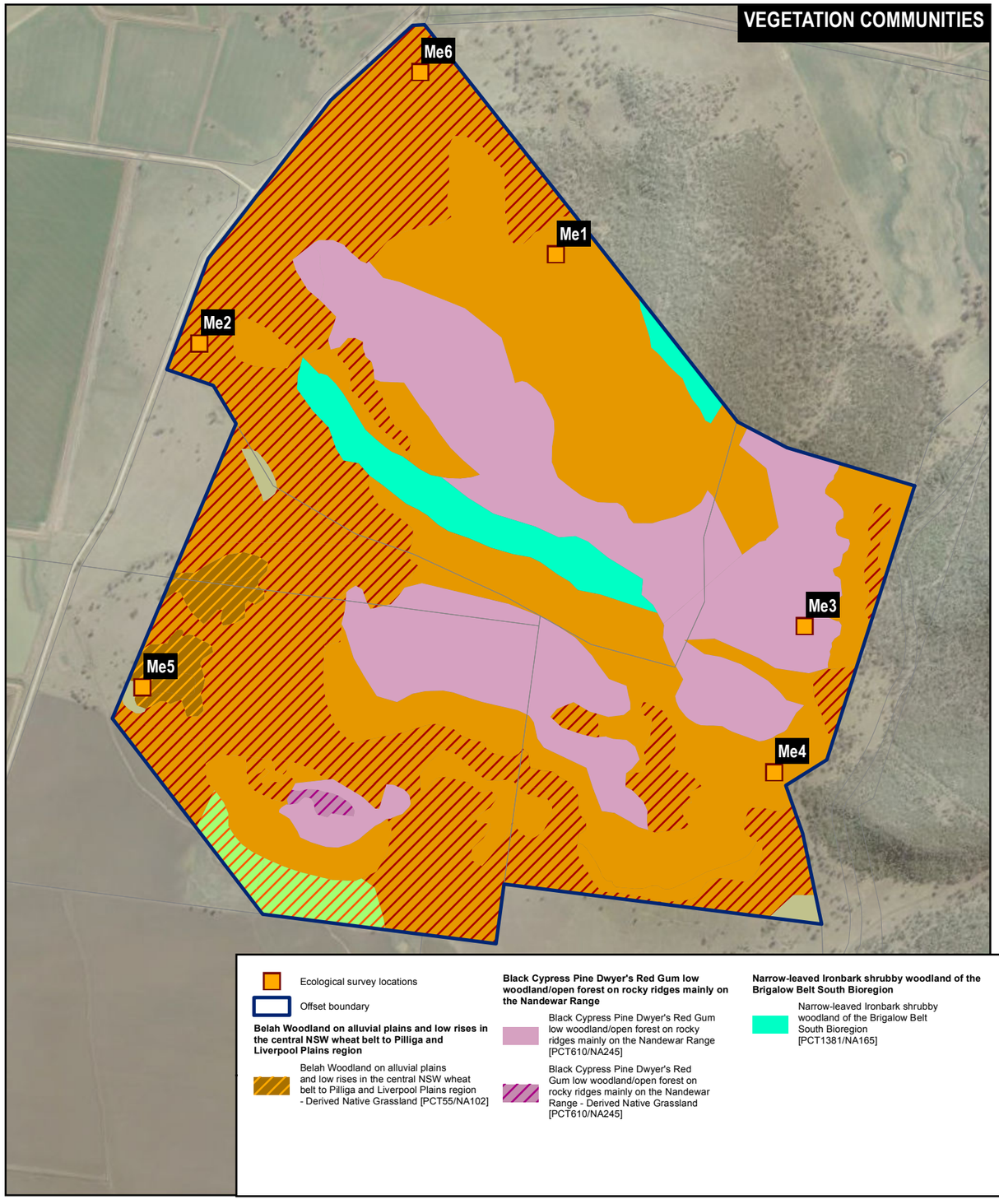
B2.4 Offset management zones

The Merriendi property contains three offset management zones, as detailed in Table B2.7.

Table B2.7 Offset management zones in the Merriendi BOA

Offset management zone	Area (ha)
Habitat management zone	329.5
Habitat restoration zone	211.7
Corridor enhancement zone	5.8
Total	**547**

VEGETATION COMMUNITIES



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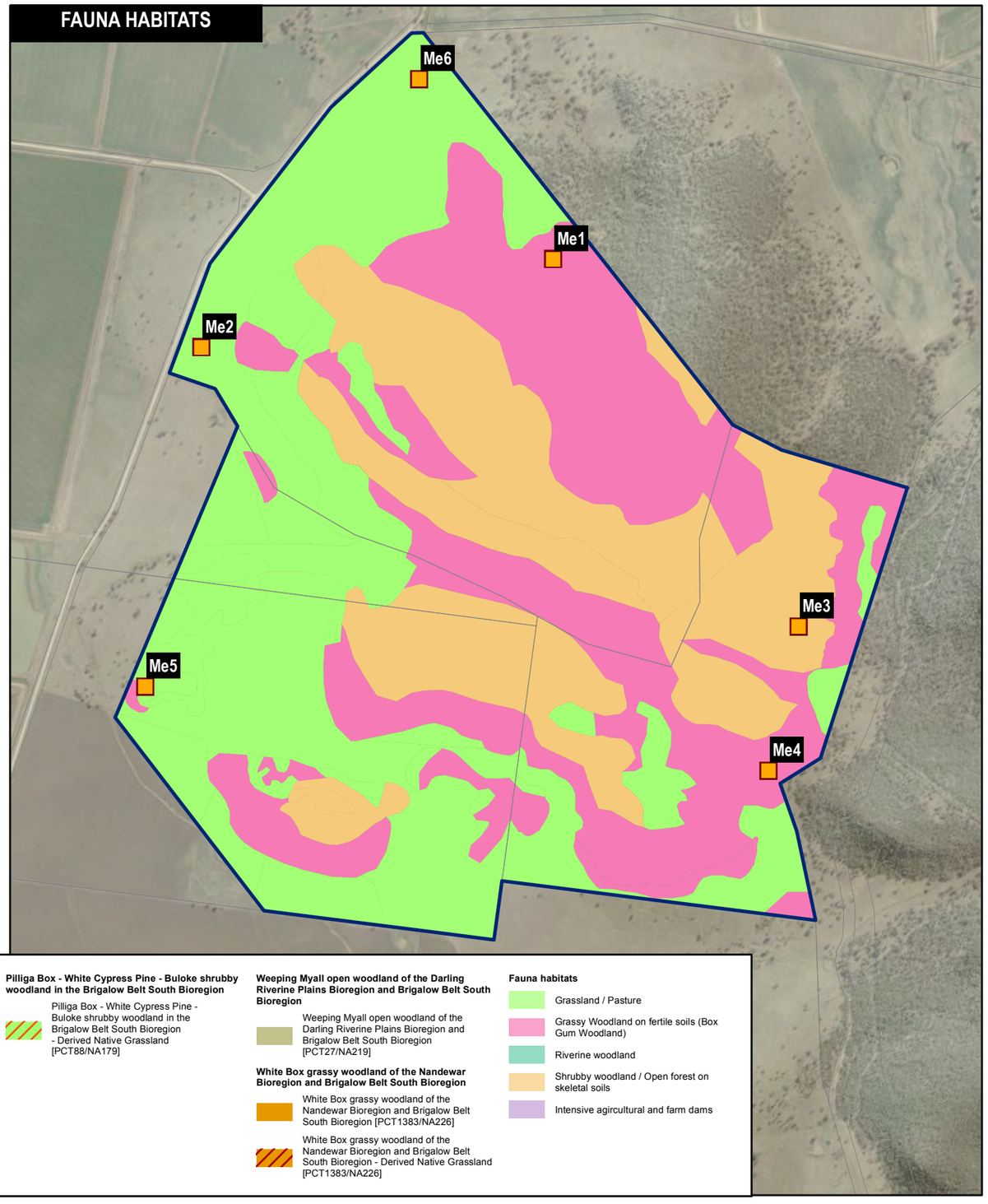

Ecological survey locations

Offset boundary

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region - Derived Native Grassland [PCT55/NA102]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range - Derived Native Grassland [PCT610/NA245]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [PCT27/NA219]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 0.25 0.5 km

1:17,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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BIODIVERSITY OFFSET STRATEGY

Figure B2.1
Vegetation communities and fauna habitats within the Merriendi BOA

THERRIBRI ROAD

MERRIENDI

Threatened species
- Brown Treecreeper
- Diamond Firetail
- Eastern Cave Bat
- Grey-crowned Babbler
- Hooded Robin
- Little Lorikeet
- Speckled Warbler
- Spotted Harrier
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheathtail-bat
- Offset boundary

Box Gum Woodland States
- Box Gum Woodland (State 1: Woodland) - EPBC Act
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act

Other Threatened Ecological Communities
- Weeping Myall Woodland (TSC Act and EPBC Act)

Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
Date: 10/07/2017	Approved by: - Cooper.N

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1:15,000

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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Figure B2.2
Threatened species and communities of the Merriendi BOA

B3. Namoi BOA

The Namoi River Floodplain property (Namoi BOA) encompasses an area of 3,336.5 ha, with the eastern extent of the property located approximately 1.9 km from the EIS mine disturbance limit (Boggabri Existing). A summary of the Namoi BOA is provided in Table B3.1.

The Namoi BOA forms the south-west area of the Regional East-West Wildlife Corridor, linking the Namoi River Floodplain with Leard State Forest. The property supports significant areas of floodplain vegetation including numerous natural soaks and approximately 7 km of the Namoi River. The western portion of the Namoi property contains significant areas of grassy and shrubby woodland with relatively few disturbances. The vegetation and fauna habitat types present are illustrated in Figure B3.1 and a breakdown is provided in Table B3.4 and Table B3.5.

Table B3.1 Summary of the Namoi BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Liverpool Plains sub-catchment
Botanical Subdivision	Bordering the North Western Slopes (NWS) and North Western Plains (NWP) subdivisions
Mitchell landscapes	Liverpool Alluvial Plains Mooki - Namoi Channels and Floodplains Upper Namoi Swamps and Lagoons Bugaldie Uplands Cubbo Uplands
Noxious weed control area	Narrabri

The Namoi BOA contains land purchased as a joint venture between Boggabri Coal and the Maules Creek Coal Mine. The Namoi BOA as discussed in this revised BOS, totalling 3,336.5 ha, encompasses properties wholly owned by Boggabri Coal and Boggabri Coal's 50 % liability (i.e. 50 % of credits generated) of land purchased under the joint venture agreement. Figure A1.8 in Appendix A illustrates the extent of the Namoi BOA that is subject to the joint venture. Figure B3.1 and Figure B3.2 show the full extent of the Namoi BOA, including all land subject to the joint venture.

B3.1 Namoi biodiversity survey effort

Presented below is a summary of biodiversity works completed for the Namoi BOA.

B3.1.1 Flora survey

Table B3.2 Summary of the Namoi BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Namoi baseline flora surveys	Niche	Biodiversity Offset Monitoring			
						2012	2014	2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	40 Plots	Independent audit of BOA	15 Plots	15 Plots	15 Plots	15 Plots
Threatened flora targeted surveys	Stratified random meander and plot based surveys	–	Targeted seasonal contexts	10 days (2009-2011)		15 Plots Opp. Survey	15 Plots Opp. Survey	11 Plots Opp. Survey	11 Plots Opp. Survey
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments	–	–	40 Plots (2009-2011)		–	–	–	–

B3.1.2 Fauna survey

Table B3.3 is a summary of survey effort completed at the BOA since the baselines surveys.

Table B3.3 Summary of Namoi BOA fauna survey history

Species Group	Frequency	Season	Namoi fauna surveys					
			Baseline	2012	2013	2014	2015	2016
Diurnal birds	Annually	Spring – Summer	8 hrs	15 sites	-	15 sites	11 sites	11 sites
BACI Monitoring	Annually	Spring – Summer	2006 – 4 sites x2	–	–	–	–	–
Herpetofauna Searches	NA Baseline biodiversity survey	Spring – Summer	2 person hrs	-	-	-	-	-
Koala spot surveys	NA Baseline biodiversity survey	Spring – Summer	3 x 5 min surveys					
Nocturnal birds	Annually	Spring – Summer	1 hr	15 sites	–	11 sites	2 sites	3 sites

Elliot A Traps	NA Baseline biodiversity survey	Spring – Summer	100 nights					
Elliot B Traps	NA Baseline biodiversity survey	Spring – Summer	24 nights					
Pitfall Traps	NA Baseline biodiversity survey	Spring – Summer	8 nights					
Funnel Traps	NA Baseline biodiversity survey	Spring – Summer	24 nights					
Microchiropteran bats	Annually	Spring – Summer	2 nights	15 sites	–	15 sites	11 sites	11 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	1 hr	15 sites	–	15 sites	11 sites	11 sites
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	8 hrs	–	–	July	May/Aug surveys	Apr/Jul
Targeted Corben's Long-eared Bat survey	Annually	Summer	2 nights	–	–	4 sites	4 sites	2 sites
Habitat Assessment	NA Baseline biodiversity survey	Spring – Summer	1 hr					

B3.2 Baseline condition

B3.2.1 Vegetation

The Namoi property forms the south-west area of the Regional East-West Wildlife Corridor, linking the Namoi River Floodplain with Leard State Forest. The property supports significant areas of floodplain vegetation including numerous natural soaks and approximately 7 km of the Namoi River. The western portion of the Namoi property contains significant areas of grassy and shrubby woodland with relatively few disturbances. The vegetation and fauna habitat types present are illustrated in Figure B3.1 and a breakdown is provided in Table B3.4 and Table B3.5.

Table B3.4 Vegetation communities of the Namoi BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Namoi BOA (ha)
Belah Alluvial Woodland	PCT55 / BVT NA102: Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region	Brigalow Clay Plain Woodlands	Grassy Woodlands	Not listed	8.5
Belah Alluvial Woodland (low condition)	PCT55 / BVT NA102: Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region (Derived Naïve Grassland)	Brigalow Clay Plain Woodlands	Grassy Woodlands	Not listed	64.4

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Namoi BOA (ha)
Dwyer's Red Gum woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	125.6
Dwyer's Red Gum woodland (low condition)	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	29.6
Pilliga Box - Poplar Box – White cypress pine grassy open forest	PCT88 / BVT NA179: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion	Pilliga Outwash Dry Sclerophyll Forest	Dry Sclerophyll Forests (shrub/ grass sub-formation)	Not listed	227.9
Pilliga Box - Poplar Box – White cypress pine grassy open forest (low condition)	PCT88 / BVT NA179: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (Derived Native Grassland)	Pilliga Outwash Dry Sclerophyll Forest	Dry Sclerophyll Forests (shrub/ grass sub-formation)	Not listed	546.1
Plains Grassland[1]	PCT102 / BVT NA181: Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion	Western Slopes Grasslands	Grasslands	Plains Grassland[1]	20.7
River Red Gum Riparian woodland and forest[2]	PCT078 / BVT NA193: River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	Inland Riverine Forests	Forested Wetlands	Aquatic Ecological Community of Darling River[2]	85.0
River Red Gum Riparian woodland and forest (low condition)[2]	PCT078 / BVT NA193: River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Inland Riverine Forests	Grasslands	Aquatic Ecological Community of Darling River[2]	106.5
Rough-barked Apple Riparian Forbs/Grass Forest	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	7.9
Silver-leaved Ironbark heathy woodland; Regrowth White Cypress Pine	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	206.1
Silver-leaved Ironbark heathy woodland (Low Condition)	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby	Not listed	4.6

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Namoi BOA (ha)
			sub-formation)		
Narrow-leaved Ironbark – White Cypress Pine shrubby open forest; Regrowth White Cypress Pine	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	443.5
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low Condition)	PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Grasslands	Not listed	7.0
Weeping Myall Woodland[3]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	Weeping Myall Woodlands (TSC Act EPBC Act)[3]	30.1
Weeping Myall Woodland (low condition) [3]	PCT27 / BVT NA219: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland)	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	Weeping Myall Woodlands (TSC Act EPBC Act)[3]	2.3
White Box – Melaleuca riparian forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	4.6
White Box – White Cypress Pine grassy woodland[4,5]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)[4,5]	324.8
White Box – White Cypress Pine grassy woodland (Low Condition)[4,5]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)[4,5]	600.4
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west; Regrowth White Cypress Pine	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	169.0

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Namoi BOA (ha)
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west (Low condition)	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	23.7
Yellow Box - Blakely's Red Gum grassy woodland[4,5]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)[4,5]	18.2
Yellow Box - Blakely's Red Gum grassy woodland (Low Condition)[4,5]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)[4,5]	29.2
Corridor enhancement	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation (Intensive Agriculture/Corridor Enhancement)	n/a	n/a	Not listed	21
Crop land/ other land for agriculture	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation (Crop Land/ Other Land for Agriculture)	n/a	n/a	Not listed	229.8
Total[6]					**3,336.5**

1 Critically Endangered Ecological Community, Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland.
2 Endangered Ecological Community, Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River FM Act.
3 Endangered Ecological Community, Weeping Myall Woodlands.
4 Critically Endangered Ecological Community, White Box -Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the EPBC Act.
5 Endangered Ecological Community, White Box – Yellow Box – Blakely's Red Gum Woodland Endangered Ecological Community listed under the TSC Act.
6 Total calculated on Boggabri Coal's wholly owned properties and Boggabri Coal's 50% liability (i.e. 50% of credits generated) of properties subject to the joint venture.

B3.2.2 Fauna habitats

A diverse range of fauna habitat types have been recorded across the Namoi BOA (Table B3.5), however relatively large areas of grassy box woodland habitats were suitable for a range of threatened woodland birds.

Table B3.5 Fauna habitat types of the Namoi BOA

Fauna habitat	Area (ha)
Grassland	1,431.5
Grassy woodland on fertile soils	609.5
Shrubby woodlands/Open forest on skeletal soils	944.2
Riverine woodland	100.5
Other land (intensive agriculture and farm dams)	250.8
Total	**3,336.5**

B3.2.3 Threatened species and ecological communities

Table B3.6 summarises the threatened species recorded or predicted to occur within the Namoi property. A diversity of threatened woodland bird and microchiropteran bat species have been recorded across the Namoi BOA. Evidence of Koala has been recorded in riparian habitats within the Namoi BOA. Threatened species and ecological communities recorded within the Namoi property are illustrated in Figure B3.2.

Table B3.6 Threatened species and communities recorded or predicted to occur in the Namoi BOA

Species	EPBC Act[1]	TSC Act[2]	FM Act[3]	Note
Threatened Ecological Communities				
Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling Rive			E	Recorded
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland	CE	E		
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E		
Weeping Myall Woodlands	E	E		
Flora				
Digitaria Porrecta	E	E1		Potential habitat
Pomaderris queenslandica		E1		
Diuris tricolor	V	V		
Fauna				
Birds				
Brown Treecreeper		V		Presence confirmed
Diamond Firetail		V		
Grey-crowned Babbler		V		

Hooded Robin		V		
Little Lorikeet		V		
Painted Honeyeater		V		
Masked Owl		V		
Speckled Warbler		V		
Spotted Harrier		V		
Turquoise Parrot		V		
Varied Sittella		V		
Black-chinned Honeyeater		V		
Pied Honeyeater		V		Potential habitat
Regent Honeyeater	CE	CE		
Square-tailed Kite		V		
Superb Parrot	V	V		
Swift Parrot	CE	E1		
Mammals				
Eastern Cave Bat		V		Presence confirmed
Eastern Bent-wing Bat		V		
Yellow-bellied Sheathtail-bat		V		
Little Pied Bat		V		
Koala		V		
Corben's Long-eared Bat	V	V		
Eastern False Pipistrelle		V		Potential habitat
Large-eared Pied Bat	V	V		
Spotted-tailed Quoll	E	V		
Reptiles				
Border Thick-tailed Gecko	V	V		Potential habitat
Pale-headed Snake		V		Potential habitat
Amphibians				
Sloane's Froglet		V		Potential habitat

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E), Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act
3 Listed as Endangered (E) under the FM Act.

B3.3 Baseline habitat conditions for matters of National Environmental Significance

The Namoi BOA contains three threatened ecological communities that occur as MNES (Figure B3.2), including:

- 343 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 629.6 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the TSC Act listing for this community.
- 20.7 ha of the EPBC Act listed Critically Endangered Ecological Community Natural Grassland on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland (Plains Grassland).
- 30.1 ha of the EPBC Act listed Endangered Ecological Community Weeping Myall Woodlands. A further 2.3 ha of this ecological community occurs as derived native grassland.

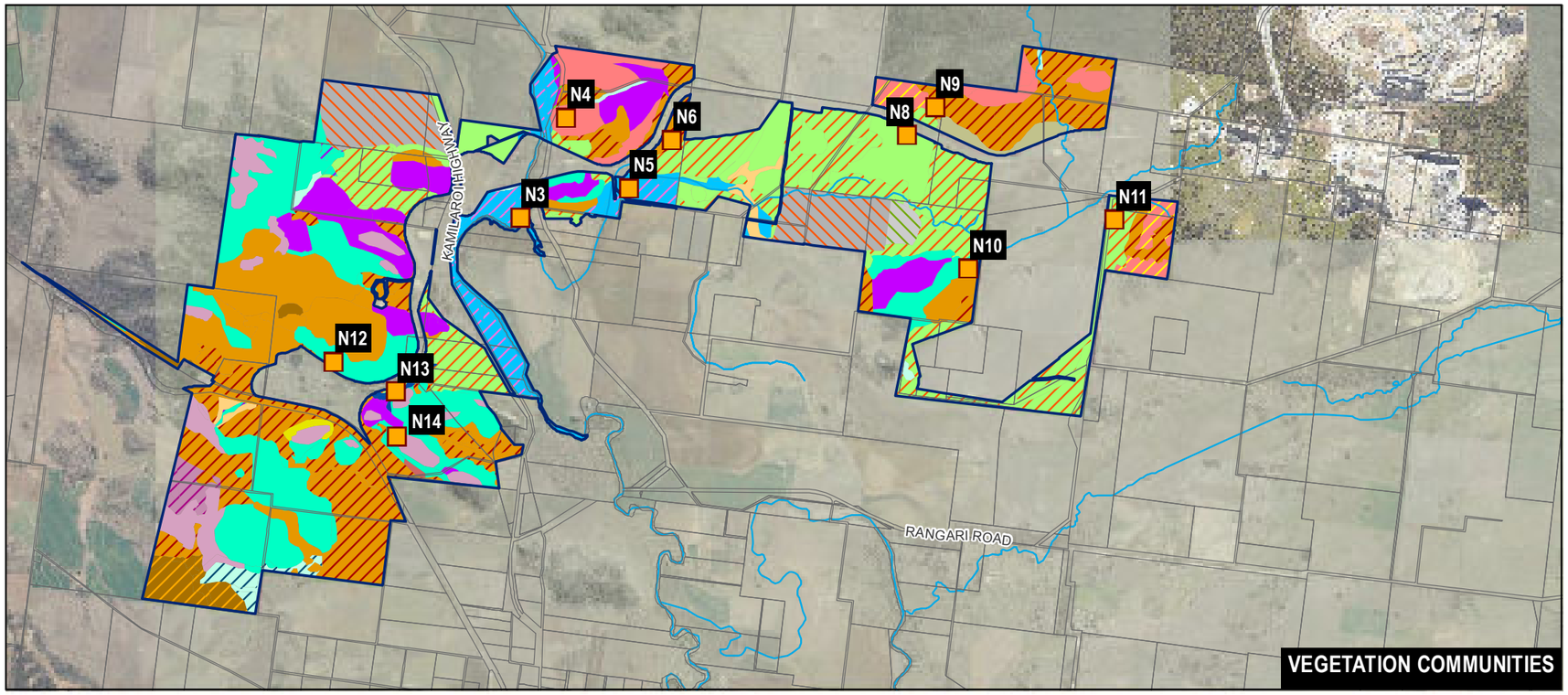
Corben's Long-eared Bat, which is listed as Vulnerable under the EPBC Act has been recorded in two disparate locations of the Namoi BOA (Figure B3.2). The Namoi BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot and Superb Parrot.

B3.4 Offset management zones

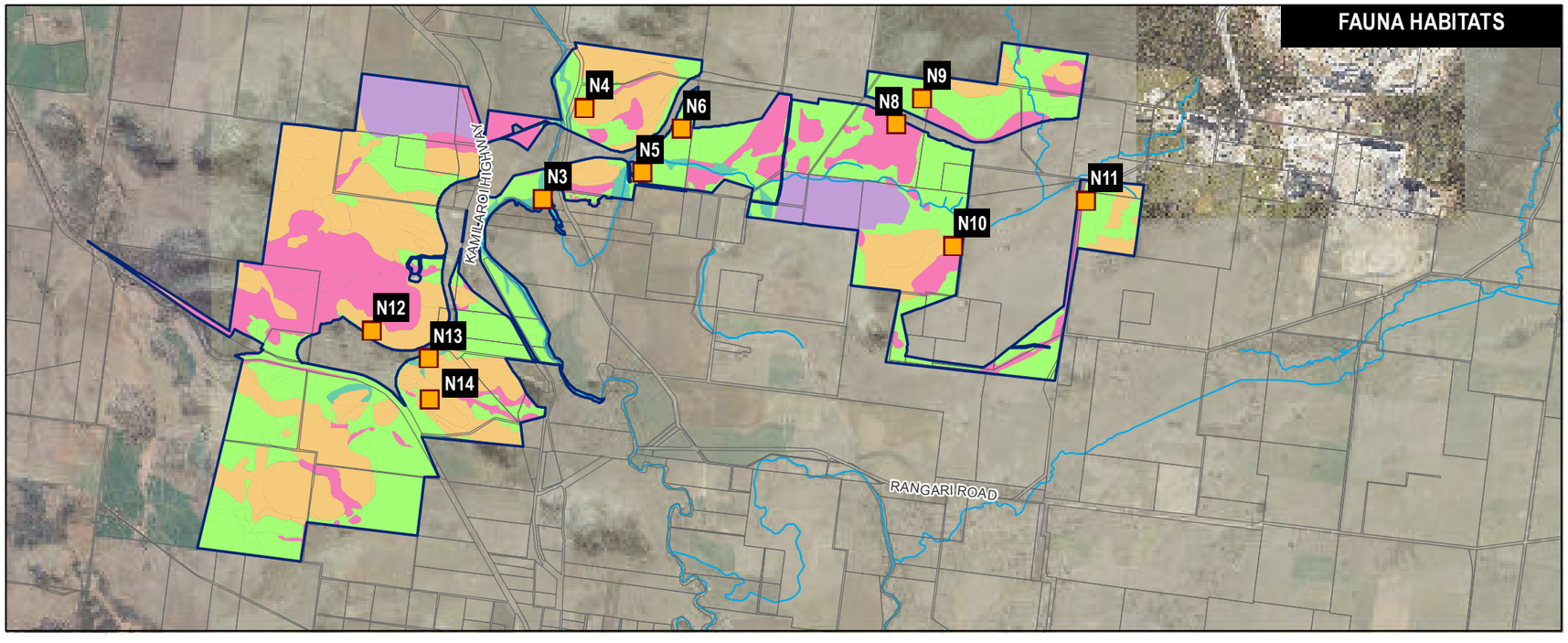
The Namoi property contains four offset management zones, as detailed in Table B3.7.

Table B3.7 Offset management zone of the Namoi BOA

Offset management zone	Area (ha)
Habitat management zone	1,626.0
Habitat restoration zone	1,459.7
Corridor enhancement zone	21.0
Other lands for agriculture zone	229.8
Total	**3,336.5**



VEGETATION COMMUNITIES



FAUNA HABITATS

Ecological survey location

Offset boundary

Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region

- Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region [PCT55/NA102]
- Belah Woodland on alluvial plains and low rises in the central NSW wheat belt to Pilliga and Liverpool Plains region - Derived Native Grassland [PCT55/NA102]

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

- Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]
- Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range - Derived Native Grassland [PCT610/NA245]

Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion

- Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion [PCT102/NA181]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

- Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]
- Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

- Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]
- Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

- River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion

- River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT78/NA193]
- River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT78/NA193]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

- Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion

- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion [PCT27/NA219]
- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT27/NA219]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1384/NA227]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1384/NA227]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

- White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]
- White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

- White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]
- White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion - Derived Native Grassland [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]
- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion - Derived Native Grassland [PCT1329/237]

Miscellaneous

- Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low
- Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS002_A1	Author: SuansriR
Date: 2/08/2017	Approved by: - CooperN

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Coordinate system: GDA 1994 MGA Zone 56
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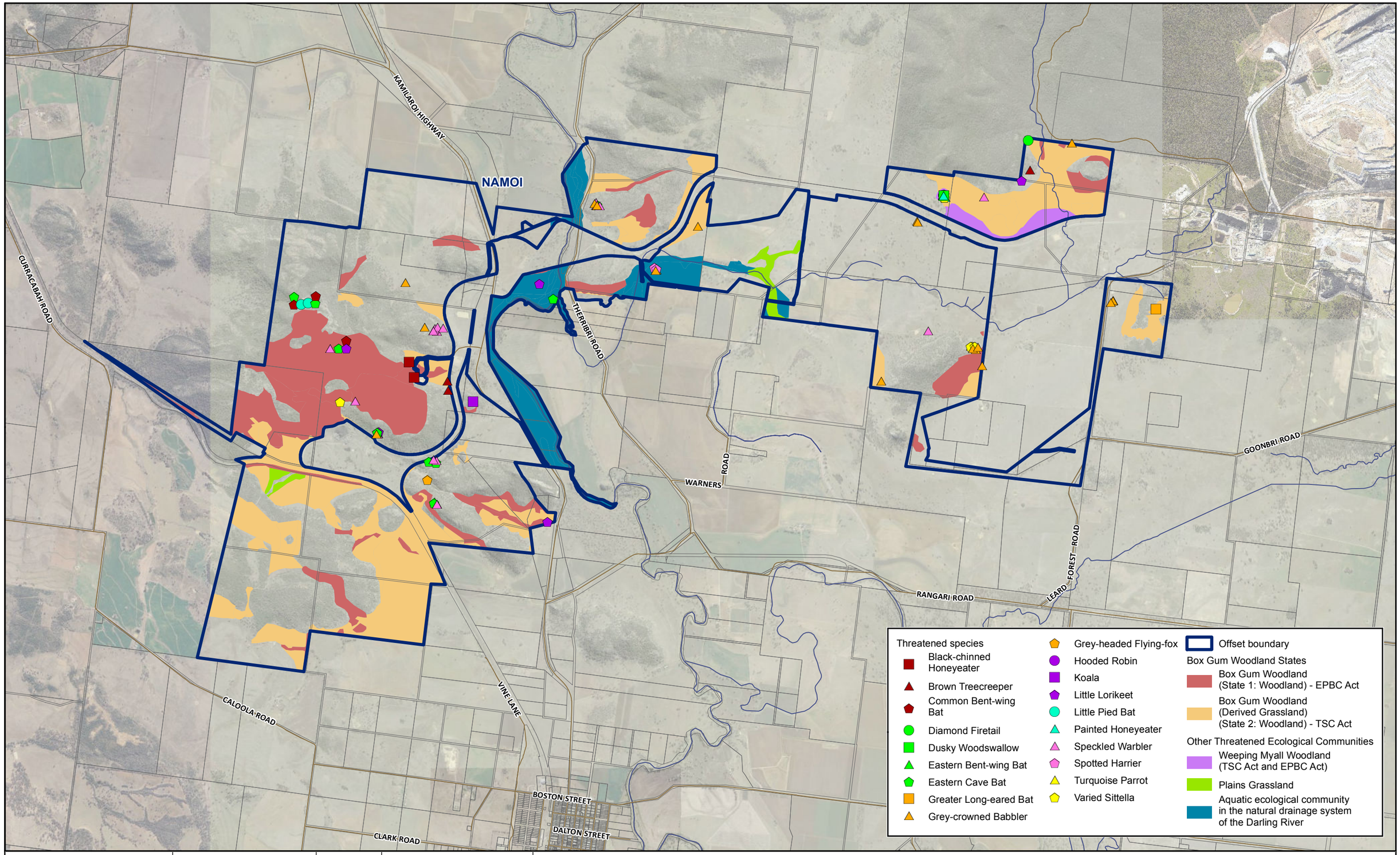
Figure B3.1
Vegetation and fauna habitats of the Goonbri BOA



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Date: 12/07/2017	Approved by: - Bangel.T

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Figure B3.2
Threatened species and communities of the Namoi BOA

B4. Jerralong BOA

The Jerralong BOA encompasses an area of 570.1 ha and is located approximately 2.8 km from the EIS mine disturbance limit (Boggabri Existing). The Jerralong BOA adjoins to the south-east of the Namoi BOA and provides offsets for the original project approval and subsequent project modifications. A summary of the Jerralong BOA is provided in Table B4.1.

The Jerralong property forms part of the Namoi BOA's eastern edge where it widens the Nandewar Range to Namoi River corridor south of the project. It represents a section of the Namoi River floodplain that is traversed by Bollol Creek east of its confluence with the Namoi River.

The Jerralong property has been used as grazing land in the past and much of it remains as open grassland habitats with remnant woodlands dominated be Poplar Box *(Eucalyptus populneus*), White Box *(E. albens*) and stony rises dominated by White Cypress Pine *(Callitris glaucophylla*). The vegetation and fauna habitat types present are illustrated in Figure B4.1 and a breakdown is provided in Table B4.4

Table B4.1 Summary of the Jerralong BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Liverpool Plains sub-catchment
Botanical Subdivision	Bordering the North Western Slopes (NWS) and North Western Plains (NWP) subdivisions
Mitchell landscapes	Liverpool Alluvial Plains Mooki - Namoi Channels and Floodplains Upper Namoi Swamps and Lagoons Bugaldie Uplands Cubbo Uplands
Noxious weed control area	Narrabri

B4.1 Jerralong biodiversity survey effort

The Jerralong BOA was inspected during daylight hours by a suitably qualified ecologist on the 10 and 11 August 2016 and 9 November 2016. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitats therein. Details regarding the specific surveys undertaken are provided below and in Appendix C. Presented below is a summary of biodiversity survey works completed for the Jerralong BOA.

B4.1.1 Flora survey

Flora surveys involved a combination of random meanders and quadrat based assessments to determine the nature and condition of vegetation which occurred within the study area. three quantitative (quadrat/transect) site surveys were completed as outlined in the procedure contained within the BioBanking Assessment Methodology (BBAM) (Office of Environment and Heritage 2014b) (Table B4.2). The location of these site surveys is provided in Appendix C.

Table B4.2 Summary of the Jerralong BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline surveys	Jerralong flora survey	
					2015	2016
Floristic diversity, threatened flora surveys and v vegetation community delineation	Transect and quadrat plot-based survey	Annually	Spring	3 sites	3 sites	3 sites

B4.1.2 Fauna survey

Table B4.3 is a summary of fauna survey effort completed on the Jerralong BOA to date.

Table B4.3 Summary of Jerralong BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Jerralong fauna surveys	
				2015	2016
Diurnal birds	Annually	Spring – Summer	-	3 sites	3 sites
Nocturnal birds	Annually	Spring – Summer		1 site	1 site
Microchiropteran bats	Annually	Spring – Summer		3 sites	3 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer		3 sites	3 sites
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter		May/Aug surveys	Apr/Jul surveys

B4.2 Baseline condition

B4.2.1 Vegetation

The Jerralong property forms part of the south-west area of the regional East-West Wildlife Corridor. The property supports relatively small remnants of woodland communities and large areas of grassland habitats characterised by a mixture of native and exotic grasses, and includes areas inundated erratically in association with Bollol Creek. The vegetation and fauna habitat types are illustrated in Figure B4.1 and breakdown is provided in Table B4.4.

Table B4.4 Vegetation communities of the Jerralong BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Jerralong BOA (ha)
Pilliga Box - Poplar Box – White cypress pine grassy open forest	PCT88 / BVT NA179: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion	Pilliga Outwash Dry Sclerophyll Forest	Dry Sclerophyll Forests (shrub/ grass sub-formation)	Not listed	209.0
Pilliga Box - Poplar Box – White cypress pine grassy open forest (low condition)	PCT88 / BVT NA179: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (Derived Native Grassland)	Pilliga Outwash Dry Sclerophyll Forest	Dry Sclerophyll Forests (shrub/ grass sub-formation)	Not listed	300.8
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest; south-west	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	13.4
Exotic grassland/ crop land/ other land for agriculture	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	46.9
Total					**570.1**

B4.2.2 Fauna habitat

A relatively low diversity of fauna habitat types have been recorded across the Jerralong BOA, however relatively large areas of grassy box woodland habitats were suitable for a range of threatened woodland birds.

Table B4.5 Fauna habitat types of the Jerralong BOA

Fauna habitat	Area (ha)
Grassy woodland on fertile soils	209.0
Shrubby woodlands/Open forest on skeletal soils	13.4
Grassland / Pasture	300.8
Other land (intensive agriculture and farm dams)	46.9
Total	**570.1**

B4.2.3 Threatened species and ecological communities

Table B4.6 summarises threatened species recorded or predicted to occur within the Jerralong property.

Table B4.6 Threatened species recorded or predicted to occur in the Jerralong BOA

Threatened Species	EPBC Act[1]	TSC Act[2]	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Birds			
Grey-crowned Babbler		V	Presence confirmed
Little Eagle		V	
Brown Treecreeper		V	Potential habitat
Barking Owl		V	
Black-chinned Honeyeater		V	
Diamond Firetail		V	
Dusky Woodswallow		V	
Hooded Robin		V	
Little Lorikeet		V	
Masked Owl		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Speckled Warbler		V	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Mammals			
Yellow-bellied Sheathtail-bat		V	Presence confirmed
Eastern Cave Bat		V	Potential habitat
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Koala	V	V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	

Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B4.3 Baseline habitat conditions for matters of National Environmental Significance

No threatened ecological communities listed under the EPBC Act have been recorded in the Jerralong BOA. Notwithstanding this, The Jerralong BOA provides suitable habitat for the Regent Honeyeater, Swift Parrot and Superb Parrot.

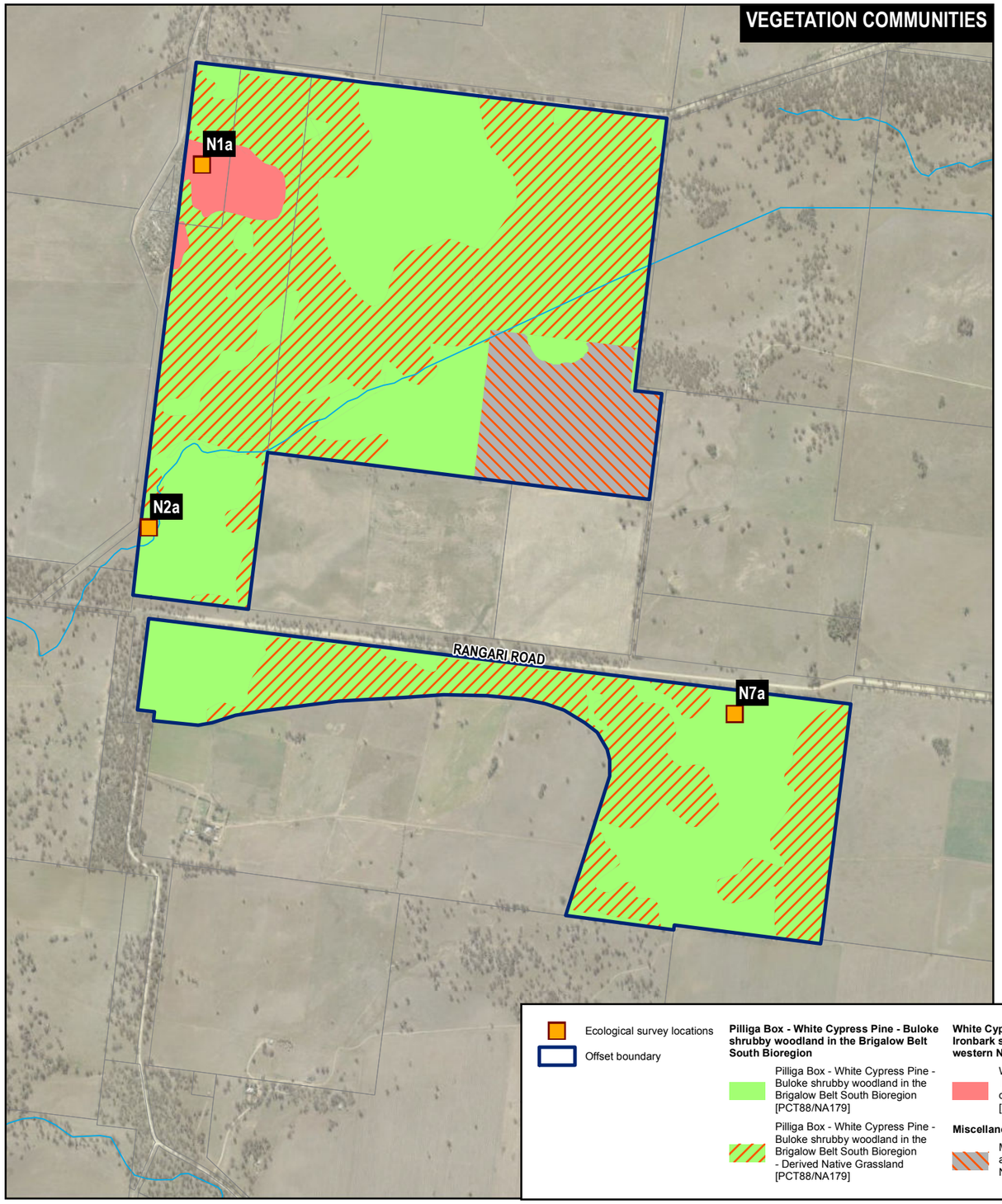
B4.4 Offset management zones

The Jerralong BOA contains three offset management zones, as detailed in Table B4.7.

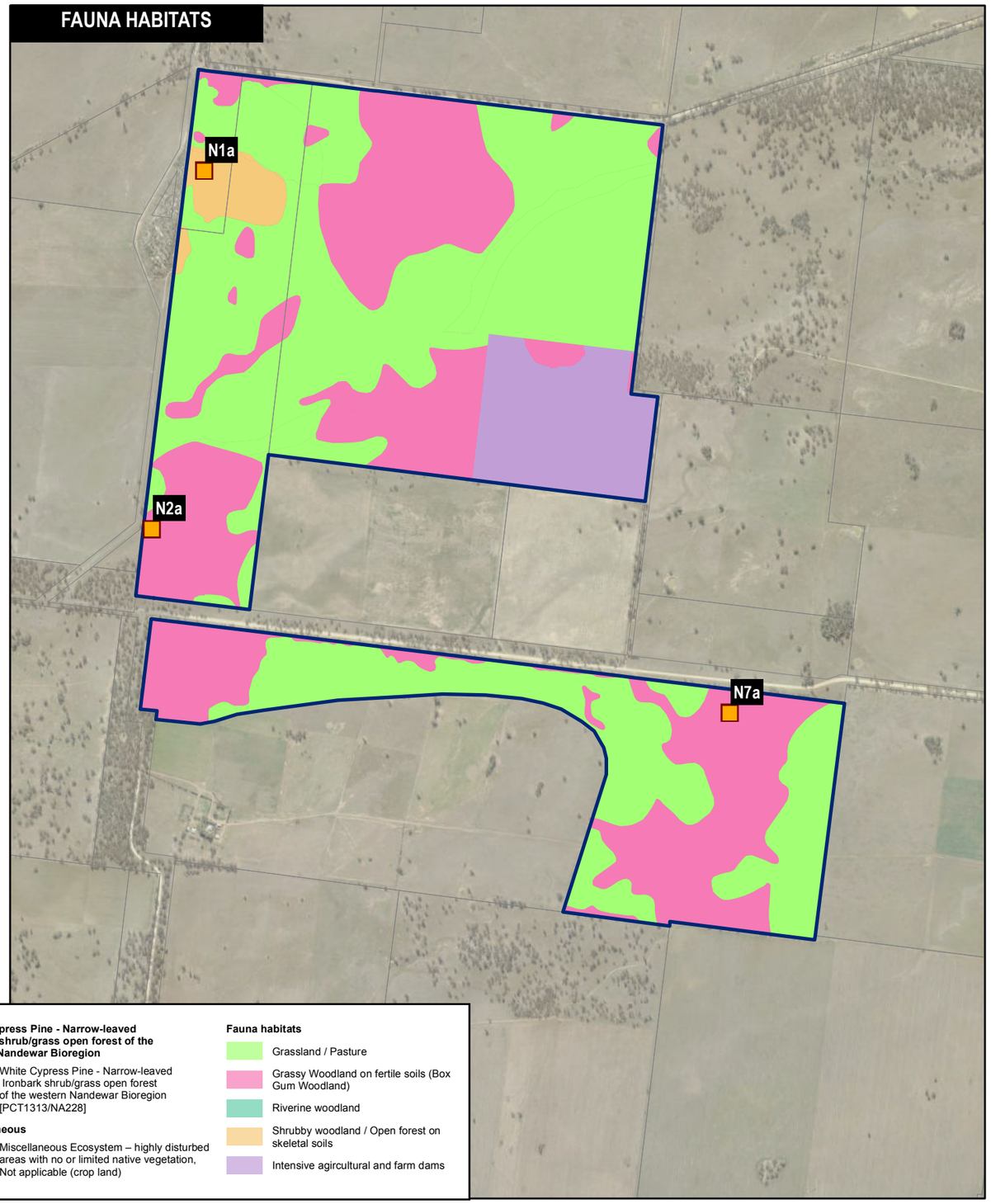
Table B4.7 Offset management zones of the Jerralong BOA

Offset management zone	Area (ha)
Habitat management zone	222.4
Habitat restoration zone	300.8
Other lands for agriculture zone	46.9
Total	**570.1**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

Grassland / Pasture

Grassy Woodland on fertile soils (Box Gum Woodland)

Riverine woodland

Shrubby woodland / Open forest on skeletal soils

Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 0.25 0.5 km

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Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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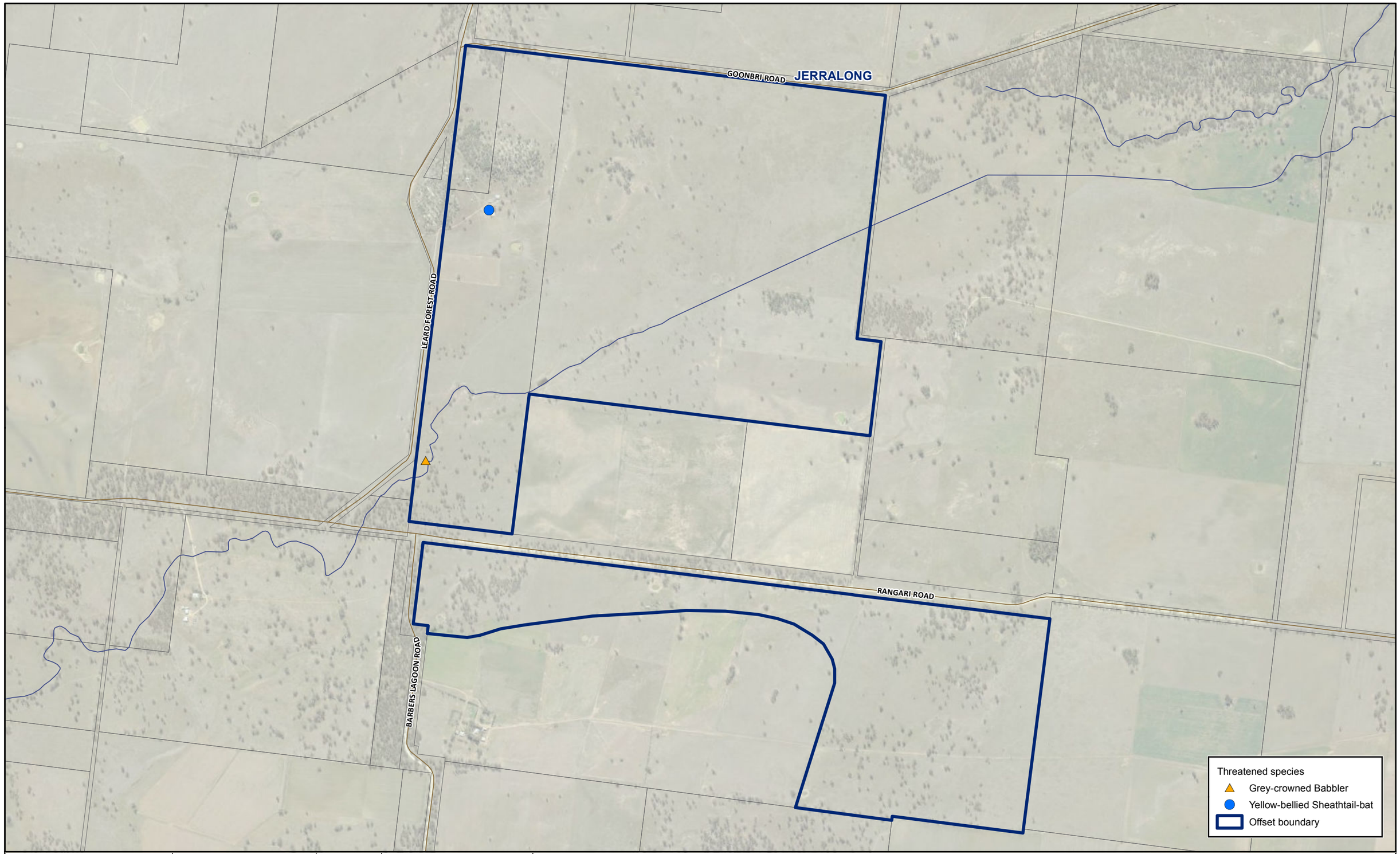
Figure B4.1
Vegetation communities and fauna habitats within the Jerralong BOA



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Date: 10/07/2017	Approved by: - Cooper.N		

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Figure B4.2
Threatened species and communities of the Jerralong BOA

B5. Goonbri BOA

The Goonbri BOA encompasses an area of 223.4 ha and is located approximately 3.9 km north-west of the EIS mine disturbance limit (Boggabri Existing). The Goonbri BOA occurs to the south of the Wirrilah BOA boundary. A summary of the Goonbri BOA is provided in Table B5.1.

The Goonbri property represents part of the western edge of the Nandewar Range occurring as two separate sections of the Wirrilah property with which it shares its northern boundary. It functions to bolster the north-east corner of the Regional East-West Wildlife Corridor. Much of the woodland within the Goonbri BOA is in relatively good condition although there are sections of the eastern portion that are dominated by White Cypress Pine (*Callitris glaucophylla*) and the western section shows evidences of a history of grazing pressures. In the west, a number of vegetation types occur in an open woodland structure providing habitat for woodland bird species. The vegetation and fauna habitat types present are illustrated in Figure B5.1 and a breakdown provided in Table B5.3 and Table B5.4.

Table B5.1 Summary of the Goonbri BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Bugaldie Uplands Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Narrabri

B5.1 Goonbri biodiversity survey effort

The Goonbri BOA was inspected during daylight hours by a suitably qualified ecologist on the 10 and 11 August 2016 and 9 November 2016. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitats therein. Details regarding the specific surveys undertaken are provided below and in Appendix C. Presented below is a summary of biodiversity survey works completed for the Goonbri BOA.

B5.1.1 Flora survey

Flora surveys involved a combination of random meanders and quadrat based assessments to determine the nature and condition of vegetation which occurred within the BOA. Eleven quantitative (quadrat/transect) site surveys were completed as outlined in the procedure contained within the BioBanking Assessment Methodology (BBAM) (Office of Environment and Heritage 2014b) (Table B5.2). The location of these site surveys is provided in Appendix C.

Table B5.2 Summary of Goonbri BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline surveys
Floristic diversity and threatened flora surveys and vegetation community delineation	Transect and quadrat plot-based survey	Annually	Spring	10 plots

B5.1.2 Fauna Survey

Fauna surveys for the Goonbri BOA at the time of writing this report consist of opportunistic surveys undertaken during the assessment of native vegetation communities. Baseline fauna surveys for the Goonbri site have not been undertaken prior to the release of this report.

B5.2 Baseline condition

B5.2.1 Vegetation

Table B5.3 Vegetation communities of the Goonbri BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Goonbri BOA (ha)
White Box – White Cypress Pine grassy woodland	PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	38.7
White Box – White Cypress Pine grassy woodland (Low Condition)	PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low condition)	Western Slopes Grassy Woodlands	Grassy Woodlands		51.6
Yellow Box - Blakely's Red Gum grassy woodland	PCT 1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands		29.2
Yellow Box - Blakely's Red Gum grassy woodland (Low Condition)	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands		33.5
Silver-leaved Ironbark heathy woodland	PCT 1307 / BVT 224: White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	14.5
Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	PCT 1313 / BVT NA228: White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	37.2

White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	3.6
Exotic grassland	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	15.1
				Total	**223.4**

B5.2.2 Fauna habitats

Table B5.4 Fauna habitat types of the Goonbri BOAs

Fauna habitat	Area (ha)
Grassland	85.1
Grassy woodland on fertile soils	67.9
Shrubby woodlands/Open forest on skeletal soils	55.3
Other land (intensive agriculture and farm dams)	15.1
Total	**223.4**

B5.2.3 Threatened species and ecological communities

Table B5.5 summarises the threatened species recorded or predicted to occur within the Goonbri property.

Table B5.5 Threatened species recorded or predicted to occur within the Goonbri BOA

Threatened species	EPBC Act[1]	TSC Act[2]	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Birds			
Little Lorikeet		V	Presence confirmed
Brown Treecreeper		V	Potential habitat
Dusky Woodswallow		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Lorikeet		V	
Speckled Warbler		V	
Barking Owl		V	
Black-chinned Honeyeater		V	
Diamond Firetail		V	
Little Eagle		V	

Masked Owl		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Mammals			
Eastern Cave Bat		V	Potential habitat
Yellow-bellied Sheathtail-bat		V	
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Koala		V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B5.3 Baseline habitat conditions for matters of National Environmental Significance

The Goonbri BOA contains approximately 67.9 ha of the EPBC Act listed White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 85.1 ha occurs as Derived Native Grassland (State 2: Native Pasture) Box Gum Woodland and meets the TSC Act listing for this community. This ecological community is situated throughout the Goonbri BOA on the lower slopes and flatter land (Figure B5.2).

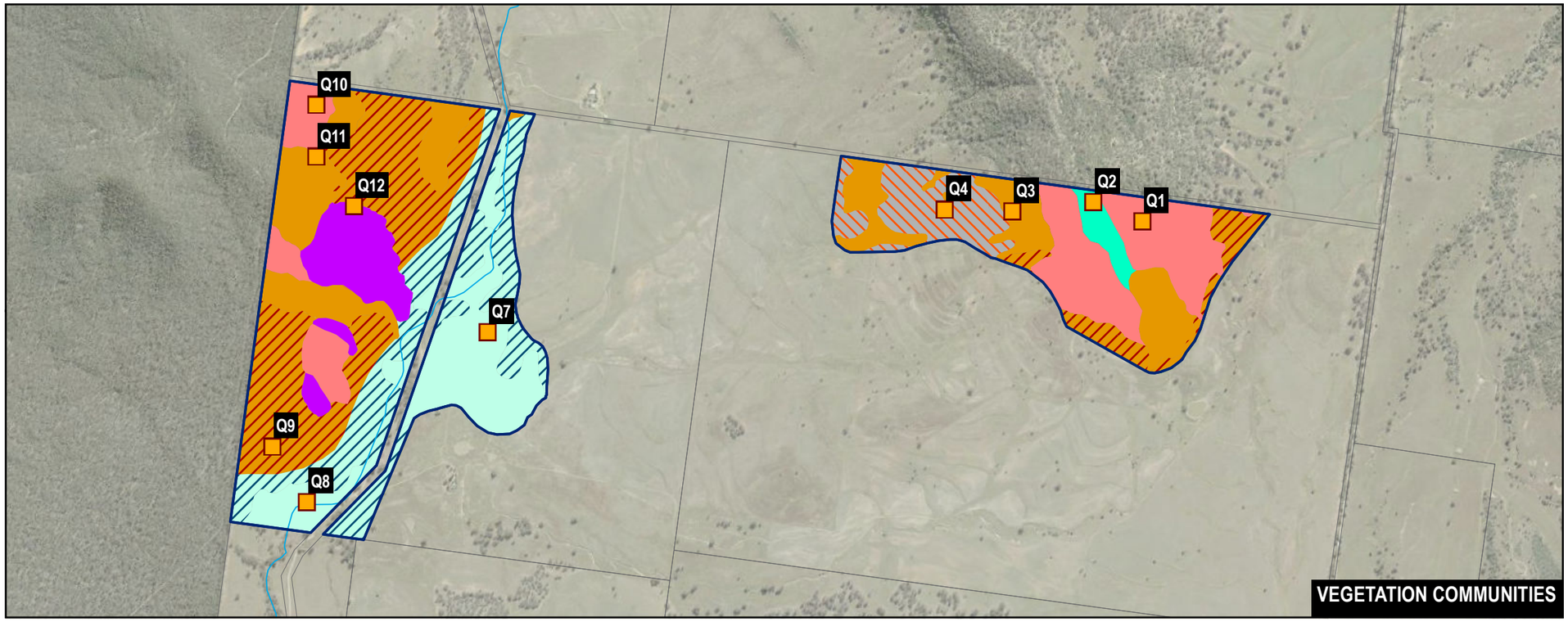
The Goonbri BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot and Corben's Long-eared Bat.

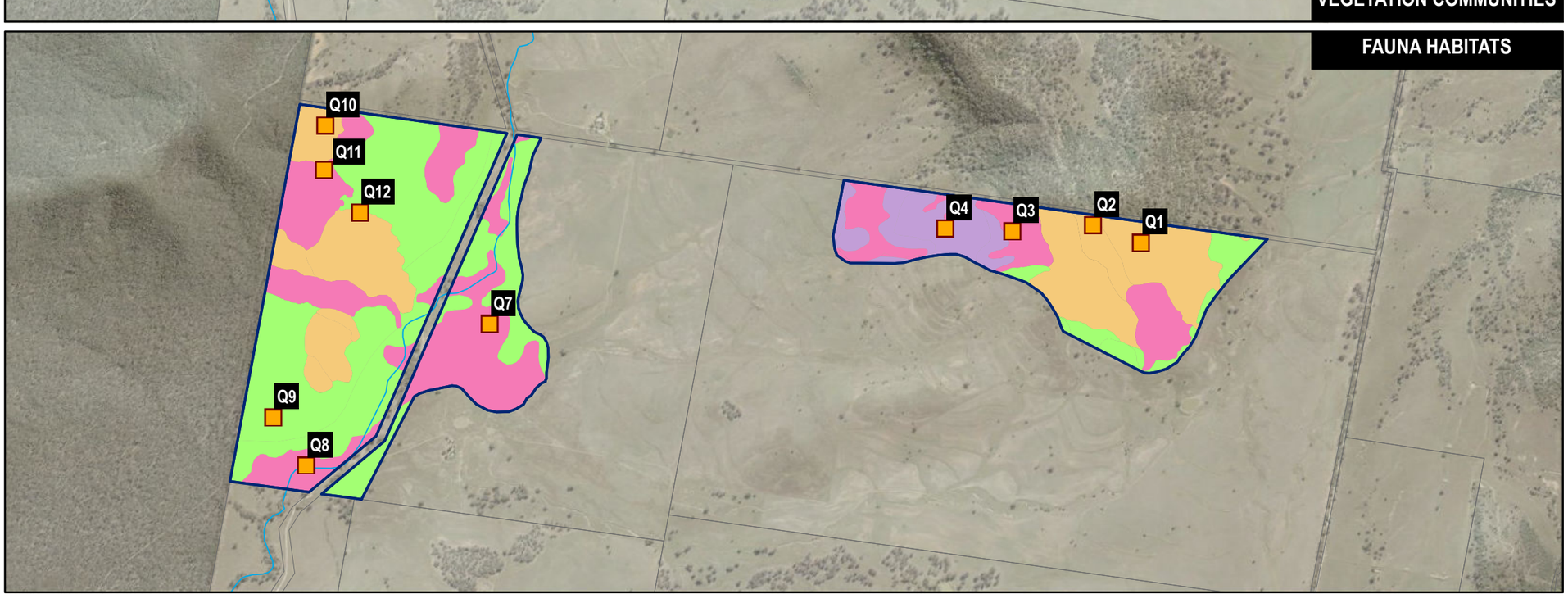
B5.4 Offset management zones

The Goonbri BOA contains three offset management zones, as detailed in Table B5.6.

Table B5.6 Offset management zones of the Goonbri BOA

Offset management zone	Area (ha)
Habitat management zone	123.2
Habitat restoration zone	85.1
Corridor enhancement	15.1
Total	**223.4**





Ecological survey location

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion - Derived Native Grassland [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

Grassland / Pasture

Grassy Woodland on fertile soils (Box Gum Woodland)

Shrubby woodland / Open forest on skeletal soils

Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS003_A1	Author: SuansriR
Date: 12/07/2017	Approved by: - CooperN

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Coordinate system: GDA 1994 MGA Zone 56
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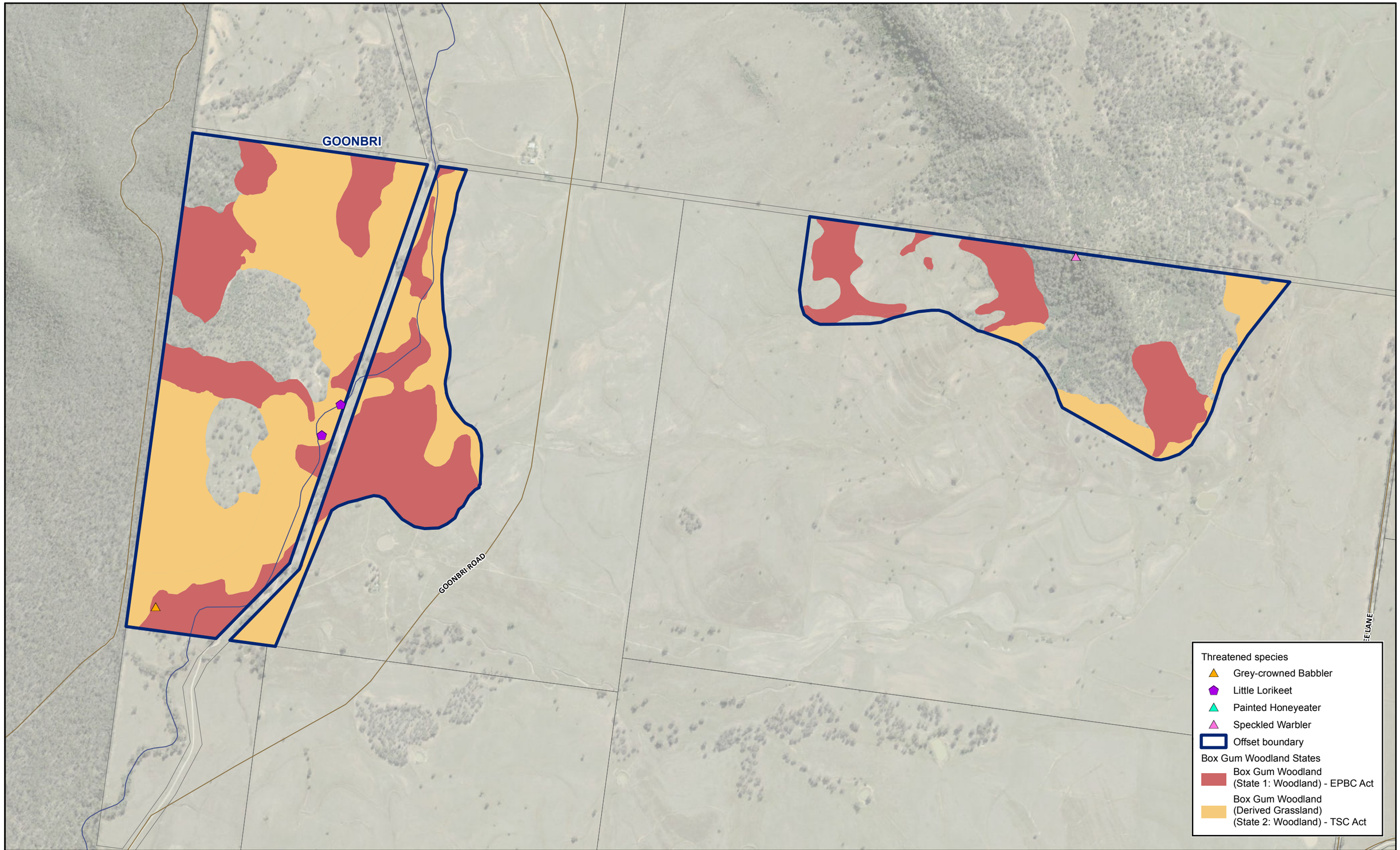
Figure B5.1
Vegetation and fauna habitats of the Goonbri BOA



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Date: 12/07/2017	Approved by: - Cooper.N		

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Coordinate system: GDA 1994 MGA Zone 56
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Figure B5.2
Threatened species and communities of the Goonbri BOA

B6. Wirrilah BOA

The Wirrilah BOA encompasses an area of 873.1 ha and is located approximately 3.9 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Wirrilah BOA is provided in Table B6.1.

Table B6.1 Summary of the Wirrilah BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Bugaldie Uplands Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Narrabri

B6.1 Wirrilah biodiversity survey effort

Presented below is a summary of biodiversity survey works completed for the Wirrilah BOA.

B6.1.1 Flora survey

Baseline flora plots were conducted as combined effort over the Mallee, Myall Plains and Wirrilah properties, therefore the effort presented the Wirrilah BOA in Table B6.2 below is part of the combined 41 plot figure presented.

Table B6.2 Summary of the Wirrilah BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline survey	Wirrilah flora survey				
					2012	2013	2014	2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	41 plots (combined)	6 sites		6 sites	6 sites	6 sites
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments	N/A	N/A	2009-2011					

B6.1.2 Fauna survey

Table B6.3 is a summary of survey effort completed at the BOA since the baselines surveys.

Table B6.3 Summary of the Wirrilah BOA flora condition survey history

Species Group	Frequency	Season	Baseline surveys	Wirrilah fauna surveys				
				2012	2013	2014	2015	2016
Diurnal birds	Annually	Spring – Summer	8 hrs	6 sites	6 sites	6 sites	6 sites	6 sites
Herpetofauna Searches	NA Baseline biodiversity survey	Spring – Summer	2 person hrs	-	-	-	-	-
Koala spot surveys	NA Baseline biodiversity survey	Spring – Summer	4 x 5 min surveys		-			
Nocturnal birds	Annually	Spring – Summer	1 hr	6 sites	-	3 sites	1 site	1 site
Microchiropteran bats	Annually	Spring – Summer	-	6 sites	-	6 sites	6 sites	6 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	1 hr	6 sites	-	6 sites	6 sites	6 sites
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	8hrs		-		May/ Aug surveys	Apr/Jul surveys
Targeted Corben's Long-eared Bat survey	Annually	Summer	-		-	2 sites	2 sites	2 sites
Habitat Assessment	NA Baseline biodiversity survey	Spring – Summer	1 hr		-			

B6.2 Baseline condition

B6.2.1 Vegetation

The Wirrilah property lies within the Nandewar Range and forms the north-east corner of the Regional East-West Wildlife Corridor. Much of the woodland within the Wirrilah BOA is in relatively good condition. Regeneration is present on many parts of the main ridge, particularly on the lower slopes. The vegetation and fauna habitat types present are illustrated in Figure B6.1 and a breakdown is provided in Table B6.4 and Table B6.5.

Table B6.4 Vegetation communities of the Wirrilah BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Wirrilah BOA (ha)
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest; Regrowth White Cypress Pine	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	106.4
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low condition)	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion (Derived Native Grassland)	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	24.7
White Box – White Cypress Pine grassy woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	145.8
White Box – White Cypress Pine grassy woodland (Low Condition) [2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	506.7
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Grassy Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	76.9
Emergent Rough-barked Apple low closed forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	12.6
Total					**873.1**

1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 2 = Commensurate with State 2 Derived Native Grassland TSC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

B6.2.2 Fauna habitats

A diverse range of fauna habitat types have been recorded across the Wirrilah BOA, as described in Table B6.5.

Table B6.5 Fauna habitat types of the Wirrilah BOA

Fauna habitat	Area (ha)
Grassland	355.1
Grassy woodland on fertile soils	145.8
Shrubby woodlands/Open forest on skeletal soils	183.3
Riverine Woodland	12.6
Other land (intensive agriculture and farm dams)	176.3
Total	**873.1**

B6.2.3 Threatened species and ecological communities

Table B6.6 summarises the threatened species and ecological communities recorded or predicted to occur within the Wirrilah BOA. Threatened species and ecological communities recorded within the Wirrilah property are illustrated in Figure B6.2.

Table B6.6 Threatened species and communities recorded or predicted to occur in the Wirrilah BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Barking Owl		V	Presence confirmed
Brown Treecreeper		V	
Grey-crowned Babbler		V	
Little Eagle		V	
Little Lorikeet		V	
Painted Honeyeater		V	
Speckled Warbler		V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Black-chinned Honeyeater		V	Potential habitat

Diamond Firetail		V	
Hooded Robin		V	
Masked Owl		V	
Regent Honeyeater	CE	CE	
Pied Honeyeater		V	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Mammals			
Eastern Cave Bat		V	Presence confirmed
Yellow-bellied Sheathtail-bat		V	
Eastern Bent-wing Bat		V	Potential habitat
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Koala		V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	Potential habitat

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B6.3 Baseline habitat conditions for matters of National Environmental Significance

The Wirrilah BOA contains approximately 145.8 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 506.7 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the TSC Act listing for this community. This ecological community is situated the throughout the Wirrilah BOA on lower slopes and flatter land.

Swift Parrot, which is listed as Critically Endangered under the EPBC Act, has been recorded in the Wirrilah BOA. In addition, the Wirrilah BOA also provides suitable habitat for the Regent Honeyeater, Superb Parrot and Corben's Long-eared Bat.

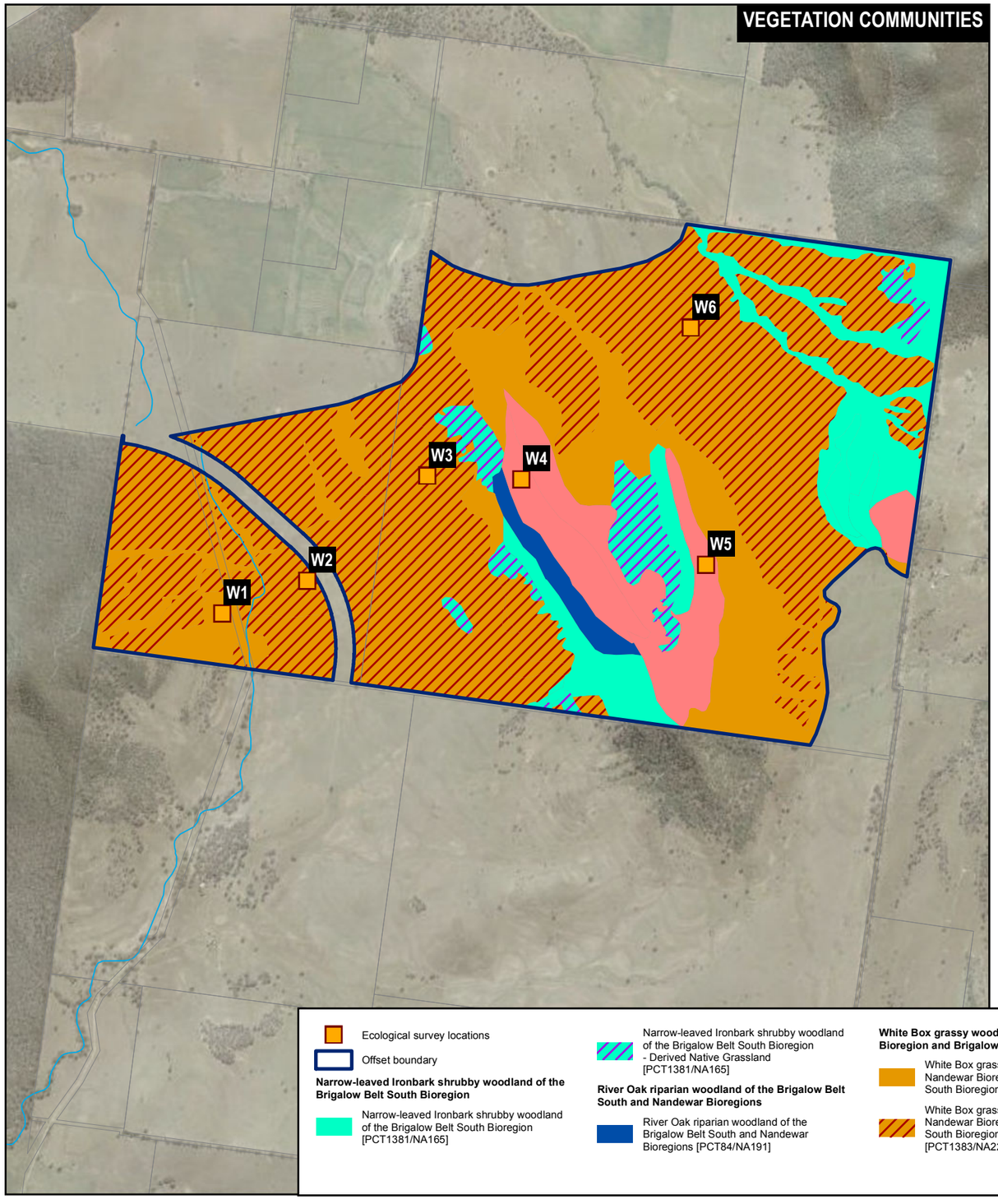
B6.4 Offset management zones

The Wirrilah property contains three offset management zones, as detailed in Table B6.7.

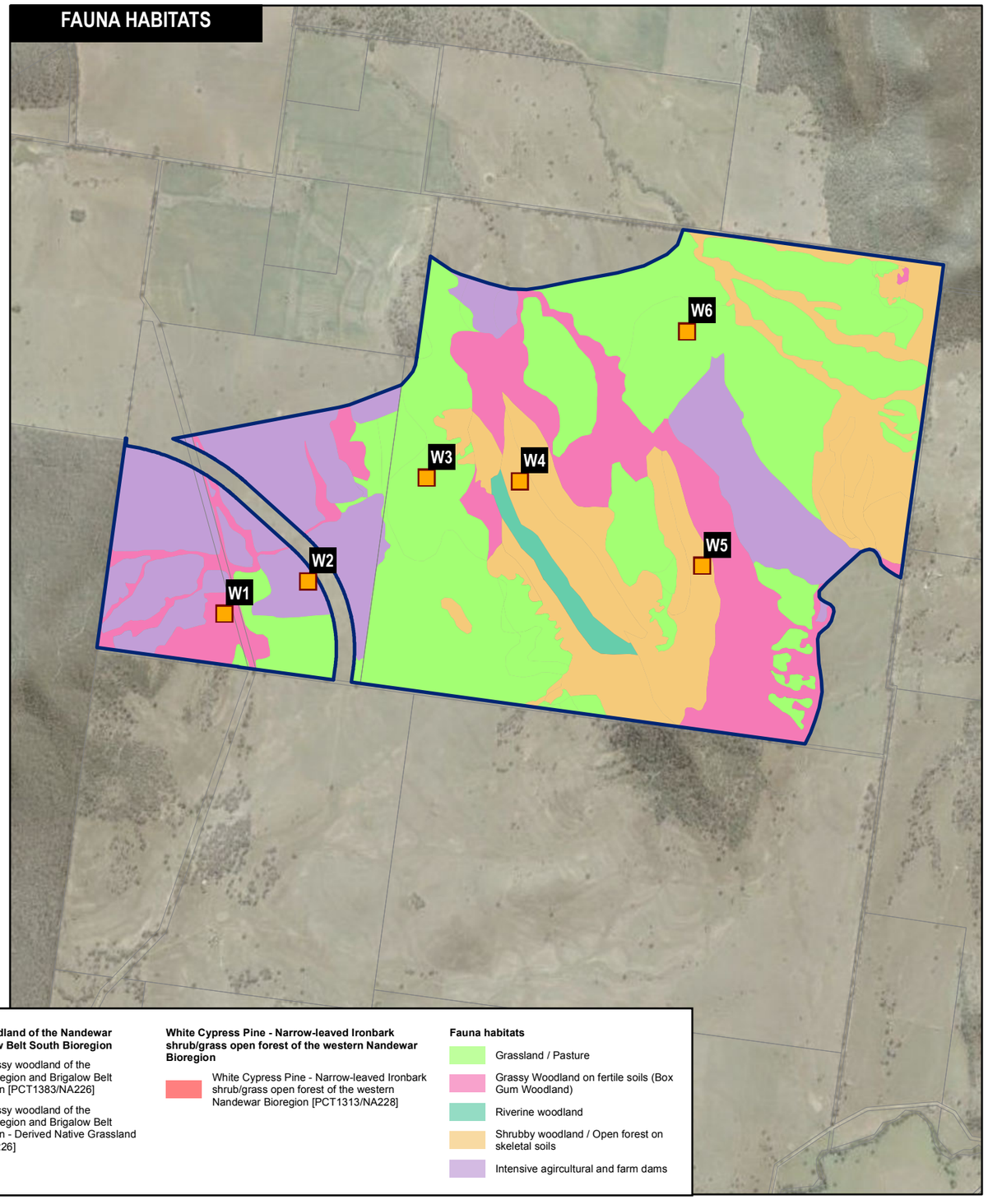
Table B6.7 Offset management zones of the Wirrilah and Goonbri BOAs

Offset management zone	Area (ha)
Habitat management zone	326.5
Habitat restoration zone	370.3
Corridor enhancement zone	176.3
Total	**873.1**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 12/07/2017	Approved by: - CooperN

0 0.25 0.5 km

1:27,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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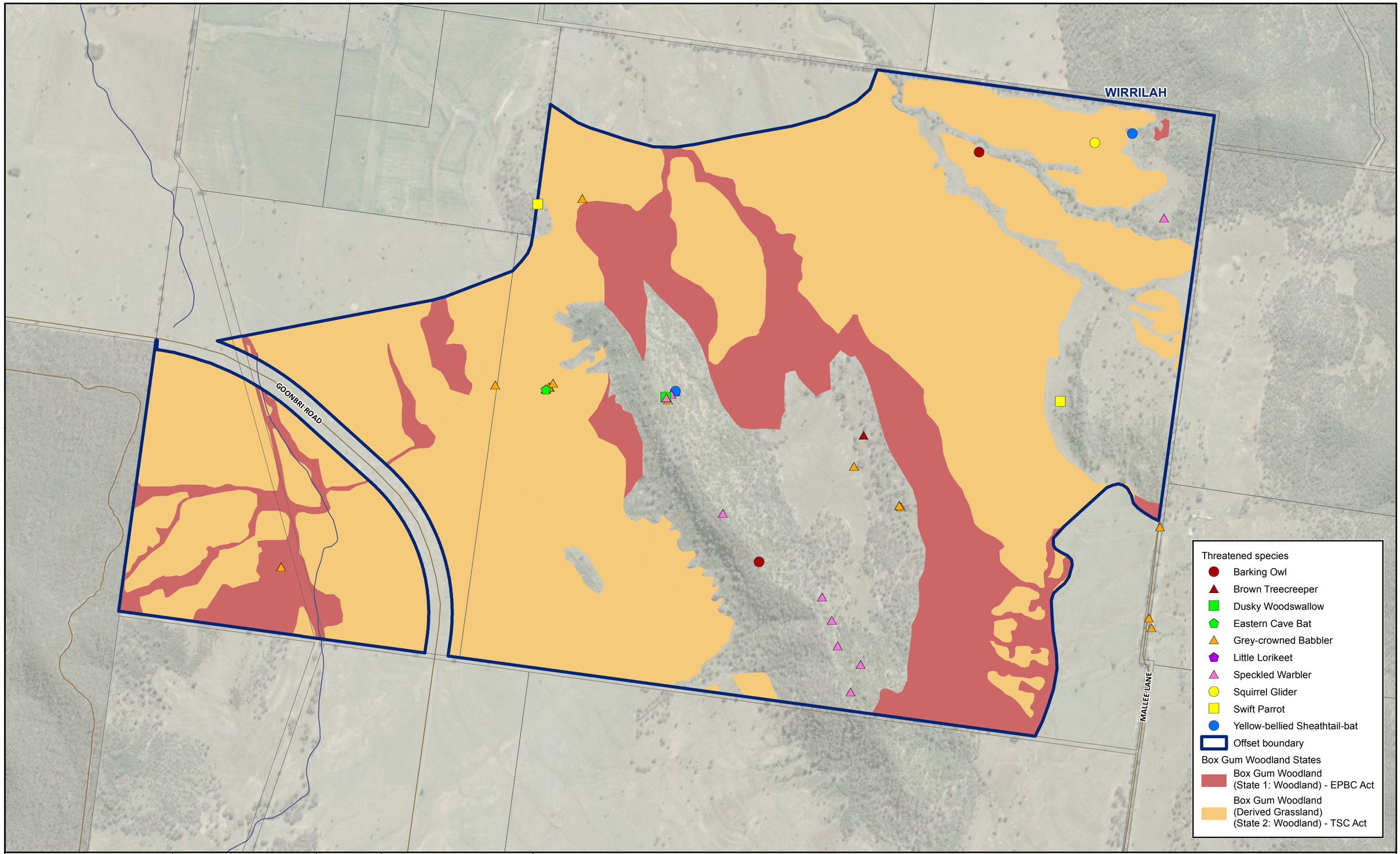
Figure B6.1
Vegetation communities and fauna habitats within the Wirrilah BOA



Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
Date: 10/07/2017	Approved by: - Cooper.N

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Coordinate system: GDA 1994 MGA Zone 56
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Figure B6.2
Threatened species and communities of the Wirrilah BOA

B7. Myall Plains BOA

The Myall Plains property encompasses an area of 480.4 ha and is located approximately 8 km north-west of the EIS mine disturbance limit (Boggabri Existing). The southern boundary of the Myall Plains BOA adjoins the Mallee and Wirrilah BOAs. A summary of the Myall Plains BOA is provided in Table B7.1.

Table B7.1 Summary of the Myall Plains BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Keepit Slopes and Plains Liverpool Alluvial Plains
Noxious weed control area	Narrabri

B7.1 Myall Plains biodiversity survey effort

Presented below is a summary of biodiversity survey works completed for the Myall Plains BOA.

B7.1.1 Flora survey

Baseline flora plots were conducted as combined effort over the Mallee, Myall Plains and Wirrilah properties, therefore the effort presented the Myall Plains BOA in Table B7.2 below is part of the combined forty-one (41) plot figure presented.

Table B7.2 Summary of the Myall Plains BOA

Flora Group	Methods	Frequency	Season	Baseline survey	Myall Plains flora survey				
					2012	2013	2014	2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	41 plots (combined)	6 sites		6 sites	6 sites	6 sites
Threatened flora targeted surveys	Stratified random meander and plot based surveys		Targeted seasonal contexts						
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments	N/A	N/A	2009-2011					

B7.1.2 Fauna survey

Table B7.3 is a summary of survey effort completed at the BOA since the baselines surveys.

Table B7.3 Summary of the Myall Plains BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Myall Plains fauna surveys				
				2012	2013	2014	2015	2016
Diurnal birds	Annually	Spring – Summer	8 hrs	6 sites		6 sites	6 sites	6 sites
Herpetofauna Searches	NA Baseline biodiversity survey	Spring – Summer	2 hrs					
Koala Spot Surveys	NA Baseline biodiversity survey	Spring – Summer	10 x 5 min surveys					
Nocturnal birds	Annually	Spring – Summer	1 hr	6 sites		3 sites	1 site	1 site
Elliot A Traps	NA Baseline biodiversity survey	Spring – Summer	100 nights					
Elliot B Traps	NA Baseline biodiversity survey	Spring – Summer	24 nights					
Pitfall Traps	NA Baseline biodiversity survey	Spring – Summer	8 nights					
Funnel Traps	NA Baseline biodiversity survey	Spring – Summer	24 nights					
Microchiropteran bats	Annually	Spring – Summer	1 night	6 sites		6 sites	6 sites	6 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	1 hr	6 sites		6 sites	6 sites	6 sites
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	8 hrs				May/Aug surveys	Apr/Jul surveys
Targeted Corben's Long-eared Bat survey	Annually	Summer	2 nights			2 site	2 site	2 site
Remote camera	Passive monitoring	Spring – Summer	4 nights					
Habitat assessment	N/A		1 hr					

B7.2 Baseline condition

B7.2.1 Vegetation

The Myall Plains property lies within the Nandewar Range and forms the north-east corner of the Regional East-West Wildlife Corridor. The property supports woodland habitats in relatively good condition. The vegetation and fauna habitat types present are illustrated in Figure B7.1 and a breakdown is provided in Table B7.4 and Table B7.5.

Table B7.4 Vegetation types of the Myall Plains BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Myall Plains BOA (ha)
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	6.1
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	100.7
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low condition)	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion (Derived Native Grassland)	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	43.1
White Box – White Cypress Pine grassy woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	66.7
White Box – White Cypress Pine grassy woodland (Low Condition)[2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	43.9
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	200.1
White Pine/Narrow-leaved Ironbark Shrub/Grass	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby	Not listed	19.8

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Myall Plains BOA (ha)
Open Forest (Low Condition)	Nandewar Bioregion (Derived Native Grassland)		sub-formation)		
Total					**480.4**

1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland TSC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

B7.2.2 Fauna habitats

Table B7.5 Fauna habitat types of the Myall Plains BOA

Fauna habitat	Area (ha)
Grassland	62.9
Grassy woodland on fertile soils	66.7
Shrubby woodlands/Open forest on skeletal soils	306.9
Other land (intensive agriculture and farm dams)	43.9
Total	**480.4**

B7.2.3 Threatened species and ecological communities

Table B7.6 summarises the threatened species recorded or predicted to occur within the Myall Plains property. Threatened species and ecological communities recorded within the Myall Plains property are illustrated in Figure B7.2.

Table B7.6 Threatened species and communities recorded or predicted to occur in the Myall Plains BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria Porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Fauna			
Birds			
Brown Treecreeper		V	Presence confirmed
Grey-crowned Babbler		V	
Little Eagle		V	
Little Lorikeet		V	
Speckled Warbler		V	
Turquoise Parrot		V	

Varied Sittella		V	
Barking Owl		V	
Hooded Robin		V	
Black-chinned Honeyeater		V	Potential habitat
Diamond Firetail		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Masked Owl		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Mammals			
Eastern Bent-wing Bat		V	Presence confirmed
Eastern Cave Bat		V	
Eastern False Pipistrelle		V	
Koala		V	
Squirrel Glider		V	
Yellow-bellied Sheathtail-bat		V	
Corben's Long-eared Bat	V	V	
Little Pied Bat		V	Potential habitat
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	E	V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	Potential habitat

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B7.3 Baseline habitat conditions for matters of National Environmental Significance

The Myall Plains BOA contains approximately 66.7 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A further 43.9 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the TSC Act listing for this community. This ecological community is situated in the western and central portions of the Myall Plains BOA on lower slopes and flatter land.

Corben's Long-eared Bat, which is listed as Vulnerable under the EPBC Act, has been recorded in the Myall Plains BOA. In addition, the Myall Plains BOA provides suitable habitat for the Regent Honeyeater, Swift Parrot and Superb Parrot.

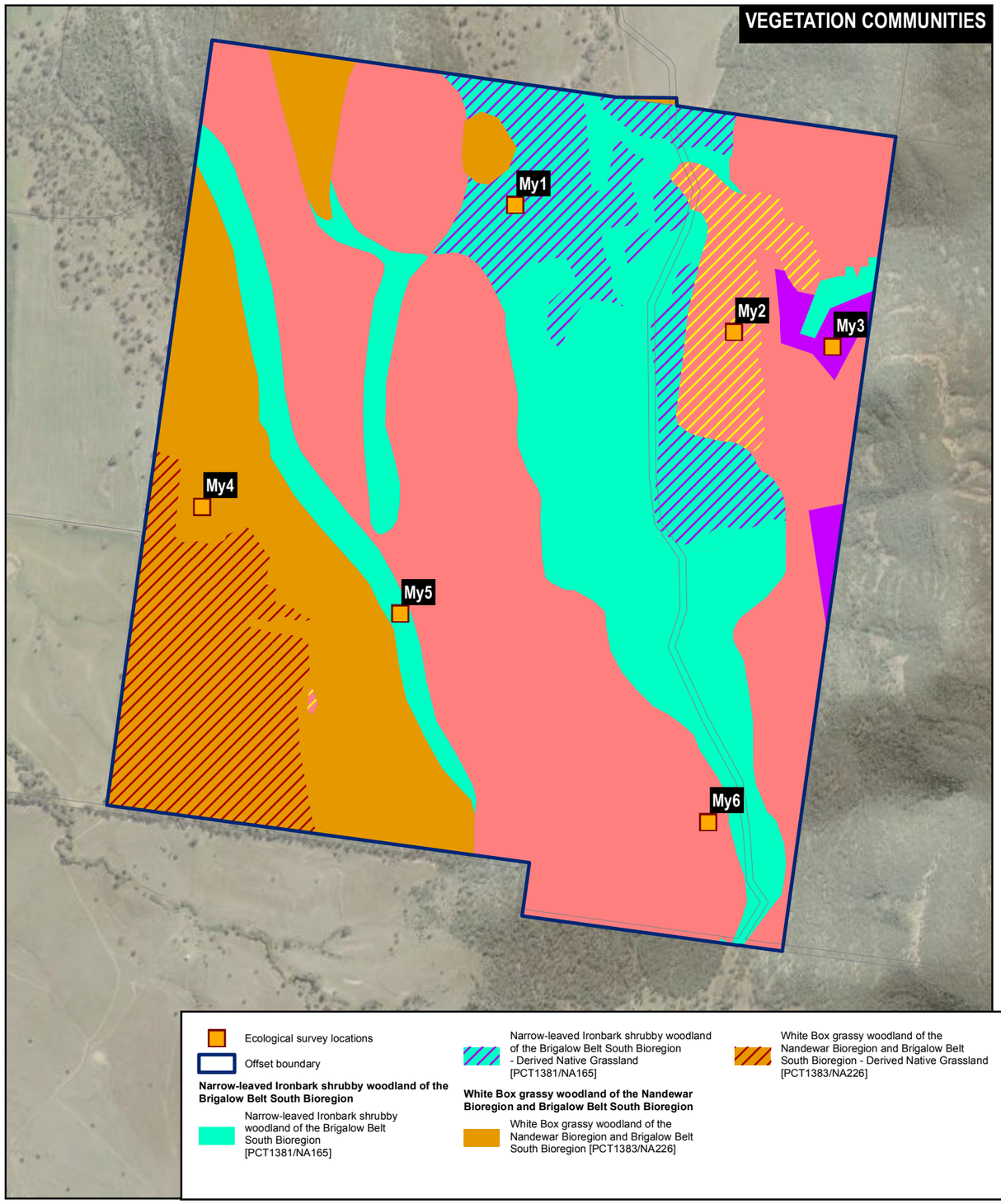
B7.4 Offset management zones

The Myall Plains BOA contains three offset management zones, as detailed in Table B7.7.

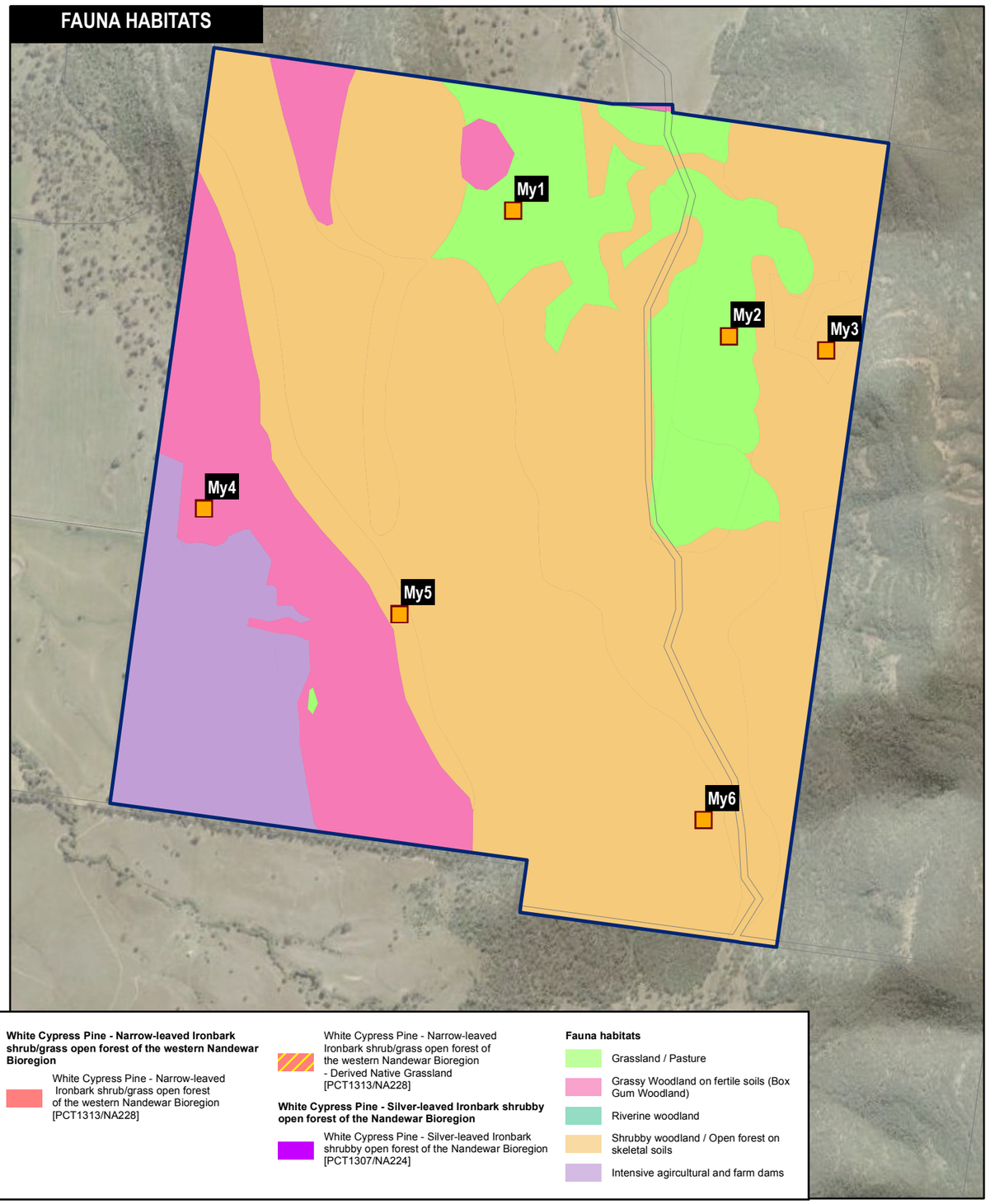
Table B7.7 Offset management zones of the Myall Plains BOA

Offset management zone	Area (ha)
Habitat management zone	373.6
Habitat restoration zone	62.9
Corridor enhancement zone	43.9
Total	**480.4**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 0.25 0.5 Km

1:15,000

Coordinate system: GDA 1994 MGA Zone 56
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Figure B7.1
Vegetation communities and fauna habitats within the Myall Plains BOA

MYALL PLAINS

Threatened species
- Brown Treecreeper
- Eastern Bent-wing Bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Grey-crowned Babbler
- Hooded Robin
- Koala
- Little Eagle
- Little Lorikeet
- Speckled Warbler
- Squirrel Glider
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheathtail-bat
- Offset boundary

Box Gum Woodland States
- Box Gum Woodland (State 1: Woodland) - EPBC Act
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act

Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
Date: 10/07/2017	Approved by: - Cooper.N

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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0 150 300 Meters

1:15,000

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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BIODIVERSITY OFFSET STRATEGY

Figure B7.2
Threatened species and communities of the Myall Plains BOA

B8. Mallee BOA

The Mallee property encompasses an area of 2,066.2 ha and is located approximately 8.4 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Mallee property is provided in Table B8.1.

Table B8.1 Summary of the Mallee BOA

Criteria	Location
Council	Narrabri Shire Council
Bioregion	Nandewar
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment
Botanical subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Keepit Slopes and Plains, Split Yard Plateau Bugaldie Uplands
Noxious weed control area	Narrabri

B8.1 Mallee biodiversity survey effort

Presented below is a summary of biodiversity survey works completed for the Mallee BOA.

B8.1.1 Flora survey

Baseline flora plots were conducted as combined effort over the Mallee, Myall Plains and Wirrilah properties, therefore the effort presented the Mallee BOA in Table B6.2 below is part of the combined forty-one (41) plot figure presented.

Table B8.2 Summary of the Mallee BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline survey	Mallee flora survey				
					2012	2013	2014	2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	41 plots (combined)	5 sites		5 sites	5 sites	5 sites
Threatened flora targeted surveys	Stratified random meander and plot based surveys		Targeted seasonal contexts	2009-2011					
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments			41 plots 2009-2011					

B8.1.2 Fauna survey

Table B8.3 is a summary of survey effort completed in the BOA since the baselines surveys.

Table B8.3 Summary of the Mallee BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Mallee fauna surveys				
				2012	2013	2014	2015	2016
Diurnal birds	Annually	Spring – Summer	10.5 hrs	5 sites		5 sites	5 sites	5 sites
Herpetofauna Searches	N/A Baseline biodiversity survey	Spring – Summer	2 hrs					
Koala spot surveys	N/A Baseline biodiversity survey	Spring – Summer	11 x 5 min surveys					
Nocturnal birds	Annually	Spring – Summer	4 hr	5 sites		3 sites	2 sites	2 sites
Elliot A Traps	N/A Baseline biodiversity survey	Spring – Summer	200 nights					
Elliot B Traps	N/A Baseline biodiversity survey	Spring – Summer	48 nights					
Pitfall Traps	N/A Baseline biodiversity survey	Spring – Summer	16 nights					
Funnel Traps	N/A Baseline biodiversity survey	Spring – Summer	48 nights					
Microchiropteran bats	Annually	Spring – Summer	3 nights	5 sites		5 sites	5 sites	5 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	4 hr	5 sites		5 sites	5 sites	5 sites
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	10.5 hrs				May/Aug surveys	Apr/Jul surveys
Remote camera	Passive monitoring	Spring – Summer	4 nights					
Targeted Corben's Long-eared Bat survey	Annually	Summer	2 nights			3 sites	2 sites	1 site
Habitat assessment	N/A	N/A	1 hr					

B8.2 Baseline condition

B8.2.1 Vegetation

The Mallee property lies within the Nandewar Range and forms the north-east corner of the Regional East-West Wildlife Corridor. The property supports woodland habitats of good quality with very few edge effects. The vegetation and fauna habitat types present are illustrated in Figure B8.1 and a breakdown is provided in Table B8.4 and Table B8.5.

Table B8.4 Vegetation types of the Mallee BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Mallee BOA (ha)
Dwyer's Red Gum Woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	91.4
Myrtle Shrubland (+- White Pine/Tumbledown Red Gum); Dripping Rock	PCT427 / BVT NA4105: Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion	Inland Rocky Hill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	Not listed	142.9
River Oak Riparian Open Forest	PCT84 / BVT NA4191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	2.1
Rough-barked Apple Riparian Forb/Grass Open Forest	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	16.8
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	30.9
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Low Condition)	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	36.3
White Box – White Cypress Pine grassy woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act) [1]	9.2
Yellow Box - Blakely's Red Gum grassy woodland[1]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act) [1]	5.0

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Mallee BOA (ha)
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	1,727.6
White Pine/Narrow-leaved Ironbark Shrub/Grass Open Forest (Low Condition)	PCT1313 / BVT NA228: White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	4.0
				Total	**2,066.2**

1 = Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

B8.2.2 Fauna habitat

Table B8.5 Fauna habitat types of the Mallee BOA

Fauna habitat	Area (ha)
Grassland	40.3
Grassy woodland on fertile soils	14.2
Shrubby woodlands/Open forest on skeletal soils	1,992.8
Riverine woodland	18.9
Total	**2,066.2**

B8.2.3 Threatened species and ecological communities

Table B8.6 summarises the threatened species and ecological communities recorded or predicted to occur within the Mallee BOA. Threatened species and ecological communities recorded within the Mallee property are illustrated in Figure B8.2.

Table B8.6 Threatened species recorded or predicted to occur in the Mallee BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria Porrecta	E	E1	Potential habitat
Pomaderris queenslandica		E1	
Diuris tricolor	V	V	
Fauna			
Birds			

Brown Treecreeper		V	Presence confirmed
Diamond Firetail		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Eagle		V	
Little Lorikeet		V	
Speckled Warbler		V	
Turquoise Parrot		V	
Varied Sittella		V	
Barking Owl		V	Potential habitat
Black-chinned Honeyeater		V	
Masked Owl		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Mammals			
Eastern Cave Bat		V	Presence confirmed
Eastern Bent-wing Bat		V	
Eastern False Pipistrelle		V	
Squirrel Glider		V	
Yellow-bellied Sheathtail-bat		V	
Brush-tailed Rock Wallaby	V	E	Potential habitat
Corben's Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Little Pied Bat		V	
Koala		V	
Spotted-tailed Quoll	E	V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	Potential habitat

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B8.3 Baseline habitat conditions for matters of National Environmental Significance

The Mallee BOA contains approximately 14.2 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. All of the vegetation within the Mallee Property has been classified as State 1 Woodland.

The Mallee BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot and Corben's Long-eared Bat.

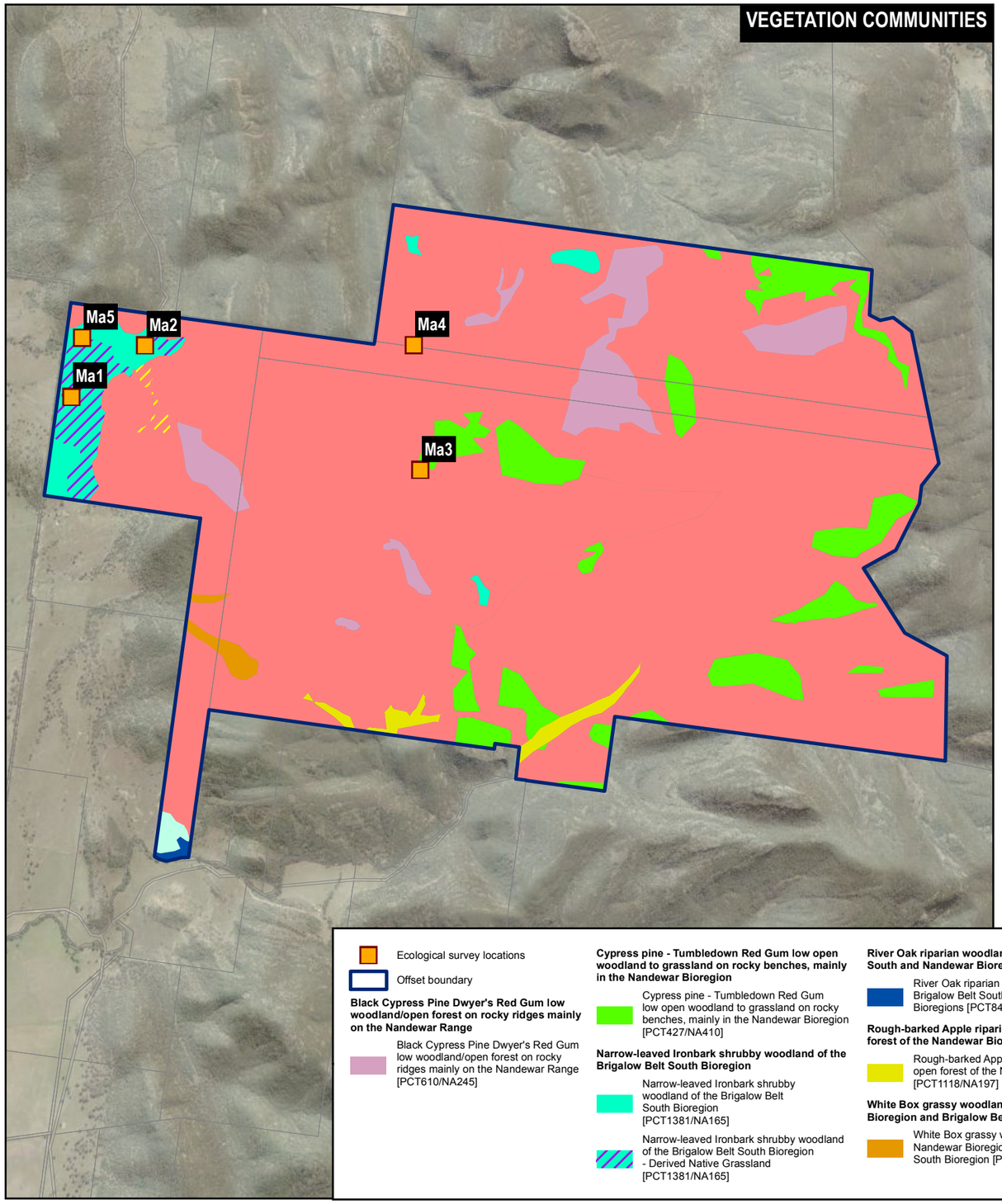
B8.4 Offset management zones

The Mallee property contains two offset management zones, as detailed in Table B8.7.

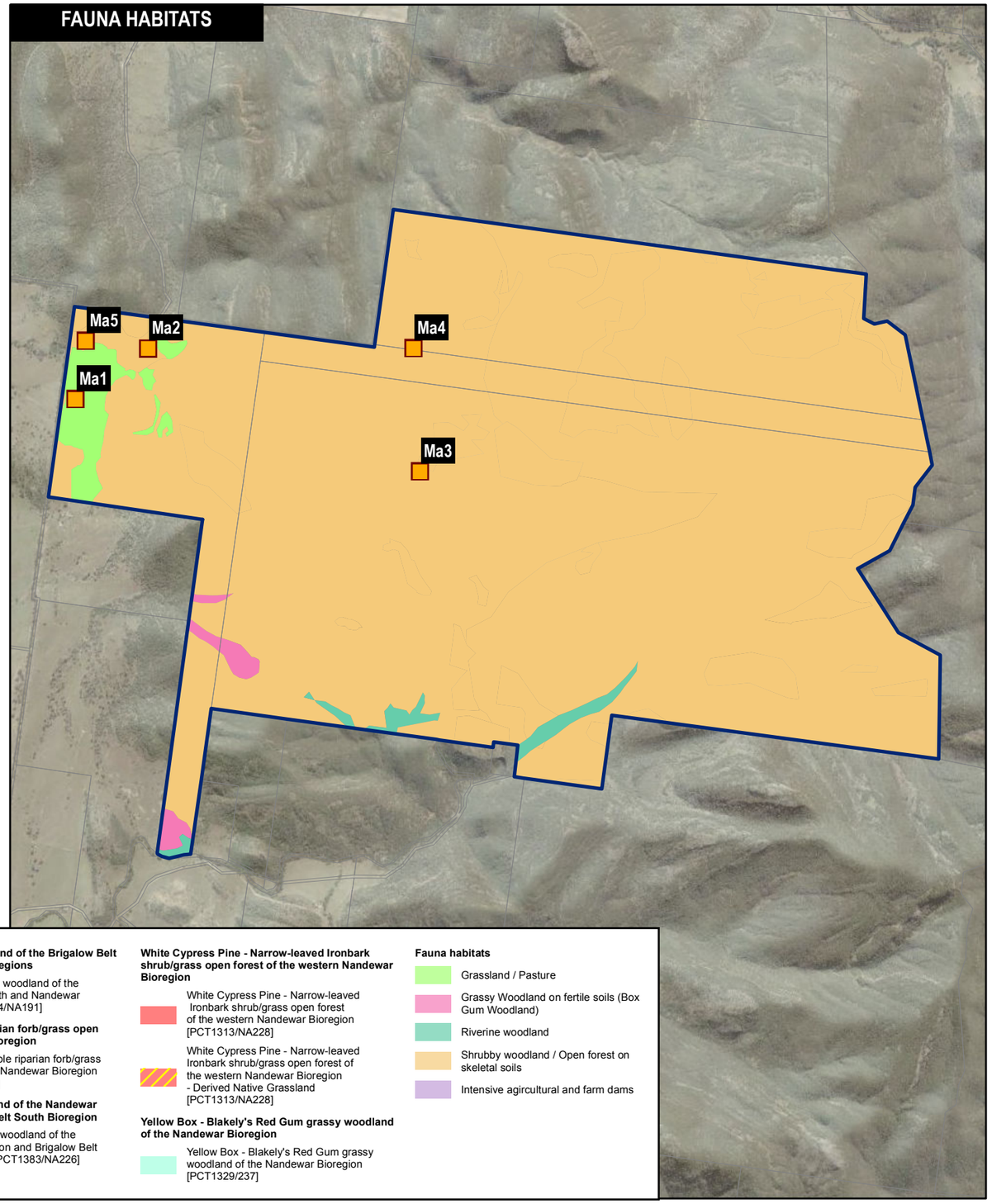
Table B8.7 Offset management zones of the Mallee BOA

Offset management zone	Area (ha)
Habitat management zone	2,025.9
Habitat restoration zone	40.3
Total	**2,066.2**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [PCT427/NA410]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion - Derived Native Grassland [PCT1313/NA228]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 0.25 0.5 km

1:37,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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BIODIVERSITY OFFSET STRATEGY

Figure B8.1
Vegetation communities and fauna habitats within the Mallee BOA

MALLEE

MALLEE LANE

DRIPPING ROCK ROAD

Threatened species
- Brown Treecreeper
- Diamond Firetail
- Eastern Bent-wing Bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Grey-crowned Babbler
- Hooded Robin
- Little Eagle
- Little Lorikeet
- Satin Flycatcher
- Speckled Warbler
- Squirrel Glider
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheathtail-bat
- Offset boundary

Box Gum Woodland States
- Box Gum Woodland (State 1: Woodland) - EPBC Act

Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
Date: 10/07/2017	Approved by: - Cooper.N

0 150 300 Meters

1:25,000

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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BIODIVERSITY OFFSET STRATEGY

Figure B8.2
Threatened species and communities of the Mallee BOA

B9. Nioka North BOA

The Nioka North property encompasses an area of 867.9 ha and is located approximately 16.5 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Nioka North property is provided in Table B9.1.

Table B9.1 Summary of the Nioka North BOA

Criteria	Location
Council	Narrabri Shire Council and Gunnedah Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Narrabri

B9.1 Nioka North biodiversity survey effort

Field validation surveys of the Nioka North BOA were undertaken between the 23 March 2015 and 29 March 2015 and 6 April and 10 April 2015. These surveys sought primarily to assess the extent and condition of vegetation and flora and fauna habitat, particularly including threatened species and ecological communities.

Presented below is a summary of biodiversity survey works completed for the Nioka North BOA.

B9.1.1 Flora survey

Table B9.2 Summary of the Nioka North BOA flora condition survey effort

Flora Group	Methods	Frequency	Season	Baseline surveys	Nioka North flora survey	
					2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	-	6 sites	6 sites
Threatened flora targeted surveys	Stratified random meander and plot based surveys	-	Targeted seasonal contexts	12 days		
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments	-	-	31 plots (2015)		

B9.1.2 Fauna survey

Table B9.3 is a summary of survey effort completed at the BOA since the baselines surveys.

Table B9.3 Summary of the Nioka North BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Nioka North fauna surveys	
				2015	2016
Diurnal birds	Annually	Spring – Summer	30 person hours	6 sites	6 sites
Nocturnal birds	Annually	Spring – Summer	-	1 site	1 site
Microchiropteran bats	Annually	Spring – Summer	4 harp trap nights	6 sites	6 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	45 remote camera trap nights	1 site	1 site
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	-	May/Aug surveys	Apr/Jul surveys
Targeted Corben's Long-eared Bat survey	Annually	Summer	4 trap nights	-	3 sites

B9.2 Baseline condition

B9.2.1 Vegetation

The Nioka North BOA lies within the Nandewar Range and forms part of the eastern section of the Regional East-West Wildlife Corridor. The most intact areas of woodland habitat occur in the west and far-east of the Nioka North BOA, although understorey vegetation exhibits the effects of grazing on the lower slopes. Large remnant intact native vegetation occurs on the ridges in the south west linking the BOA to larger areas of intact native vegetation extending the north and south. Elsewhere throughout the BOA remnant woodland trees are largely scattered or form residual patches along drainage lines or regrowth covering on hills. The vegetation and fauna habitat types present are illustrated in Figure B9.1 and a breakdown is provided in Table B9.4 and Table B9.5.

Table B9.4 Vegetation types of the Nioka North BOA

Vegetation community	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Nioka North BOA (ha)
Dwyer's Red Gum Woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	4.3
Rough-barked Apple – White Box Shrubby Woodland	PCT1308 / BVT NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	11.7

Vegetation community	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Nioka North BOA (ha)
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland[1]	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	117.1
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest; White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Shiny Bush); White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Callitris Regrowth)	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	263.2
White Box Grassy Woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	118.3
White Box Grassy Woodland (low condition – Derived Native Grassland) [2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	270.2
Yellow Box – Blakely's Red Gum Grassy Woodland[1]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	60.5
Silver-leaved Ironbark heathy woodland (Low condition)	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	4.8

Vegetation community	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Nioka North BOA (ha)
Other land (intensive agriculture)	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	17.6
Farm dams	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)	n/a	n/a	Not listed	0.2
				Total	**867.9**

1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland TSC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Table B9.5 Fauna habitat types of the Nioka North BOA

Fauna habitat	Area (ha)
Grassland	275.0
Grassy woodland on fertile soils	178.8
Shrubby woodlands/Open forest on skeletal soils	279.2
Riverine Woodland	117.1
Other land (intensive agriculture and farm dams)	17.8
Total	**867.9**

B9.2.2 Threatened species and ecological communities

Table B9.6 summarises the threatened species and ecological communities recorded or predicted to occur within the Nioka North BOA. Threatened species and ecological communities recorded within the Nioka North BOA are illustrated in Figure B9.2.

Table B9.6 Threatened species and communities recorded or predicted to occur in the Nioka North BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Picris evae	V	V	
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	E	-	
Tylophora linearis	E	V	
Pomaderris queenslandica	-	E1	
Fauna			

Birds			
Black-chinned Honeyeater		V	Presence confirmed
Brown Treecreeper		V	
Diamond Firetail		V	
Grey-crowned Babbler		V	
Little Lorikeet		V	
Speckled Warbler		V	
Turquoise Parrot		V	
Varied Sittella		V	
Hooded Robin		V	Potential habitat
Painted Honeyeater		V	
Barking Owl		V	
Regent Honeyeater	CE	CE	
Swift Parrot	CE	E1	
Pied Honeyeater		V	
Masked Owl		V	
Little Eagle		V	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Mammals			
Squirrel Glider		V	Recorded
Eastern Cave Bat		V	Potential habitat
Eastern Bent-wing Bat		V	
Yellow-bellied Sheathtail-bat		V	
Little Pied Bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	V	V	
Koala		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential Habitat
Pale-headed Snake		V	

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E), Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B9.3 Baseline habitat conditions for matters of National Environmental Significance

The Nioka North BOA contains approximately 295.9 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, which is classified as State 1 Woodland. A further 270.2 ha is derived native grassland (State 2: Native pasture) Box Gum Woodland and meets the TSC Act listing for this community. This ecological community is situated the throughout the Nioka North BOA on lower slopes and flatter land (Figure B9.2).

The Nioka North BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot and Corben's Long-eared Bat.

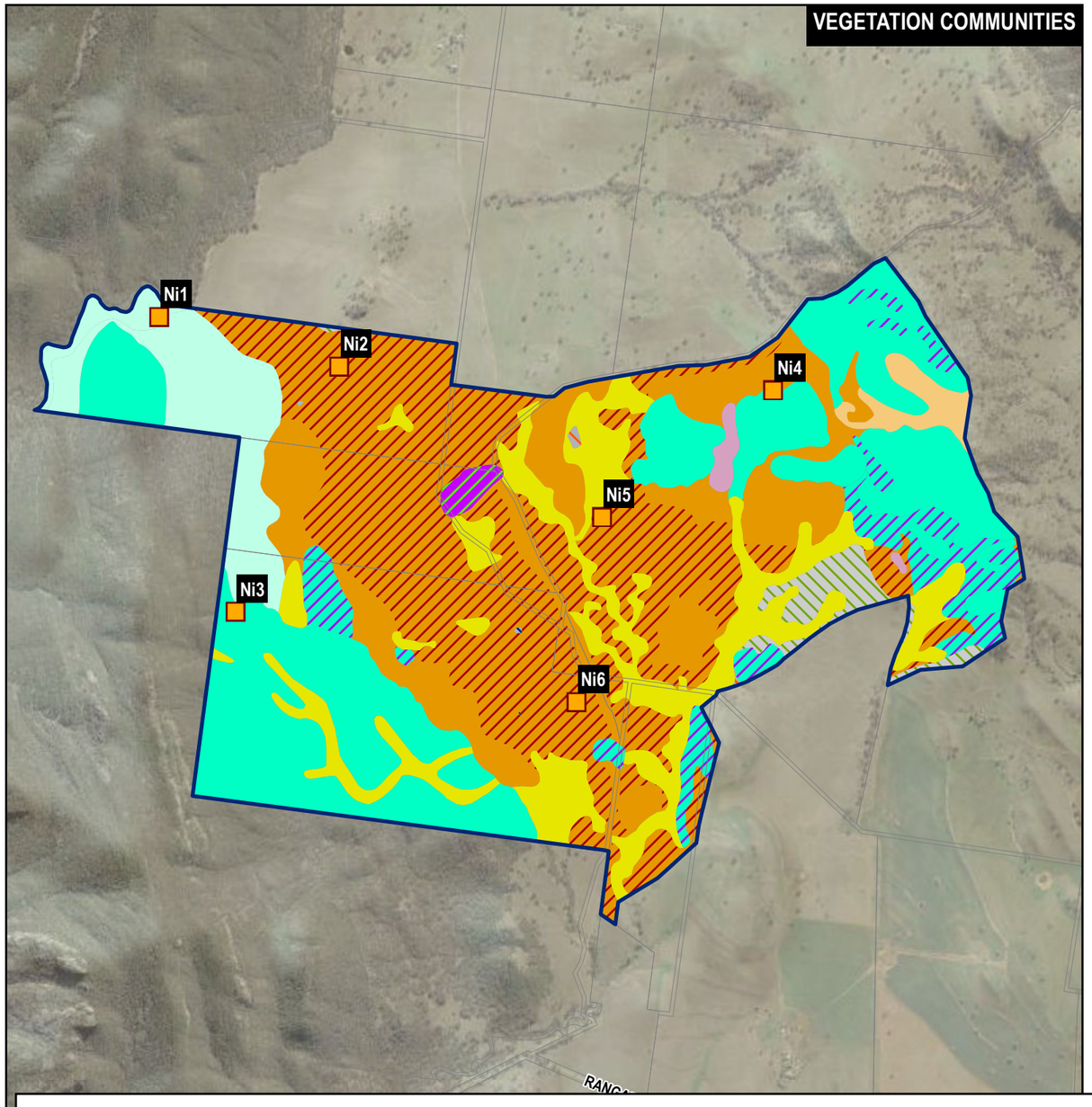
B9.4 Offset management zones

The Nioka North property contains three offset management zones, as detailed Table B9.7.

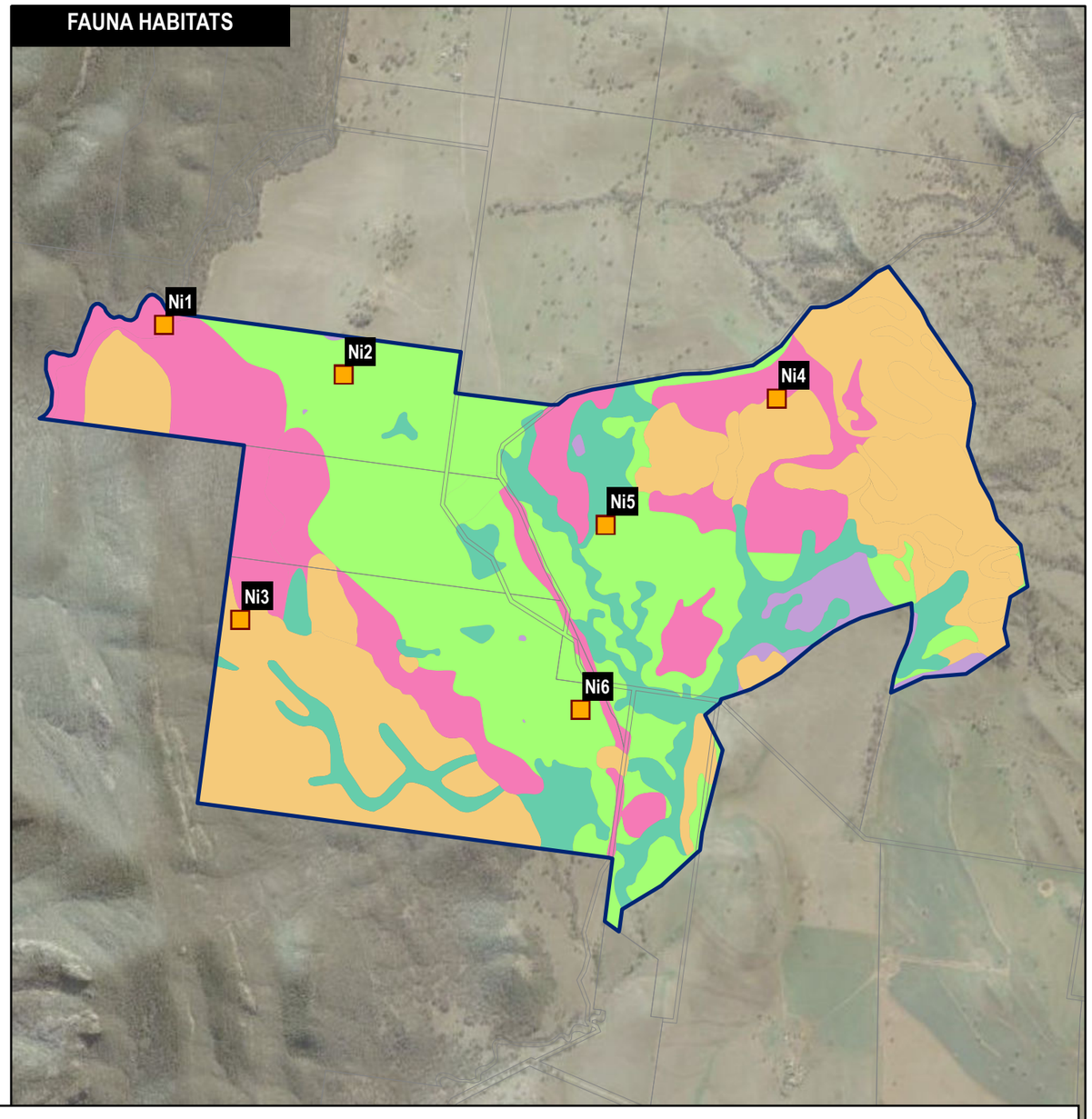
Table B9.7 Offset management zones of the Nioka North BOA

Offset management zone	Area (ha)
Habitat management zone	527.5
Habitat restoration zone	322.6
Corridor enhancement zone	17.8
Total	**867.9**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion - Derived Native Grassland [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable

Fauna habitats

Grassland / Pasture

Grassy Woodland on fertile soils (Box Gum Woodland)

Riverine woodland

Shrubby woodland / Open forest on skeletal soils

Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 12/07/2017	Approved by: -

0 0.5 1 km

1:27,500

Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

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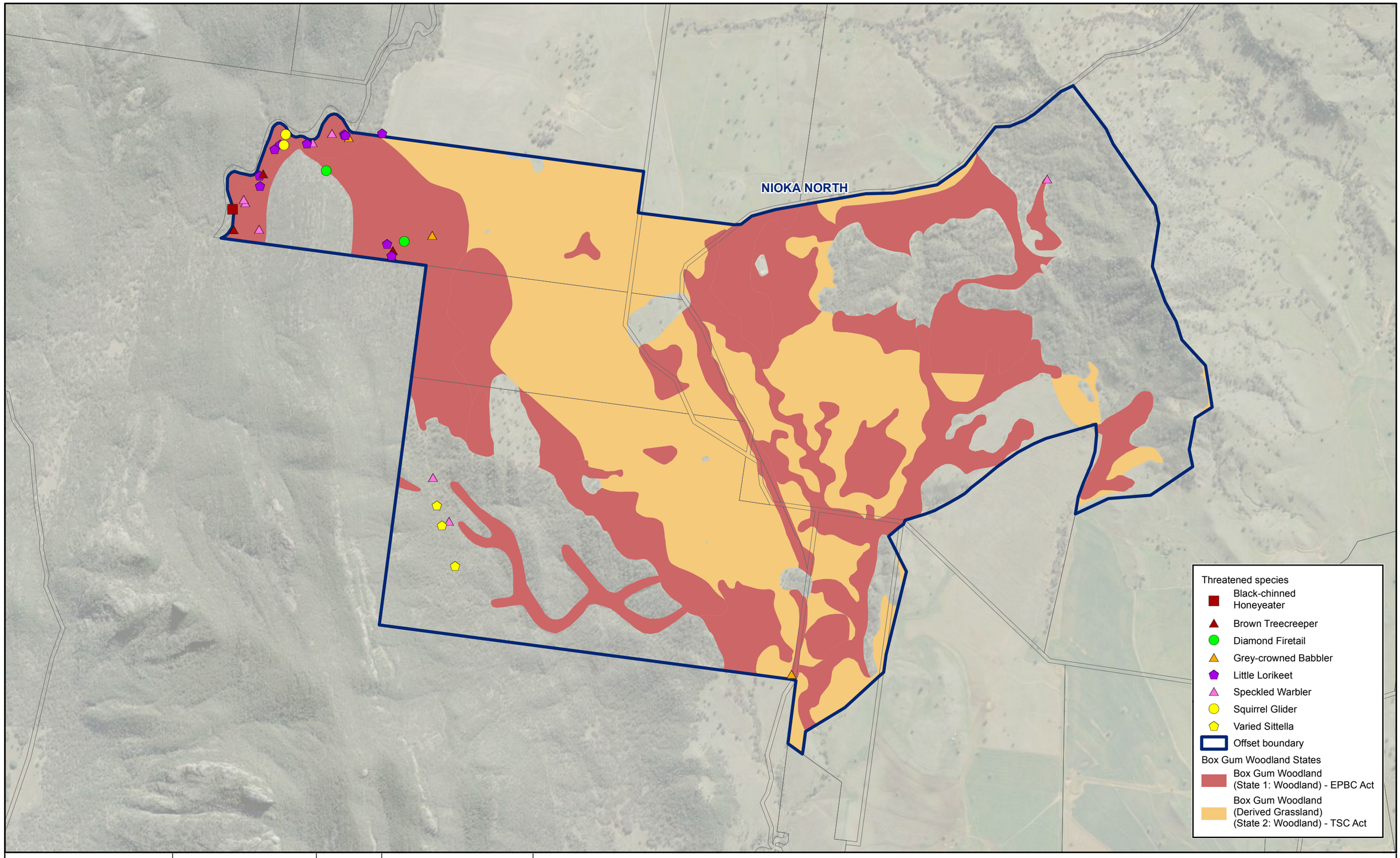
Figure B9.1
Vegetation communities and fauna habitats within the Nioka North BOA



Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
Date: 10/07/2017	Approved by: - Cooper.N

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Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3

Data source: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Figure B9.2
Threatened species and communities of the Nioka North BOA

B10. Sunshine BOA

The Sunshine property encompasses an area of 738.1 ha and is located approximately 18 km north-west of the EIS mine disturbance limit (Boggabri Existing). A summary of the Sunshine property is provided in Table B10.1

Table B10.1 Summary of the Sunshine BOA

Criteria	Location
Council	Gunnedah Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Liverpool Alluvial Plains Tamworth - Keepit Slopes and Plains
Noxious weed control area	Gunnedah

B10.1 Sunshine biodiversity survey effort

Field validation surveys of the Sunshine BOA were undertaken between the 23 March 2015 and 29 March 2015, and 6 April and 10 April 2015. These surveys sought primarily to assess the extent and condition of vegetation and flora and fauna habitat, particularly including threatened species and ecological communities.

Presented below is a summary of biodiversity survey works completed for the Sunshine BOA.

B10.1.1 Flora survey

Table B10.2 Summary of the Sunshine BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline surveys	Sunshine flora survey	
					2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	30 person hours	6 sites	6 sites
Threatened flora targeted surveys	Stratified random meander and plot based surveys	-	Targeted seasonal contexts	42 hours	-	-
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments	-	-	43 Plots (2015)	-	-

B10.1.2 Fauna survey

Table B10.3 is a summary of survey effort completed at the BOA since the baselines surveys.

Table B10.3 Summary of the Sunshine BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Sunshine fauna surveys	
				2015	2016
Diurnal birds	Annually	Spring – Summer	30 person hours	6 sites	6 sites
Nocturnal birds	Annually	Spring – Summer	-	1 site	1 site
Microchiropteran bats	Annually	Spring – Summer	4 harp trap nights	6 sites	6 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	66 remote camera trap nights	1 site	1 site
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter		May/Aug surveys	Apr/Jul surveys
Targeted Corben's Long-eared Bat survey	Annually	Summer	4 trap nights	-	-

B10.2 Baseline condition

B10.2.1 Vegetation

The Sunshine property lies within the Nandewar Range and forms part of the south-eastern portion of the Regional East-West Wildlife Corridor. Much of the woodland within the Sunshine BOA occurs in fragmented landscape. Regeneration is present on many parts of the throughout the northern uplands, particularly along ridgetops and drainage lines. The vegetation and fauna habitat types present are illustrated in Figure B10.1 and a breakdown is provided in Table B10.4 and Table B10.5 respectively.

Table B10.4 Vegetation types of the Sunshine BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Sunshine BOA (ha)
Dwyer's Red Gum Woodland	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	1.3
Rough-barked Apple – White Box shrubby/grassy woodland	PCT1308 / BVT NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	5.1
White Box – Blakely's Red Gum - Rough-barked Apple	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum	159.3

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Sunshine BOA (ha)
Riparian grassy woodland[1]	forest of the Nandewar Bioregion (grassy variant)			Woodland (TSC Act & EPBC Act)	
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland (low condition)[2]	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (Derived Native Grassland)	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	3.0
White Box – Blakely's Red Gum - Rough-barked Apple Riparian grassy woodland (Shrubby variant)	PCT1118 / BVT NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (shrubby variant)	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	12.2
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest (Shiny Bush)	PCT1381 / NA166. Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	138.6
White Box Grassy Woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	81.2
White Box Grassy Woodland (Low condition)[2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions (Derived native Grassland) [2]	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	245.9
Silver-leaved Ironbark heathy woodland	PCT1307 / BVT NA231: White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	6.8
Exotic grassland (intensive agriculture)	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	84.3

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Sunshine BOA (ha)
Farm dams	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)	n/a	n/a	-	0.4
				Total	**738.1**

1 Commensurate with EPBC Act State 1 Woodland of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
2 Commensurate with State 2 Derived Native Grassland TSC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

B10.2.2 Fauna habitats

Table B10.5 Fauna habitat types of the Sunshine BOA

Fauna habitat	Area (ha)
Grassland	248.9
Grassy woodland on fertile soils	81.2
Shrubby woodlands/Open forest on skeletal soils	151.8
Riverine Woodland	171.5
Other land (Intensive agriculture and farm dams)	84.7
Total	**738.1**

B10.2.3 Threatened species and ecological communities

Table B10.6 summarises the threatened species recorded or predicted to occur within the Sunshine BOA. Threatened species and ecological communities recorded within the Sunshine BOA are illustrated in Figure B10.2.

Table B10.6 Threatened species recorded or predicted to occur in the Sunshine BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Digitaria Porrecta	E	E1	Potential habitat
Diuris tricolor	V	V	
Pomaderris queenslandica	-	E1	
Tylophora linearis	E	V	
Fauna			
Birds			
Brown Treecreeper		V	Recorded
Little Lorikeet		V	

Speckled Warbler		V	
Turquoise Parrot		V	
Grey-crowned Babbler		V	
Black-chinned Honeyeater		V	Potential habitat
Barking Owl		V	
Diamond Firetail		V	
Hooded Robin		V	
Masked Owl		V	
Painted Honeyeater		V	
Pied Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Superb Parrot	V	V	
Swift Parrot	CE	E1	
Varied Sittella		V	
Mammals			
Eastern Cave Bat		V	Potential habitat
Eastern Bent-wing Bat		V	
Yellow-bellied Sheathtail Bat		V	
Little Pied Bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	V	V	
Squirrel Glider		V	
Koala		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E), Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B10.3 Baseline habitat conditions for matters of National Environmental Significance

The Sunshine BOA contains approximately 240.5 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which is classified as State 1 Woodland. A

further 248.9 ha of derived native grassland that meets TSC Act and meets State 2 native pastures. This ecological community is situated throughout the Sunshine BOA on lower slopes and flatter land.

The Sunshine BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Superb Parrot and Corben's Long-eared Bat.

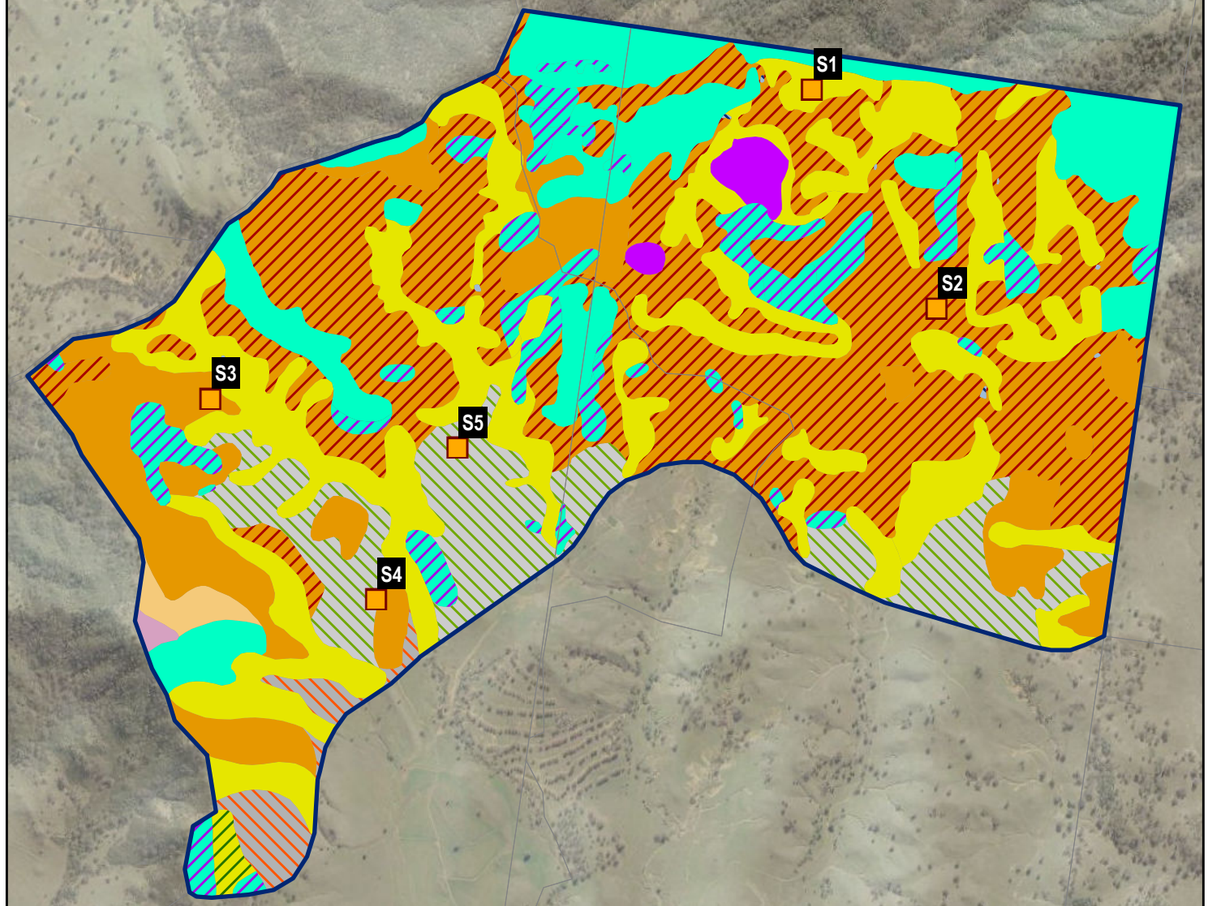
B10.4 Offset management zones

The Sunshine property contains three offset management zones, as detailed in Table B10.7.

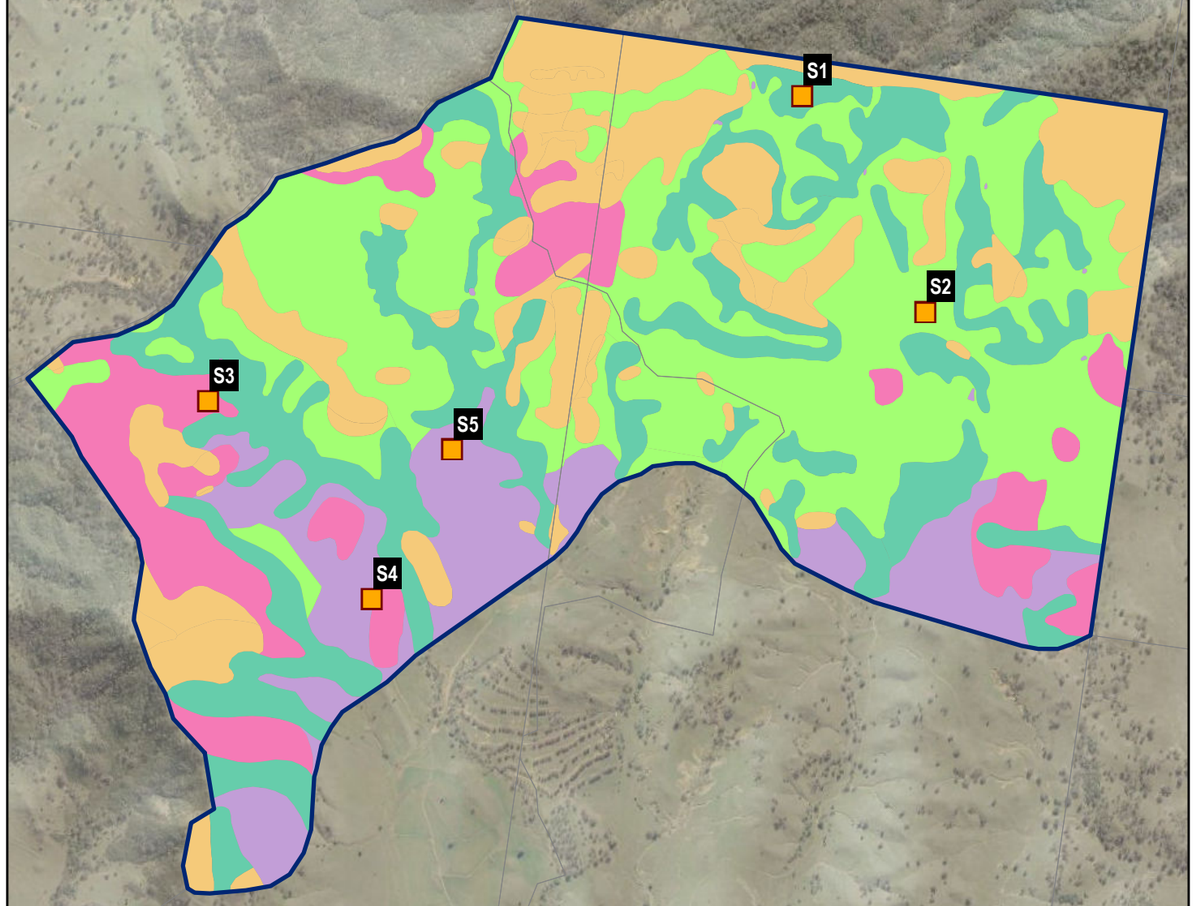
Table B10.7 Offset management zones of the Sunshine BOA

Offset management zone	Area (ha)
Habitat management zone	353.2
Habitat restoration zone	300.2
Corridor enhancement zone	84.7
Total	**738.1**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion - Derived Native Grassland [PCT1381/NA165]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion - Derived grassland [PCT1118/NA197]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Low

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

Fauna habitats

Grassland / Pasture

Grassy Woodland on fertile soils (Box Gum Woodland)

Riverine woodland

Shrubby woodland / Open forest on skeletal soils

Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 0.25 0.5 km

1:22,500

Coordinate system: GDA 1994 MGA Zone 56
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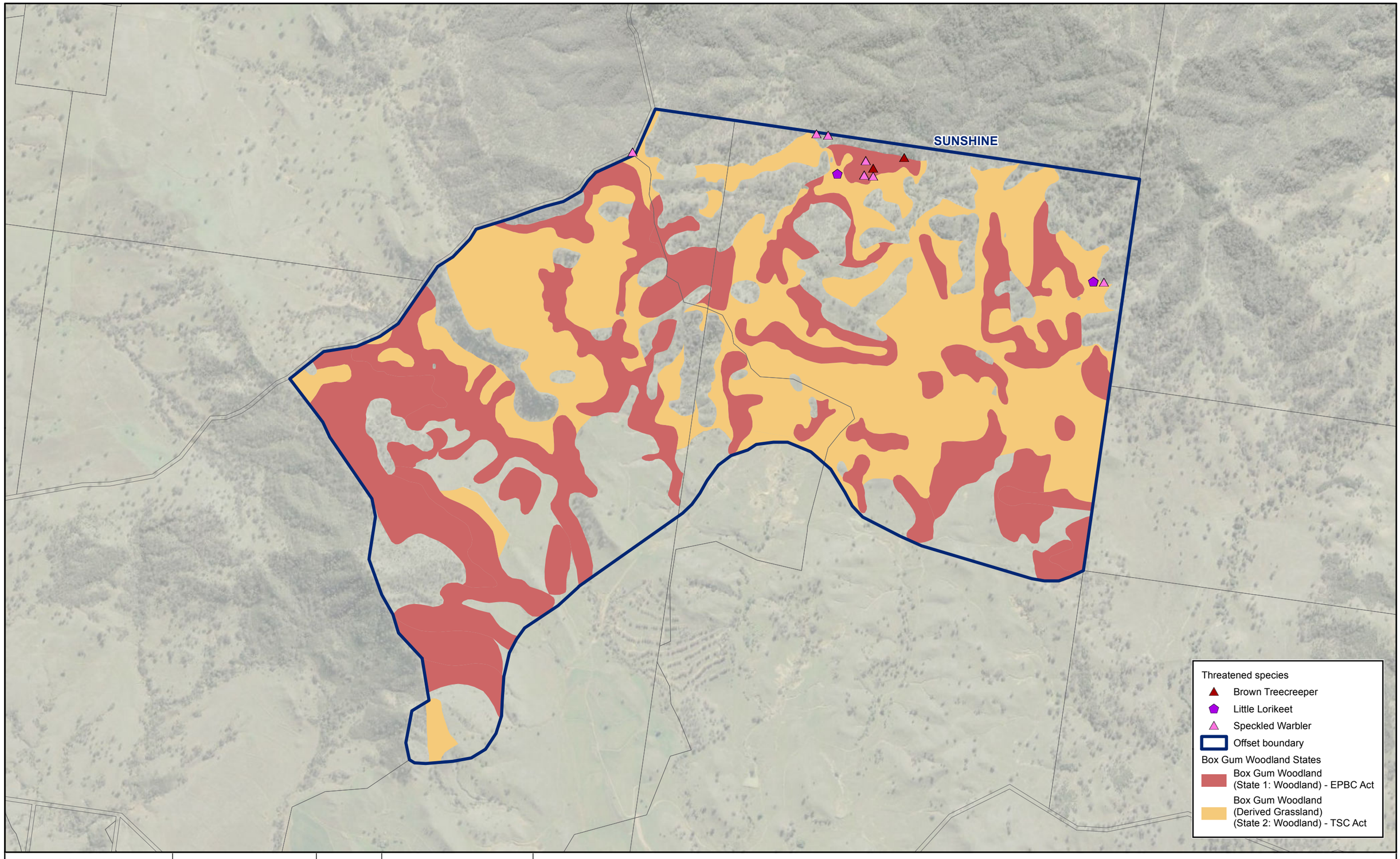
Figure B10.1
Vegetation communities and fauna habitats within the Sunshine BOA



Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
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Figure B10.2
Threatened species and communities of the Sunshine BOA

B11. Braefield BOA

The Braefield property encompasses an area of 1,400.7 ha and is located approximately 20 km east of the EIS mine disturbance limit (Boggabri Existing). A summary of the Braefield property is provided in Table B11.1.

Table B11.1 Summary of the Braefield BOA

Criteria	Location
Council	Gunnedah Shire Council
Bioregion	Nandewar Brigalow Belt South
Catchment Management Area (CMA)	Namoi CMA Peel sub-catchment Liverpool Plains sub-catchment
Botanical Subdivision	North Western Slopes (NWS)
Mitchell landscapes	Tamworth - Keepit Slopes and Plains
Noxious weed control area	Gunnedah

B11.1 Braefield biodiversity survey effort

Field validation surveys of the Braefield BOA were undertaken between 20 April 2015 and 30 April 2015. This survey primarily sought to assess the extent and condition of vegetation and flora and fauna habitat, especially for threatened species and ecological communities.

Presented below is a summary of biodiversity survey works completed for the Braefield BOA.

B11.1.1 Flora survey

Table B11.2 Summary of the Braefield BOA flora condition survey history

Flora Group	Methods	Frequency	Season	Baseline survey	Braefield flora survey	
					2015	2016
Floristic diversity and threatened flora surveys	Transect and quadrat plot-based survey	Annually	Spring	-	6 sites	6 sites
Threatened flora targeted surveys	Stratified random meander and plot based surveys	-	Targeted seasonal contexts	165 person hours		
Vegetation community delineation	Plot-based quadrats survey and quaternary rapid plot assessments	-	-	54 plots		

B11.1.2 Fauna survey

Table B11.3 is a summary of survey effort completed at the BOA since baselines surveys.

Table B11.3 Summary of the Braefield BOA fauna survey history

Species Group	Frequency	Season	Baseline surveys	Braefield fauna surveys	
				2015	2016
Diurnal birds	Annually	Spring – Summer	80 person hours	6 sites	6 sites
Nocturnal birds	Annually	Spring – Summer	–	1 site	1 site
Microchiropteran bats	Annually	Spring – Summer	–	6 sites	6 sites
Nocturnal Mammals	Bi-Annually	Spring – Summer	–	1 site	1 site
Targeted Regent Honeyeater and Swift Parrot survey	Annually	Winter	–	May/Aug surveys	Apr/Jul surveys
Targeted Corben's Long-eared Bat survey	Annually	Summer	–	-	4 sites

B11.2 Baseline condition

B11.2.1 Vegetation

The Braefield property lies within the Nandewar Range and forms part of the south-eastern portion of the Regional East-West Wildlife Corridor. The Braefield property contains over 1400.7 ha of native vegetation including high quality remnant vegetation, particularly in the north, which will complement and adjoin high quality existing vegetation and will extend the Regional East-West Wildlife Corridor. An important environmental corridor that historically linked Leard State Forest with the Nandewar Range, Namoi River and large vegetation remnants to the west. The vegetation and fauna habitat types present are illustrated in Figure B11.1 and a breakdown is provided in Table B11.4.

Table B11.4 Vegetation types of the Braefield BOA

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Braefield BOA (ha)
Tumbledown Red Gum grassy woodland	PCT427 / BVT NA410: Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion		Semi-arid Woodlands (Shrubby sub-formation)	Not listed	26.4
White Box Blakely's Red Gum Rough-barked Apple riparian forest (shrubby variant)	PCT1118/NA197: Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion (shrubby variant)	Western Slopes Grassy Woodlands	Grassy Woodlands	Not listed	150.9
White Box Blakely's Red Gum Rough-	PCT1118/NA197: Rough-barked Apple riparian forb/grass open forest of the	Western Slopes	Grassy Woodlands	White box – Yellow Box – Blakely's Red	29.2

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Braefield BOA (ha)
barked Apple riparian woodland[1]	Nandewar Bioregion (grassy variant) [1]	Grassy Woodlands		Gum Woodland (TSC Act & EPBC Act)	
White Box Grassy Woodland[1]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	152.3
White Box Grassy Woodland (low condition)[2]	PCT1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Derived Native Grassland) [2]	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	55.4
White Box Melaleuca riverine forest	PCT84 / BVT NA191: River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions	Eastern Riverine Forests	Forested Wetlands	Not listed	17.0
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	PCT1382 / BVT NA166: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Northern Tableland Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	37.1
White Box - White Cypress Pine shrubby open forest; White Box - White Cypress Pine shrubby open forest (Callitris Regrowth); White Box - White Cypress Pine shrubby open forest (Shiny Bush)	PCT1308 / BVT NA225: White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	879.9
Yellow Box – Blakely's Red Gum grassy woodland[1]	PCT1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	12.8
New England Blackbutt Rough-barked Apple shrubby open forest	PCT530 / BVT NA309: Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion	New England Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Not listed	1.3
White Box Dwyer's Red Gum Manna	PCT610 / BVT NA245: Black Cypress Pine Dwyer's Red Gum low woodland/open	Western Slopes Dry	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	38.0

Vegetation communities	PCT / BVT (OEH, 2017)	Vegetation class	Vegetation formation	Threatened ecological community	Area within Braefield BOA (ha)
Gum shrubby woodland	forest on rocky ridges mainly on the Nandewar Range	Sclerophyll Forests			
Other land (Farm Dams)	Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands)	n/a	n/a	Not listed	0.4
Total					**1,400.7**

B11.2.2 Fauna habitats

Table B11.5 Fauna habitat types of the Braefield BOA

Fauna habitat	Area (ha)
Grassland	55.4
Grassy woodland on fertile soils	165.1
Shrubby woodlands/Open forest on skeletal soils	982.7
Riverine Woodland	197.1
Other land (intensive agriculture and farm dams)	0.4
Total	**1,400.7**

B11.2.3 Threatened species and ecological communities

Table B11.6 summarises the threatened species recorded or predicted to occur within the Braefield BOA. Threatened species and ecological communities recorded within the Braefield BOA are illustrated in Figure B11.2.

Table B11.6 Threatened species recorded or predicted to occur in the Braefield BOA

Species	EPBC Act[1]	TSC Act[2]	Note
Threatened Ecological Communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	E	Recorded
Flora			
Diuris tricolor	-	V	Potential habitat
Dichanthium setosum	V	V	
Digitaria porrecta	E	E	
Pomaderris queenslandica	-	E	
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	E	-	
Tylophora linearis	E	E	
Picris evae	V	V	
Thesium australe	-	V	

Fauna			
Birds			
Brown Treecreeper		V	Recorded
Diamond Firetail		V	
Grey-crowned Babbler		V	
Hooded Robin		V	
Little Lorikeet		V	
Speckled Warbler		V	
Turquoise Parrot		V	
Varied Sittella		V	
Black-chinned Honeyeater		V	Potential habitat
Black Falcon		V	
Barking Owl		V	
Masked Owl		V	
Painted Honeyeater		V	
Regent Honeyeater	CE	CE	
Spotted Harrier		V	
Square-tailed Kite		V	
Swift Parrot	CE	E1	
Little Eagle		V	
Mammals			
Eastern Cave Bat		V	Potential habitat
Grey-headed Flying-fox	V	V	
Eastern Bent-wing Bat		V	
Yellow-bellied Sheathtail-bat		V	
Eastern False Pipistrelle		V	
Corben's Long-eared Bat	V	V	
Large-eared Pied Bat	V	V	
Spotted-tailed Quoll	V	V	
Squirrel Glider		V	
Koala		V	
Reptiles			
Border Thick-tailed Gecko	V	V	Potential habitat
Pale-headed Snake		V	

1 Listed as Migratory (M), Vulnerable (V) or Endangered (E) Critically Endangered (CE) under the EPBC Act
2 Listed as Vulnerable (V) or Endangered (E1) under the TSC Act.

B11.3 Baseline habitat conditions for matters of National Environmental Significance

The Braefield BOA contains approximately 194.3 ha of the EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland which has been classified as State 1 Box Gum woodland. A further 55.4 ha of derived grassland meets the TSC Act criteria for listing under the TSC Act and is also classified as State 2 Derived Native Pastures. This ecological community is situated the throughout the Braefield BOA on lower slopes and flatter land.

The Braefield BOA also provides suitable habitat for the Regent Honeyeater, Swift Parrot, Grey-headed Flying Fox and Corben's Long-eared Bat.

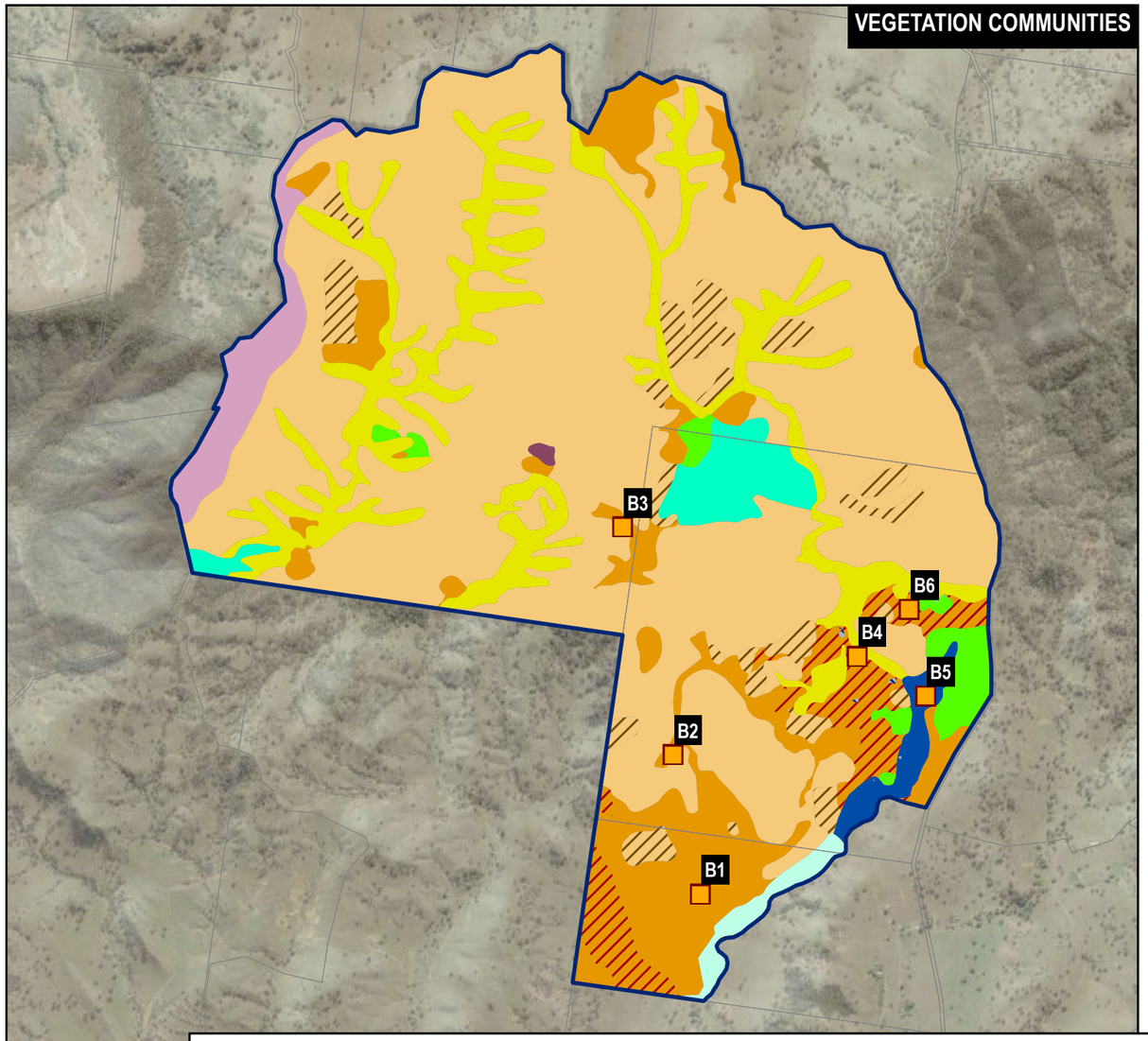
B11.4 Offset management zones

The Braefield property contains three offset management zones, as detailed in Table B11.7.

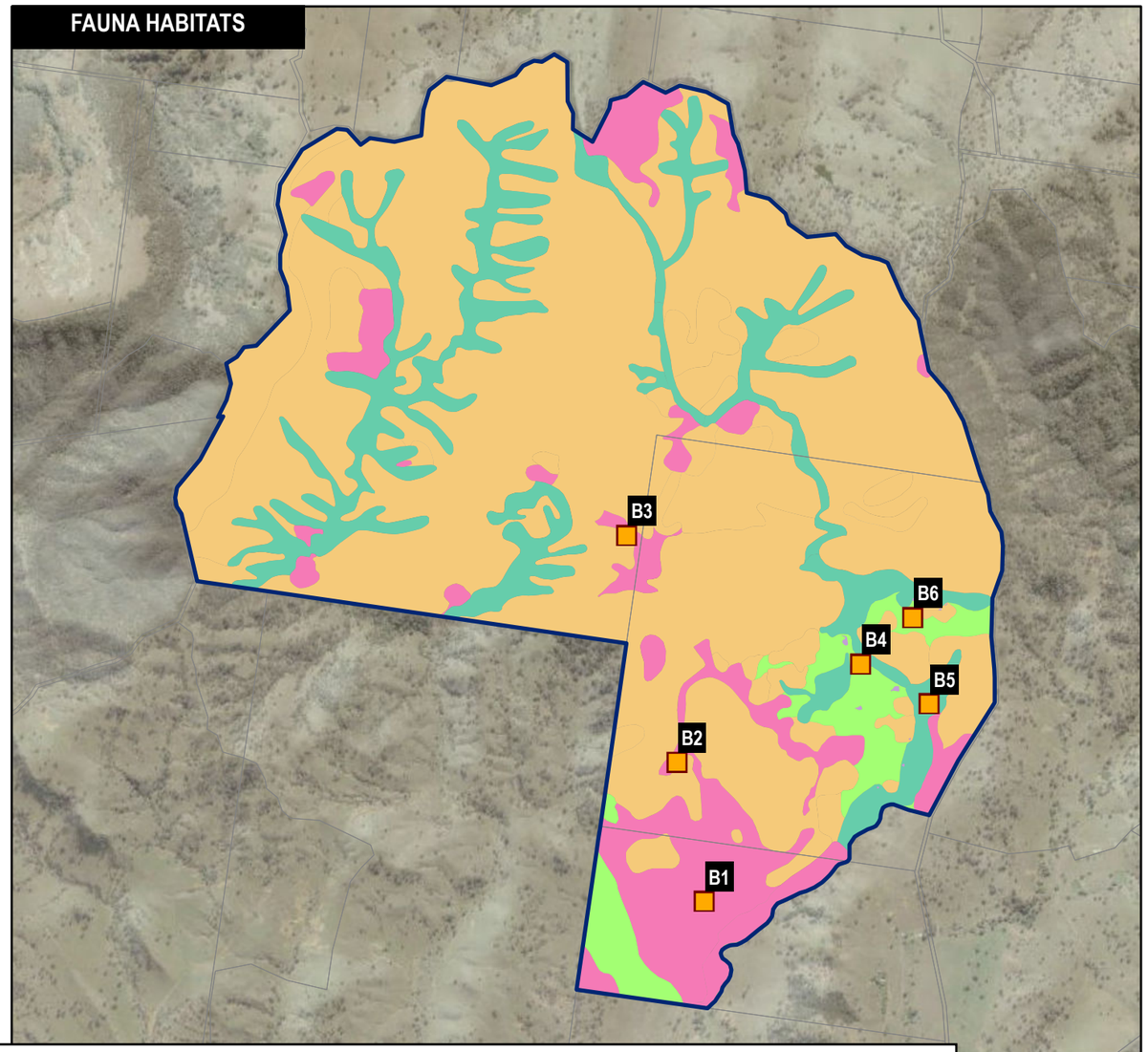
Table B11.7 Offset management zones of the Braefield BOA

Offset management zone	Area (ha)
Habitat management zone	1,283.2
Habitat restoration zone	117.1
Corridor enhancement zone	0.4
Total	**1,400.7**

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range

Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [PCT610/NA245]

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion

Cypress pine - Tumbledown Red Gum low open woodland to grassland on rocky benches, mainly in the Nandewar Bioregion [PCT427/NA410]

Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion

Nandewar Box – Western New England Blackbutt – Red Stringybark open forest in the Kaputar area of the Nandewar Bioregion [PCT530/NA309]

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions

River Oak riparian woodland of the Brigalow Belt South and Nandewar Bioregions [PCT84/NA191]

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion

Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [PCT1118/NA197]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [PCT1308/NA225]

White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions - Derived Grassland [PCT1308/NA225]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]

Miscellaneous

Miscellaneous Ecosystems - water bodies, rivers, lakes, streams (not wetlands), Not applicable (crop land)

Fauna habitats

Grassland / Pasture

Grassy Woodland on fertile soils (Box Gum Woodland)

Riverine woodland

Shrubby woodland / Open forest on skeletal soils

Intensive agricultural and farm dams

Map: 2267037B_GIS_BOS001_A1	Author: SuansriR
Date: 4/08/2017	Approved by: - CooperN

0 0.25 0.5 km

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Coordinate system: GDA 1994 MGA Zone 56
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BIODIVERSITY OFFSET STRATEGY

Figure B11.1
Vegetation communities and fauna habitats within the Braefield BOA

BRAEFIELD

Threatened species
- Brown Treecreeper
- Diamond Firetail
- Grey-crowned Babbler
- Hooded Robin
- Little Lorikeet
- Speckled Warbler
- Turquoise Parrot
- Varied Sittella
- Offset boundary

Box Gum Woodland States
- Box Gum Woodland (State 1: Woodland) - EPBC Act
- Box Gum Woodland (Derived Grassland) (State 2: Woodland) - TSC Act

Map: 2267037B_GIS_BOS004_A1	Author: SuansriR
Date: 10/07/2017	Approved by: - Cooper.N

0 250 500 Meters

1:25,000

Coordinate system: GDA 1994 MGA Zone 56
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BIODIVERSITY OFFSET STRATEGY

Figure B11.2
Threatened species and communities of the Braefield BOA

Appendix C

Jerralong and Goonbri BOA Field Survey Report

Our ref: 123456-ECO-LTR- RevC.docx

Your ref: 2200549A-ECO-LTR_RevC

4 August 2017

Daniel Martin
Environmental Superintendant
Boggabri Coal
PO Box 12
Boggabri NSW 2382

Dear Daniel

Field verification survey of Jerralong and Goonbri BOAs

1. INTRODUCTION

Site inspections of Boggabri Coal's Jerralong and Goonbri Biodiversity Offset Areas (BOAs) (Figure 2.1 and Figure 2.2) were required to verify desk based assessments of biodiversity values which occur within the BOAs. The results of these site inspections will inform the Boggabri Coal Mine's (the project) Biodiversity Offset Strategy (BOS).

This letter provides an overview of the methodology and results of the site inspections to determine the biodiversity values present within the Jerralong and Goonbri BOAs.

2. METHODOLOGY

The Jerralong and Goonbri BOAs (the study area) were inspected during the daylight hours by a suitably qualified ecologist on the 10 and 11 August 2016. The Jerralong BOA was also inspected between the 13 and 15 October 2015 and 9 and 11 November 2016 as part of the annual BOA monitoring. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitats within the study area. Details regarding the specific surveys undertaken are provided below.

2.1 FLORA SURVEYS

Flora surveys involved a combination of random meanders and quadrat based assessments were undertaken to determine the nature and condition of vegetation within the study area.

2.1.1 RANDOM MEANDERS

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 meander throughout the site recording dominant and key plant species (e.g. threatened species, noxious weeds), boundaries between various vegetation communities and condition of vegetation.

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The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

2.1.2 QUADRATS AND TRANSECTS

Thirteen quantitative (quadrat/transect) site surveys were completed as outlined in the procedure contained within the BioBanking Assessment Methodology (BBAM) (Office of Environment and Heritage 2014). The location of these site surveys are provided in Figure 2.1 and Figure 2.2. Field survey data is provided in Attachment A.

2.1.3 VEGETATION CONDITION

The condition of vegetation was firstly assessed against the BBAM definitions of 'Low' and 'Moderate to Good' condition.

BBAM defines vegetation in 'Low' condition as:

a) *woody native vegetation with native over-storey percent foliage cover less than 25% of the lower value of the over-storey percent foliage cover benchmark for that vegetation type, and where either: - less than 50% of ground cover vegetation is indigenous species, or greater than 90% of ground cover vegetation is cleared.'*

OR

b) *native grassland, wetland or herbfield where either: – less than 50% of ground cover vegetation is indigenous species, or more than 90% of ground cover vegetation is cleared.'*

'Moderate to Good' broad condition is native vegetation that is not in 'Low' broad condition.

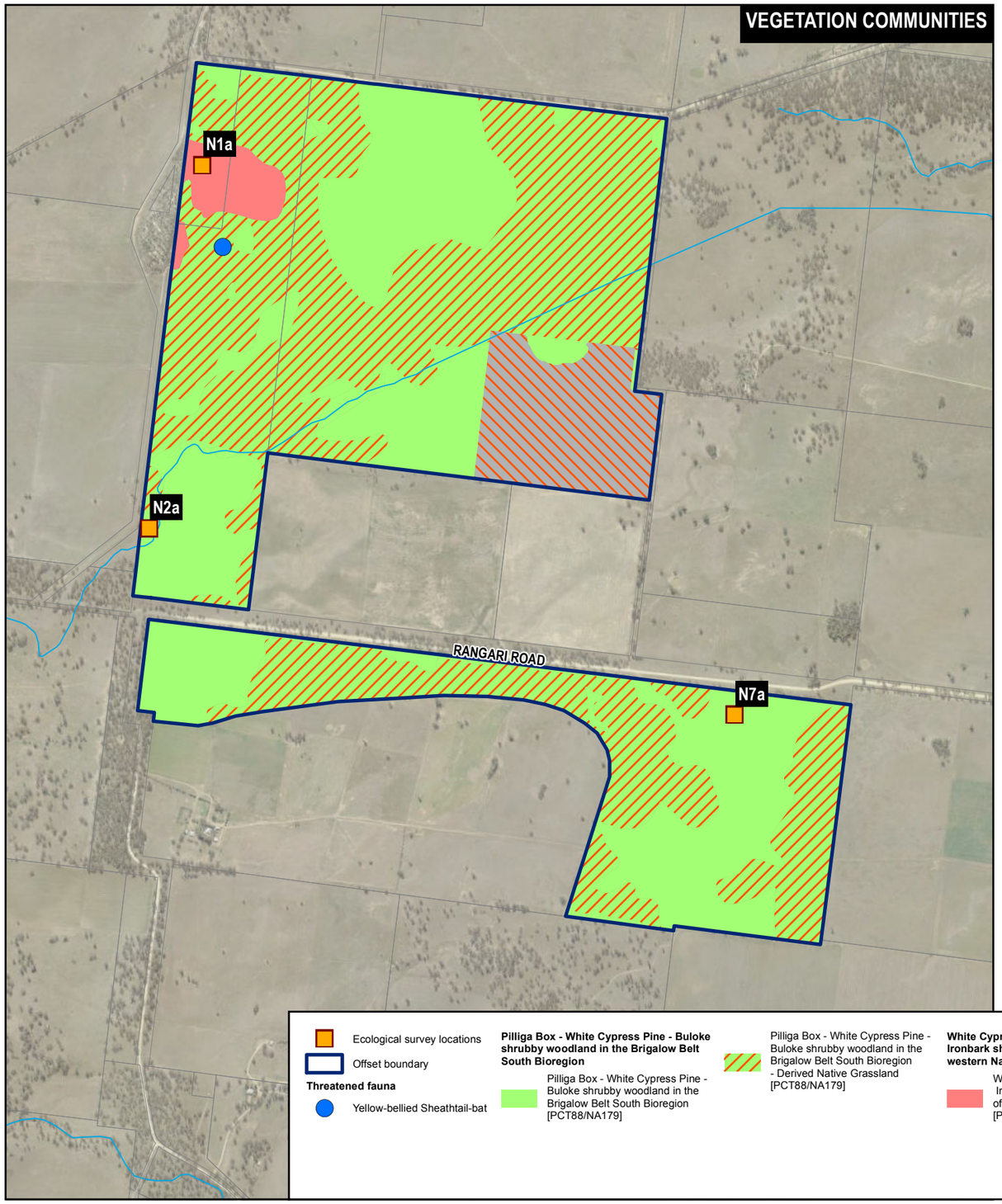
2.2 FAUNA SURVEYS

Fauna surveys undertaken within the study area included a combination of diurnal bird surveys, call-play back, spotlighting and Anabats camera trapping as described below. These surveys were undertaken as part of annual BOAs biodiversity monitoring in November 2015 and October 2016.

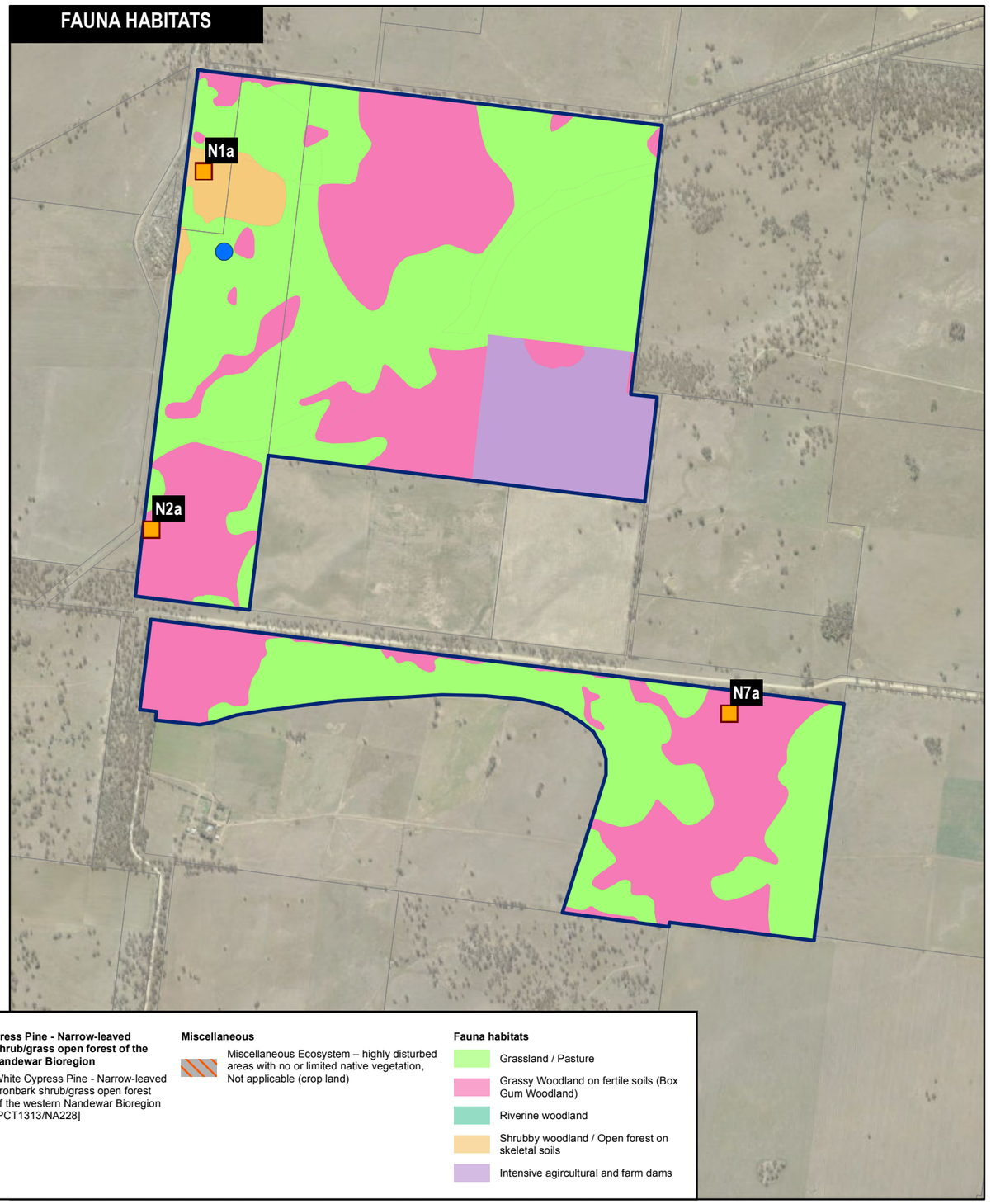
2.2.1 DIURNAL BIRD SURVEYS

Daytime area bird surveys were undertaken within 100 m of the three quadrats completed at Jerralong BOA (N1a, Na2 and Na7) (Figure 2.1), over a period of 20 minutes in October 2015 and November 2016. Designated surveys were completed during periods of high bird activity, predominately early morning or late afternoon. Surveys were completed at each sample site twice on separate days per monitoring event by two experienced ecologists. Opportunistic records were collected within each BOA concurrently during other surveys.

VEGETATION COMMUNITIES



FAUNA HABITATS



Ecological survey locations

Offset boundary

Threatened fauna

Yellow-bellied Sheathtail-bat

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion [PCT88/NA179]

Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion - Derived Native Grassland [PCT88/NA179]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

Miscellaneous

Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Riverine woodland
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOA002_A1	Author: SuansriR
Date: 3/08/2017	Approved by: -

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Coordinate system: GDA 1994 MGA Zone 56
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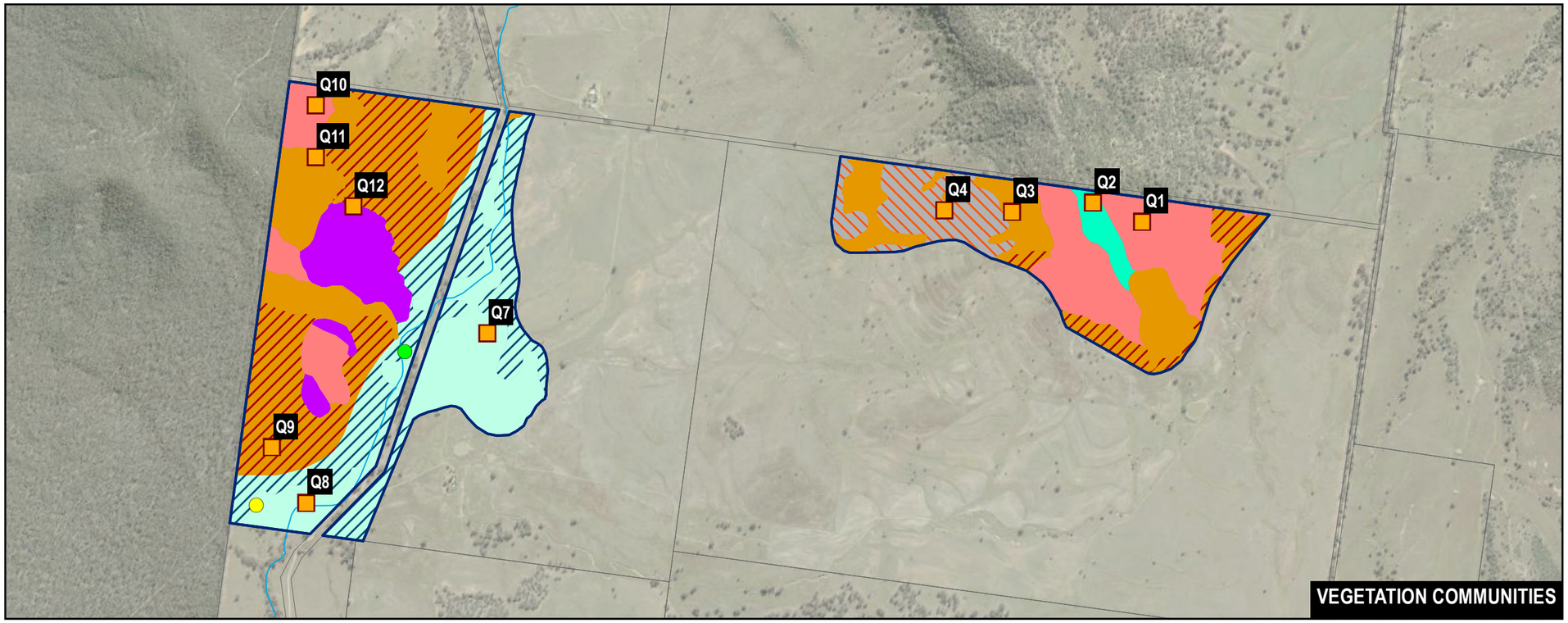
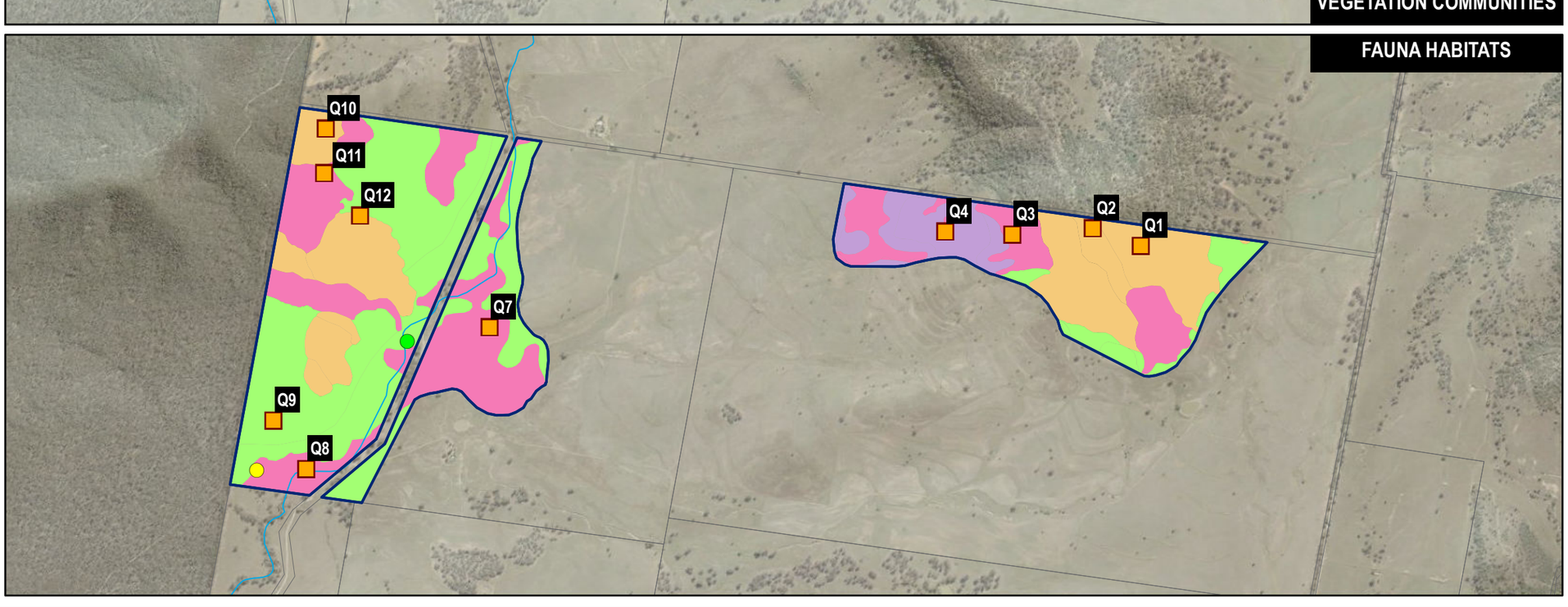
BIODIVERSITY OFFSET STRATEGY

Figure 2.1
Jerralong BOA biodiversity values and survey effort





- Ecological survey location
- Offset boundary

Threatened fauna

- Grey-crowned Babbler
- Little Lorikeet

Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion

- Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South Bioregion [PCT1381/NA165]

White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion [PCT1383/NA226]
- White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion - Derived Native Grassland [PCT1383/NA226]

White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion

- White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion [PCT1313/NA228]

White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion

- White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [PCT1307/NA224]

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [PCT1329/237]
- Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion - Derived Native Grassland [PCT1329/237]

Miscellaneous

- Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation, Not applicable (crop land)

Fauna habitats

- Grassland / Pasture
- Grassy Woodland on fertile soils (Box Gum Woodland)
- Shrubby woodland / Open forest on skeletal soils
- Intensive agricultural and farm dams

Map: 2267037B_GIS_BOA001_A1	Author: SuansriR
Date: 3/08/2017	Approved by: - CooperN

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BIODIVERSITY OFFSET STRATEGY

Figure 2.2
Goonbri BOA biodiversity values and survey effort

2.2.2 NOCTURNAL SURVEYS

Call playback was used to survey for the Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider and Koala using the methods of Kavanagh and Debus (1994) and Debus (1995). Call playback surveys involved broadcasting recordings of the vocalisations of animals to elicit a response, either vocal or behavioural. At each call playback site an initial ten minute listening period was undertaken followed by a five minute call broadcast and then a five minute listening and spotlighting period. For each additional species the 2 x 5 minute periods were repeated. A final listening period of ten minutes was undertaken after call broadcasting was concluded. Calls were broadcast using a portable MP3 player and amplified through a megaphone. Call playback was completed in conjunction with spotlighting surveys by Ecologists at N1a in October 2015.

Spotlighting was completed at Quadrat N1a on foot by two Ecologists in October 2015, targeting arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. Spotlighting was also completed informally during call playback with animals heard or observed recorded in October 2016.

2.2.3 ANABATS

Passive Ultrasonic Anabat Bat detection (Anabat SD1/SD2 or Anabat Express unit – Titley Scientific) were used to record and identify the echolocation calls of microchiropteran foraging at each of the three monitoring locations in the Jerralong BOA (Figure 2.1). Passive monitoring of Na1, Na2 and N7a was achieved by setting Anabat bat detectors to record throughout the night over two consecutive nights during October 2015 and November 2016.

2.2.4 REMOTE CAMERA TRAPS

Remote motion sensing infra-red cameras were positioned at each of the three quadrats within Jerralong BOA (Figure 2.1) to gain an understanding of terrestrial mammals and vertebrate pests, to aid management strategies. Camera traps were set with chicken necks, and left out for three nights at Na1, Na2 and Na7 in October 2015.

2.2.5 OPPORTUNISTIC SURVEYS

Opportunistic sightings of animals were recorded including diurnal birds and reptiles. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provided indirect information on animal presence and activity.

2.3 LIMITATIONS

During the August 2016 site inspections access to some areas within the Jerralong BOA were limited due to heavy rainfall in the week leading up to the survey. Subsequently, vegetation mapping of some areas had to be surveyed from a distance with the aid of binoculars.

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 during the site inspections 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 biodiversity, can change with time.

3. RESULTS

3.1 VEGETATION COMMUNITIES

Existing broad-scale vegetation mapping (Eco Logical Australia 2008) of the study area was reviewed and verified during the site inspection. The results of the site inspection verified that the Jerralong BOA comprised a two native vegetation types and one non-native vegetation type whilst the Goonbri BOA is comprised of five native vegetation types and one non-native vegetation type the distribution of which were related to geological, topographical and geomorphological characteristics as well as previous land use. A summary of the vegetation types identified are provided in Table 3.1 and Table 3.2 and illustrated in Figure 2.1 and Figure 2.2.

All vegetation within the study area was in Moderate to Good condition as defined by BBAM aside from the Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation which was in Low condition.

Table 3.1 Vegetation communities within Jerralong BOA

PCT / BVT (OEH, 2017)[1]	VEGETATION CLASS	VEGETATION FORMATION	THREATENED ECOLOGICAL COMMUNITY	AREA WITHIN JERRALONG BOA (HA)
PCT 88 / BVT NA 228: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion	Pilliga Outwash Dry Sclerophyll Forest	Dry Sclerophyll Forests (shrub/grass sub-formation)	Not listed	509.8
PCT 1313 / BVT NA228: White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	13.4
Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	46.9
			Total (ha)	570.1

1) PCT / BVT = Plant Community Type and Biometric Vegetation Type as defined in VIS Classification Version 2.1 (OEH, 2017).

Table 3.2 Vegetation communities within Goonbri BOA

PCT / BVT (OEH, 2017)[1]	VEGETATION CLASS	VEGETATION FORMATION	THREATENED ECOLOGICAL COMMUNITY[2]	AREA WITHIN GOONBRI BOA (HA)
PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	White box – Yellow Box – Blakely's Red Gum Woodland (TSC Act & EPBC Act)	90.3
PCT 1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands		62.7

PCT / BVT (OEH, 2017)[1]	VEGETATION CLASS	VEGETATION FORMATION	THREATENED ECOLOGICAL COMMUNITY[2]	AREA WITHIN GOONBRI BOA (HA)
PCT 1307 / BVT 224: White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	14.5
PCT 1313 / BVT NA228: White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	37.2
PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Western Slopes Dry Sclerophyll Woodlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Not listed	3.6
Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	n/a	n/a	Not listed	15.1
			Total (ha)	223.4

1) PCT / BVT = Plant Community Type and Biometric Vegetation Type as defined in VIS Classification Version 2.1 (OEH, 2017)
2) White box – Yellow Box – Blakely's Red Gum Woodland listed as Endangered under the TSC Act and Critically Endangered under the EPBC Act.

3.2 FAUNA HABITATS

The quality of vertebrate fauna habitats is typically correlated to the patch size, configuration, structure, species composition and connectivity of the vegetation present at a given site and the presence of non-biological features such as rock outcrops and water bodies. Therefore fauna habitats present in the study area varies from low condition in highly modified areas (derived native grasslands with scattered trees) to moderate and high condition in areas where patches of intact vegetation occurred. The study area consisted of four fauna habitat types as outlined in Table 3.3.

Table 3.3 Fauna habitat with corresponding vegetation types

FAUNA HABITAT	CORRESPONDING VEGETATION TYPE
Grassy Woodlands on fertile soils	PCT 88 / BVT NA 228: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion PCT 1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion

FAUNA HABITAT	CORRESPONDING VEGETATION TYPE
Shrubby woodland / Open forest on skeletal soils	PCT 1307 / BVT 224: White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion PCT 1313 / BVT NA228: White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion
Grasslands	PCT 88 / BVT NA 228: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (DNG) PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion (DNG) PCT 1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (DNG)
Intensive agriculture and farm dams	Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation

A total of 40 fauna species have been recorded within the study area including 32 bird species and eight microchiropteran bat species. Full list of fauna species recorded within the survey area is provided in Attachment B.

4. THREATENED BIODIVERSITY

4.1.1 THREATENED ECOLOGICAL COMMUNITIES

One threatened ecological community was recorded within the Goonbri BOA being White box – Yellow Box – Blakely's Red Gum Woodland (White Box Woodland) which is listed an Endangered under the TSC Act and Critically Endangered under the EPBC Act. Two vegetation types recorded constituent this threatened ecological community which include:

— PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion; and

— PCT 1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion.

These vegetation types both occurred as remnant woodland and as derived native grassland (DNG).

The woodland variants of these communities are consistent with both the TSC Act and EPBC Act listings for White Box Woodland as they meet the following condition criteria:

— canopy is dominated by either White Box or Yellow Box

— patches contain > 50% native perennial understorey cover

— > 0.1 ha in size

— > 12 or more native understorey species (excluding grasses); and

— contain at least one important species.

The DNG variants of these communities are consistent only with the TSC Act listing for White Box Woodland as they do not meet the above Commonwealth condition thresholds for the EPBC Act listing.

4.1.2 THREATENED FLORA SPECIES

No threatened flora species were recorded during the site inspections at either the Jerralong or the Goonbri BOAs.

4.1.3 THREATENED FAUNA SPECIES

Three threatened fauna species were recorded within the study area; being Little Lorikeet, Grey-crowned Babbler and Yellow-bellied Sheathtail Bat. The location of where these species were found is provided in Figure 2.1 and Figure 2.2.

5. CONCLUSIONS

In summary six native vegetation types and one non-native vegetation type were recorded within the study area. Two of these vegetation types are consistent with White Box Woodland listed as Endangered under the TSC Act and Critically Endangered under the EPBC Act. One additional vegetation type is currently under a preliminary listing for the proposed Poplar Box Woodland on alluvial Floodplains which is being investigated for its eligibility as an endangered ecological community.

Although no threatened flora species where recorded, three threatened fauna species were recorded including Little Lorikeet, Grey-crowned Babbler and Yellow-bellied Sheathtail-bat. Four habitat types were recorded within the study area which all provide habitat for other threatened species.

The vegetation and fauna habitats recorded within the study area will provide offsets suitable for inclusion in the BOP. An overview of the contributions these BOAs will have to the BOS are outlined in Table 5.1 and Table 5.2.

Table 5.1 Vegetation to be included in BOS

VEGETATION TYPE	WOODLAND OR DNG	AREA WITHIN JERRALONG BOA (HA)	AREA WITHIN GOONBRI BOA (HA)	TOTAL (HA)
PCT 88 / BVT NA 228: Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion	Remnant	209.0	-	209.0
	DNG	300.8	-	300.8
PCT 1383 / BVT NA226: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Remnant	-	38.7	38.7
	DNG	-	51.6	51.6
PCT 1329 / BVT NA237: Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Remnant	-	29.2	29.2
	DNG	-	33.5	33.5
PCT 1307 / BVT 224: White Cypress Pine - Silver-leaved Ironbark –shrubby open forest of the Nandewar Bioregion	Remnant	-	14.5	14.5
PCT 1313 / BVT NA228: White Cypress Pine – Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Remnant	13.4	37.2	50.6

VEGETATION TYPE	WOODLAND OR DNG	AREA WITHIN JERRALONG BOA (HA)	AREA WITHIN GOONBRI BOA (HA)	TOTAL (HA)
PCT1381 / BVT NA165: Narrow-leaved Ironbark shrubby woodland of the Brigalow Belt South bioregion	Remnant	-	3.6	3.6
Miscellaneous Ecosystem – highly disturbed areas with no or limited native vegetation	Intensive agriculture	46.9	15.1	62.0
Totals (ha)	-	570.1	223.4	793.5

Table 5.2 Fauna habitat to be included in BOS

FAUNA HABITAT TYPE	AREA WITHIN JERRALONG BOA	AREA WITHIN GOONBRI BOA	TOTAL
Grassy Woodlands on fertile soils	209.0	67.9	264.2
Shrubby woodland / Open forest on skeletal soils	13.4	55.3	76.6
Grasslands	300.8	85.1	390.3
Intensive agriculture and farm dams	46.9	15.1	62.4
Totals (ha)	570.1	223.4	793.5

Yours sincerely

Alex Cockerill
Team Manager, Environment, Hunter Region

ATTACHMENTS

Attachment A – Flora field survey data

Attachment B – Fauna species recorded

REFERENCES

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

Debus, SJS 1995, 'Surveys of large forest owls in Northern New South Wales: methodology, calling behaviour and owls responses', *Corella*, vol. 19, no. 2, pp. 38-50.

Eco Logical Australia 2008, *A Vegetation Map for the Namoi Catchment Management Authority*, An unpublished report prepared for Namoi Catchment Management Authority, December 2008.

Kavanagh, RP & Debus, SJS 1994, 'The Powerful Owl *Ninox strenua* in New South Wales', *Australian Birds* vol. 28, supplement 21-38.

Office of Environment and Heritage 2014, *BioBanking Assessment Methodology 2014*, Sydney.

PB PARSONS BRINCKERHOFF

Survey Site Form - BioBanking		Site ID: Nala				Vegetation zone: HMZ
Date	9-11-16	Surveyor(s): TB				
Waypoint ID	AS PER LAST YEAR	Photo numbers	5550	5551	5552	5553
Coordinates	E 0224258 N 6604738	Photo direction	N	E	(S)	W
Mapped Vegetation type: CALLITRIS IRONBARK REGROWTH			Condition:		Low	(Mod-good)
Slope: Gentle, (Mod), Steep	Aspect (degrees or cardinal): 300		Altitude: 262			
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?						
Vegetative Structure (formation) = OPEN FOREST		Ecologically Dominant Layer (EDL) - most biomass = CANOPY				

Strata	Height interval	Median	Est. cover	Dominant Species & Dominance
E	-			
T1	4 - 10	8	20-40	CALLITRIS GLAUCOPHYLLA (OLD + YOUNG COHORT)
T2	-			
T3	-			
S1	0.4 - 2	1.2	5-10	BOXTHORN +
S2	-			
G	0.1 - 0.5	0.3	60-90	HYDROCOTYLE RADICATA S SCABRA STACHYS, CHELANTHES SIEBERI

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 l = 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	25	0	0
15m	5	0	0
20m	40	0	0
25m	20	0	0
30m	25	0	0
35m	25	0	0
40m	5	0	0
45m	20	0	0
50m		0	0
Total (sum / 10) =		0	0
Larger 50 x 20m plot			
Length of woody debris >10cm wide & >0.5m long			2, 2, 16 = 18
Proportion of canopy sp. regeneration (Callitris only)			1
Number of trees with hollows >5cm			Ø

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 𝍸 ||	32	64
Native other (herb, fern, sedge, etc) tally - 𝍸 ||||	9	18
Native shrub tally - —	0	0
Exotic tally - 𝍸 𝍸 𝍸 ||||	19	38
Bare ||||	4	8

PARSONS BRINCKERHOFF

Site ID: Nala	Survey type:Quadrat 20m x 20m

Species	Cover	Strata	Species	Cover	Strata
1 CALLITRIS GLAUCOPHYLLA	5	C	41 ENTEROPOGON ACICULATUS	2	G
2 GOLDEN EVERLASTING	3	G	42 ARISTIDA RAMOSA	3	G
3 STACHYS ARVENSE	4	G	43 TRIPLODISCUS PYGM	2	G
4 TRIFOLIUM GLOMERATUM	4	G	44 PETROPHAGIA NAN	2	G
5 TRIFOLIUM CAPESTRUM	3	G	45 HYPOCHAERIS RADICATA	4	G
6 STIPA SCABRA	5	G	46 EINADIA NUTANS	2	G
7 VULPIA MYUROS	4	G	47 CHEILANTHES SIEBERI	3	G
8 POLYCARPON TETRAPHYLLUM	4	G	48 CAREX INVOLSA	3	G
9 CALANDRINIA EREMAEA	2	G	49 EINADIA TRIG	2	G
10 SONCHUS OLE	3	G	50 PARSONSEA EUC	1	G
11 OXALIS PERENNANS	3	G	51 EINADIA POLY	2	G
12 SIDA CORRUGATA	3	G	52 DICHONDRA SP A	2	G
13 LYCIUM FEROCISSIMUM	2	S	53 BOTHRIOCHLOA DECIPIENS	2	G
14 EREMOPHILA DESERTI	2	G	54 SOLENOGYNE BELLIOIDES		G
15 ROSTULLERIA ADSCENDENS	3	G	55 STIPA SETACEAE	2	G
16 TRIFOLIUM ARVENSE	4	G	56		
17 GYPSOPHILA TUBULOSA	2	G	57		
18 SOLANUM SP	2	G	58		
19 SIDA CUNNINGHAMII	2	G	59		
20 CHEILANTHES DISTANS	2	G	60		
21 EINADIA HASTATA	2	G	61		
22 CRASSULA SIEBERIANA	3	G	62		
23 ERAGROSTIS LEPTOSTACHYA	3	G	63		
24 WAHLENBERGIA SMALL	1	G	64		
25 FIMBRYSTYLIS DICHOTOMA	1	G	65		
26 ERAGROSTIS ELONGATA	2	G	66		
27 WAHLENBERGIA GRAC	1	G	67		
28 LAMARKIA AUREA	1	G	68		
29 ARENARIA LEPTOCLADIES	2	G	69		
30 Thyridolepis mitchelliana	4	G	70		
31 Eulalia aurea	3	G	71		
32 GERANIUM SOLANDERI	2	G	72		
33 OCIN BETCHII	1	G	73		
34 CHAMAESYCE DRUMONDII	3	G	74		
35 BOEHAVIA DOMINII	1	G	75		
36 ERODIUM CICINATUM	1	G	76		
37 STACKHOUSIA VIMINALIS	2	G	77		
38 ENNAERGION GRACILIS	3	G	78		
39 SOLIVA SESSILIS	2	G	79		
40 PLYLLATHUS VIRGATUS	2	G	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	30	40	60	40	55
Native other grass	–	–	–	–	–
Native forb & other	15	10	–	5	5
Native shrub (<1m)	5	–	–	–	–
Exotic grass	10	5	0	5	0
Exotic forb & other	15	10	20	25	10
Leaf & stick litter	5	5	5	10	15
Rocks	10	10	10	5	25
Bare ground	5	15	5	5	20
Cryptogams	10	5	–	5	10
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		Fire damage:	✗
Clearing (inc. logging):	✓	Storm damage:	✗
Cultivation (inc. pasture):	✗	Trampling:	✓
Soil erosion:	✗	Flood damage:	✗
Firewood collection:	✓	Feral herbivores:	RABBIT ✓
Stock grazing:	COWS ✓	Other:	BURROWS + SCATS
Salinity:	✗		

SW corner, plot faces sth.

PB PARSONS BRINCKERHOFF

Survey Site Form - BioBanking		Site ID: Na2a				Vegetation zone: HMZ
Date	9-11-16	Surveyor(s): TB				
Waypoint ID	AS PER LAST YEAR	Photo numbers	5546	5547	5548	5549
Coordinates	E 0224022 N 6603124	Photo direction	N	E	(S)	W
Mapped Vegetation type: PILLIGAR/POPLAR BOX			Condition:		Low	(Mod-good)
Slope: (Gentle) Mod, Steep	Aspect (degrees or cardinal): NW		Altitude: 247			
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? DNG REGROWTH PILLIGAR/POP						
Vegetative Structure (formation) = DNG		Ecologically Dominant Layer (EDL) - most biomass = GROUND				

Strata	Height interval	Median	Est. cover	Dominant Species & Dominance
E	-			
T1	10 - 18	16	10-40	Eucalyptus POP Eucalyptus pilligarensis
T2	6 - 10	8	0-10	ACACIA PENDULA
T3	-			
S1	0.5 - 1.8	1.2	5 10	ACACIA PENDULA 1M
S2	0.2 - 0.4	0.3	<1	SCLEROLEANA MURICATA.
G	0.1 - 1.6	0.1	90-100	AUST. ARISTAGLUMIS STIPA LOLIUM SP. CAREX INVERSA.

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

→ Weeping Myall regrowth.

50m Transect	10 Points - Foliage Projective Cover		
Point	Canopy % (photos)	Midstorey %	Exotic %
5m	0	0	0
10m	0	0	0
15m	0	0	0
20m	0	0	0
25m	0	0	0
30m	0	25	0
35m	0	30	0
40m	0	5	0
45m	0	0	0
50m	0	0	0
Total (sum / 10) =	0		0

Larger 50 x 20m plot

Length of woody debris >10cm wide & >0.5m long	Ø
Proportion of canopy sp. regeneration	Ø
Number of trees with hollows >5cm	Ø

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 II 𝍸 I	37	74
Native other (herb, fern, sedge, etc) tally - 𝍸 𝍸 IIII	14	28
Native shrub tally - —	0	0
Exotic tally - 𝍸 𝍸 𝍸 𝍸 I. Lolium in high density	21	42

PARSONS BRINCKERHOFF

Site ID: Na 2a.	Survey type:Quadrat 20m x 20m

	Species	Cover	Strata		Species	Cover	Strata
1	Acacia pendula	2	C	41	ELEOCHARIS PALLENS	2	G
2	STIPA ARISTA GLUMIS	6	G	42	FSOLEPIS SP		
3	LOLIUM PERENNE	4	G	43	RUMEX TENAX		
4	SCLEROLEANA MURICATA	3	S	44			
5	CAREX INERSA	4	G	45			
6	JUNCUS CONTINUOUS	3	G	46			
7	MARSILEA DRUMONDII	3	G	47			
8	OXALIS PERRENANS	2	G	48			
9	CENCHRUS MELI	2	G	49			
10	OXALIS CORNICULARIS	2	G	50			
11	SONCHUS OLE	2	G	51			
12	EULALIA AUREA	1	G	52			
13	HEDYPNOIS RHAGADIOLOIDES	3	G	53			
14	ENTEROPOGON ARTICULARIS	4	G	54			
15	TRIFOLIUM CAPETRE	2	G	55			
16	GOODENIA FASICULARIS	2	G	56			
17	SOLIVA SESSILIS	1	G	57			
18	TRIFOLIUM GLOMERATUM	2	G	58			
19	ALTERDATHERIA SP	2	G	59			
20	PHALARIS PARADOXA	3	G	60			
21	CARTHAMUS LANATUS	2	G	61			
22	CYCLOSPERMUM LEPTOPHYLLUM	2	G	62			
23	MEDICAGO POLY	2	G	63			
24	CYPERUS LIASPAN SSP HAS	2	G	64			
25	CYPERUS GRACILIS	3	G	65			
26	ECHIUM PLANTAGINEUM	1	G	66			
27	SIDA SPINOSA	1	G	67			
28	ASPERULA CONFERTUS	1	G	68			
29	HYPOCHIRIS RADICATA	2	G	69			
30	LEPIDIUM AFRICANUM	2	G	70			
31	TRIBULUS SP	3	G	71			
32	RUMEX BROWNII	1	G	72			
33	RAPISTRUM RUGOSUM	1	G	73			
34	CIRSIUM VULGARE	1	G	74			
35	TRIPIODISCUS PYGMEOUS	1	G	75			
36	PHYLOTTA CANESCENS	2	G	76			
37	ELEOCHARIS PLANA	1	G	77			
38	CARDAMINE HIRSUTA	1	G	78			
39	WAHLENBERGIA COMMUNIS	1	G	79			
40	Leiocarpa tomentosa	1	G	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	80	80	10	55	75
Native other grass	—	—	—	—	—
Native forb & other	5	10	50	5	10
Native shrub (<1m)	—	—	—	—	—
Exotic grass	15	10	10	35	5
Exotic forb & other	—	—	15	—	5
Leaf & stick litter	—	—	5	—	—
Rocks	—	—	—	—	—
Bare ground	—	—	10	—	5
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		Fire damage:	X
Clearing (inc. logging):	✓	Storm damage:	X
Cultivation (inc. pasture):	✓	Trampling:	✓
Soil erosion: near driveway	✓	Flood damage:	X
Firewood collection:	X	Feral herbivores: RABBITS	✓
Stock grazing: SCATS	✓	Other:	
Salinity:	x		

Star picket SW corner, plot facing 180° S

PB PARSONS BRINCKERHOFF 100 YEARS

Jervalong

Survey Site Form - BioBanking		Site ID: Na7a				Vegetation zone: VM2
Date	9-11-16	Surveyor(s): TB				
Waypoint ID	AS PER LAST YEAR	Photo numbers	5542	5543	5544	5545
Coordinates	E 0226625 N 6602296	Photo direction	(N)	E	S	W
Mapped Vegetation type: PILLIGAR BOX / POPLAR BOX			Condition:		Low	(Mod-good)
Slope: Gentle, Mod, Steep	**Aspect (degrees or cardinal):**		**Altitude:** 255m			

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 COMPACTION

Remnant / Old growth (uncleared): (Yes) / No / Undecided? UNDERSTOREY DEGRADED COWS

Vegetative Structure (formation) = OPEN WOODLAND

Ecologically Dominant Layer (EDL) - most biomass = CANOPY

Strata	Height interval	Median	Est. cover	Dominant Species & Dominance
E	-			
T1	8 - 20		10 - 40	E. PILLIGARENSIS E. POD
T2	-			
T3	-			
S1	0.5 - 1.8	1.2	0 - 10	BOXTHORN
S2	0.2 - 0.4	0.3	<1	SCLEROLAENA BIRCHII
G	0.1 - 0.4	0.2	40 - 60	STIPA SCABRA, STIPA VERT KOMMANDRA + RYTIDOSPERMA SPP CRETAN WEED LOLIUM

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

D BOXTHORN

50m Transect	10 Points - Foliage Projective Cover			Ground cover tally sheet, 50 points along 50m transect - every 1m record if plant intersects (hits) point		
Point	Canopy % (photos)	Midstorey %	Exotic %			
5m	0	0	0	Native grass tally -	Total (hits/50)	
10m	0	0	0	𝍸 𝍸 𝍸 𝍸 𝍸	28	56
15m	0	0	0			
20m	0	0	0			
25m	0	0	0			
30m	10	0	5	Native other (herb, fern, sedge, etc) tally -	Total (hits/50)	
35m	20	0	5	𝍸 𝍸	11	22
40m	35	0	30			
45m	35	0	90			
50m	20	0	45			
Total (sum / 10) =		0		Native shrub tally -	Total (hits/50)	
Larger 50 x 20m plot					0	0
Length of woody debris >10cm wide & >0.5m long			27			
Proportion of canopy sp. regeneration			0	Exotic tally -	Total (hits/50)	
Number of trees with hollows >5cm			3	𝍸 𝍸	15	30

Bare 𝍸

Adam Blakester Armidale UNSW

Regen RoG crossier

Cecile Van der burgh Utrecht University

CECILIA VANDENBERG ROUTES

+ Charles Sturt Uni

PARSONS BRINCKERHOFF

Site ID: 7a	Survey type:Quadrat 20m x 20m

Species	Cover	Strata	Species	Cover	Strata
1 LYCIUM FEROCISSIMA	2	S	41 AUSTROSTIPA VERTICILLATA	3	G
2 SCLEROLEANA BIRCHII	2	S	42 BROMUS MOLLIFORMIS	3	G
3 ENTEROPOGON ARTICULARIS	4	G	43 CARTHAMUS LAN	1	G
4 MEDYPNOIS RHAGADIOLOIDES	4	G	44 RUTIDOSPERMA LONGIFOLIA	1	G
5 TRIFOLIUM GLOMERATUM	4	G	45 OXALIS PERRENANS	2	G
6 CHLORIS VENTRICOSA	4	G	46 BOERHAVIA DOMINII	2	G
7 CENTUREA MELITENSIS	3	G	47 EUCHITON SPHAERICUS	1	G
8 VULPIA MYUROS	3	G	48 SCLEROLEANA MUR	2	S
9 STIPA SCABRA	5	G	49 RUTIDOSPERMA SETACEA	1	G
10 LOLIUM PERRENE	4	G	50 SIDA CUNNINGHAMII	1	G
11 STIPA ARISTAGLUMIS	3	G	51 HYPOCHAERIS RADICATA	2	G
12 DANCUS GLOCHINOIDES	1	G	52 EINADIA NUTAS	1	G
13 VITTADINIA MULLERI	3	G	53 ERODIUM CRINATUM	1	G
14 ERAGROSTIS LEPTOSTACHYA	2	G	54 SOLIVA SESSILIS	1	G
15 VITTADINIA MULLERI	2	G	55 DIGITARIA DIVERGATISSIMA	1	G
16 SIDA SPINOSA	2	G	56 SOLENGYNE BELLOIDES	1	G
17 RANUNCULUS PUMILO	2	G	57 POLYGONUM AVICULARE	1	G
18 CRASSULA SIEBERIANA	2	G	58 STIPA SETACEAE	2	G
19 DICHONDRA SPA	4	G	59		
20 EINADIA POLYGALIFOL	3	G	60		
21 PLANTAGO T	2	G	61		
22 CHLORIS TRUNCATA	4	G	62		
23 LEPIDIUM AFRICANUM	2	G	63		
24 SIDA CORRUGATA.	3	G	64		
25 PAVONIA HASTATA	3	G	65		
26 EUCALYPTUS POP	1	G	66		
27 HORDIUM VULGARE	2	G	67		
28 BRUNONIELLA AUST	2	G	68		
29 RUTIDOSPERMIT FULVUM	3	G	69		
30 HYPOCHAERIS RADICATA	1	G	70		
31 CRASSULA COLORATA	1	G	71		
32 SOLANUM =	1	G	72		
33 QUCINE TABACINA	1	G	73		
34 SONCHUS OLE.	1	G	74		
35 CYPERUS GRACILIS	2	G	75		
36 CAREX INUERSA	2	G	76		
37 LOMANDRA MULTIFLORA	2	G	77		
38 ABUTALIN OXY	1	G	78		
39 TRIFOLIUM CAPENSE	3	G	79		
40 AVENUA FATUA	1	G	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	50	30	65	20	40
Native other grass	—	—	—	—	—
Native forb & other	10	5	5	10	5
Native shrub (<1m)	—	—	5	5	—
Exotic grass	30	5	20	10	5
Exotic forb & other	—	—	5	5	5
Leaf & stick litter	—	—	—	—	—
Rocks	—	—	—	—	—
Bare ground	10	60	5	40	45
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		Fire damage:	x
Clearing (inc. logging):	✓	Storm damage:	x
Cultivation (inc. pasture):	✓	Trampling: COMPACTION	✓
Soil erosion:	x	Flood damage:	x
Firewood collection:	✓	Feral herbivores: RABBITS	✓
Stock grazing: COWS ONSITE +SCATS	✓	Other: SCATS.	
Salinity:	x		

Boxthorn recently treated by land manager IN DECENT CONDITION

SW corner, plot faces Nth

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 10 - AUG - 2016 (1.)

Site ID: both sides of proforma: BB1 (2.)

Survey type: BB, 50m, 20x20 (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, TB, PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: — (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Goonbri East

Photo number: N)5008 E)5009 S)5010 W)5011

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: T)5012 433m (8.)

Unique Point ID #: (9.)

	ZONE	EASTING	NORTHING	
	56	0236269	6612829	WP380
		0		

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 80°

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: Regrowth.

Community age estimate:

(11.) Ground Cover %: (12.)

Weeds %:	Bare soil	20
Canopy —	Litter	10
Sub-canopy —	Timber	10
Shrub —	Rock (type)	30
Ground 100	Vegetation (type)	30
	Total 100%	100

Vegetation community: (13.)

Mapped community:

Field Community: Narrow-leaved Ironbark White Cypress Pine

Structure and composition ❖ : (14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:	
Can T1	8 - 10m	0 - 20%	E. crebra	Eucalyptus decalbata
Sub T2	4 - 8m	10 - 50%	N. longifolia Wilga	Callitris glaucophylla
Shrub	0.8 - 3m	0 - 5%	Pimelea nova-angular Senna	O. betchii Dodonaea viscosa
Ground	0.1 - 0.4m	20 - 50%	Desmodium brachypodium Lindsae	Austrostipa scabra

❖ 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: BB1

Species	Cover (%)	Abundance (individuals)	Strata/ Growth	Species	Cover (%)	Abundance (individuals)	Strata/ Growth
1 Eucalyptus crebra	5	1		42			
2 Notalaea longifolia	20	4		43			
3 Wilga	40	8		44			
4 Callitris glaucophylla	10	5		45			
5 Pimelea nova-anglae	1	2		46			
6 O. betchi	5	12		47			
7 D. brachypodium	2	20		48			
8 D. viscosa	5	7		49			
9 M. glabra	0.4	20		50			
10 Senna (N) ant	1	1		51			
11 Austrostipa scabra	10	50		52			
12 Lindsaea	5	500		53			
13 Jasmine linear	0.4	20		54			
14 Vittadinia p	0.4	50		55			
15 Daucus glochinoidies	1	50		56			
16 Oxalis perenans	1	20		57			
17 Geranium solanderi	1	50		58			
18 Einadia hastata	1	10		59			
19 Carex appressa	1	12		60	N-32		
20 Glycine	1	20		61			
21 Arthrogallas arvensis	2	20		62			
22 Indogophora	5	5		63	E-5		
23 Chickweed	5	20		64			
24 Rchondra sp A	5	100		65			
25 Santalum	1	2		66			
26 Cheilanthies sieberi	0.4	10		67			
27 Solanum sp	0.4	20		68			
28 Whorehound Marrubum	1	20		69			
29 Galium gaud	0.4	20		70			
30 Parsonsea sp?	0.4	3		71			
31 Lepidium	0.4	1		72			
32 Alphitonia excelsa	5	1		73			
33 Cymbidium canicullatum	0.4	1		74			
34 Beyeria viscosa	1	7		75			
35 Calotis lapp	0.4	10		76			
36 Schelanthies distans	0.4	7		77			
37 Cyperus gracillis	0.4	2		78	Pigs		
38				79			
39				80	Cave nearby.		
40				81			
41				82			

Transect Number 205°	Number of hits (tally) / BB Transect orientation:	Total hits	%
Native over-storey cover (%)	20, 30, 5, 0, 30, 10, 30, 30, 0, 5	160	16
Native mid-story cover (%)	10, 20, 10, 25, 50, 60, 10, 30, 30, 10	255	25.5
Native ground cover grasses (%)	𝍸 ||||	9	18
Native ground cover shrubs (%)		-	-
Native ground cover other (%)	𝍸 𝍸 |||	13	26
Exotic plant cover (%)	𝍸 |||| 𝍸 𝍸 𝍸	9	18

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	24, 8, 16 = 38
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance BioBanking Method in 20 X 20 plot		
Cover in percentage (%) for each individual species	if cover <1%	Entered as 0.4% cover
	If cover 1-5%	Record exact % cover ie 1, 2, 3, 4, 5
	If cover over 5%	Record at 5% intervals
Abundance Rating measure abundance of individuals or shoots of each species	If less than 20	Count individuals, 1,2,3,4, 5, 6, 7,8,9,10,11,12,13,14,15,16,17,18, 19,20
	If over 20 are estimates in intervals	20,50,100,500,1000
	If over 1000 enter number if required	ie 1500

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 10 - Aug - 2016 (1.)

Site ID: BB2 (2.) — both sides of proforma

Survey type: BB, SO, 20x20 (3.) — Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: – (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure

Goombi East.

Photo number: N) S013 E) S015 S) S016 W) S017

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: 7) SO18 485m (8.)

Unique Point ID #: (9.)

	ZONE	EASTING	NORTHING	
	56	0236074	6612905	WP 381
		0		

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 200°

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: Weeds, posts, regrowth?

Community age estimate:

(11.) Ground Cover %: (12.)

Weeds %:	Bare soil	20
Canopy –	Litter	10
Sub-canopy –	Timber	10
Shrub –	Rock (type)	30
Ground 100	Vegetation (type)	30
	Total 100%	100

Vegetation community: (13.)

Mapped community:

Field Community: White Box Shrubby

Structure and composition ❖ : (14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can (T1)	8 - 10 m	20-30 %	E. albens
Sub (T2)	4 - 6 m	0-10 %	Wilga N. longiflia Callitris
Shrub	0.4 - 3 m	20-40%	D. viscosa B. elliptica
Ground	0.1 - 0.4 m	20-40%	A. scubra

❖ 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: BB2

Species	Cover (%)	Abundance (individuals)	Strata/ Growth	Species	Cover (%)	Abundance (individuals)	Strata/ Growth
1 E. albens	20	4		42			
2 C. glaucophylla	5	2		43			
3 N. longifolia	10	3		44			
4 B. elliptica	3	7		45			
5 D. viscosa	10	20		46			
6 Wilga	10	3		47			
7 A. scabra	10	100		48			
8 Des brachypodium	4	50		49			
9 O. betchi	1	12		50			
10 Lomandra longifolia	1	7		51			
11 Aristida ramosa	3	50		52			
12 Glossycne bidens	0.4	3		53			
13 Daucus gloch	2	100		54			
14 Boerhavia dominii	0.4	1		55			
15 Einadia hastata	0.4	15		56			
16 Oxalis perennans	0.4	10		57			
17 Sida cunninghamia	0.4	8		58			
18 Vittadinia BBL	0.4	10		59			
19 Pimelea nov-angular	0.4	3		60			
20 Cyperus gracilis	1	20		61	N 37		
21 Optunia stricta	0.4	2		62			
22 Olearia viscosa	5	5		63			
23 Cheilanthes sieberi	0.4	7		64	E 3		
24 Dichondra sp A	1	50		65			
25 Jasime linearea	0.4	5		66			
26 Indogaphora	0.4	10		67			
27 Wahlenbergia	0.4	20		68			
28 H. glabra	0.4	2		69			
29 Carex appressa	0.4	5		70			
30 Desmodium varians	0.4	3		71			
31 Chloris truncata	0.4	1		72			
32 Chickweed	0.4	10		73			
33 Geranium solanderi	1	50		74			
34 Einadia poly	0.4	2		75			
35 Solanum sp	1	4		76			
36 Rytidosperma sp	1	20		77			
37 Glycine	0.4	20		78			
38 Lily round ligulebar	0.4	12		79			
39 Lomandra multiflore	0.4	1		80			
40 Digitaria b. anglum	0.4	1		81			
41				82			

Transect Number 150°	Number of hits (tally) / BB Transect orientation:	Total hits	%
Native over-storey cover (%)	0, 0, 25, 10, 20, 20, 30, 20, 25, 0	150	15
Native mid-story cover (%)	20, 40, 35, 35, 20, 30, 30, 30, 40, 5	285	28.5
Native ground cover grasses (%)	𝍸 𝍸 |	11	22
Native ground cover shrubs (%)	𝍸 𝍸 |	11	22
Native ground cover other (%)	𝍸 𝍸 ||	12	24
Exotic plant cover (%)		-	-

Bare 𝍸 𝍸 𝍸 \|

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	14
2. Proportion of canopy species regeneration	1
3. Number of trees with hollows > 5 cm	0

Cover abundance BioBanking Method in 20 X 20 plot		
Cover in percentage (%) for each individual species	if cover <1%	Entered as 0.4% cover
	If cover 1-5%	Record exact % cover ie 1, 2, 3, 4, 5
	If cover over 5%	Record at 5% intervals
Abundance Rating measure abundance of individuals or shoots of each species	If less than 20	Count individuals, 1,2,3,4, 5, 6, 7,8,9,10,11,12,13,14,15,16,17,18, 19,20
	If over 20 are estimates in intervals	20,50,100,500,1000
	If over 1000 enter number if required	ie 1500

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 10-AUG-2016 (1.)

Site ID: both sides of proforma — BB3 (2.)

Survey type: BB, SO, 20×20 (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: — (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Goonbri - East

Photo number: N)5019 E)5020 S)5021 W)5022

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: 396m T)5023 (8.)

Unique Point ID #: WP 382 (9.)

	ZONE	EASTING	NORTHING
	56	0235751	6612868
		0	

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, (Mod), Steep Aspect: 210

Landform (Transect) : crest, ridge, upper slope, mid slope, (down slope), gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, (conglomerate), sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, (loam), (clay) organic, skeletal?

Evidence of disturbance:

Community age estimate:

(11.) Ground Cover %: (12.)

Weeds %:	Bare soil	10
Canopy	Litter	25
Sub-canopy	Timber	10
Shrub	Rock (type)	5
Ground	Vegetation (type)	50
	Total 100%	100

Vegetation community: (13.)

Mapped community:

Field Community: White Box Grassy (medium)

Structure and composition ❖ : (14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can (T1)	10 - 18m	10-30%	E. albens
Sub (T2)	4 - 8m	0-20%	Wilga
Shrub	0.3 - 3.5m	0-10%	Callitris Acacia decora Dodonaea viscosa
Grnd	0.1 - 0.3	20-50%	Austrostipa scabra.

❖ 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: BB3

	Species	Cover (%)	Abundance (individuals)	Strata/ Growth		Species	Cover (%)	Abundance (individuals)	Strata/ Growth
1	Euc albens	20	4		42	Arctotida ramosa	2	7	
2	W.lga	20	4		43	Spathuriela juncea	5	20	
3	C. glaucophylla	5	5		44	Rumex brownii	0.4	1	
4	Not longifolia	5	6		45	Austrostipa vert	5	50	
5	Dod viscosa	5	20		46				
6	Aust scabra	10	100		47				
7	Aer solanderi	1	20		48				
8	Indogophera	1	4		49				
9	Acacia decora	20	20		50				
10	Pachondra sp. A.	1	50		51				
11	Daucus gloch	2	100		52				
12	Vittadinia	0.4	10		53				
13	Solanum sp	0.4	4		54				
14	Oxalis perennans	0.4	7		55				
15	Maireana	0.4	15		56				
16	Arthropodium (wide)	0.4	7		57				
17	Glycine tabacina	0.4	3		58				
18	Einadia poly	0.4	2		59				
19	Carex appressa	1	12		60				
20	Sonchus oleraceus	0.4	4		61				
21	Sida cunninghamii	0.4	1		62				
22	Scaevola	0.4	1		63				
23	Chickweed	1	20		64				
24	O. betchi	0.4	6		65				
25	Desmodium brachy	0.4	15		66	Pigs			
26	Lomandra multiflora	0.4	3		67				
27	Cymbocephalus apetalus	0.4	7		68				
28	Opthia stricta	0.4	1		69				
29	Vittadinia sp2.	0.4	1		70				
30	Crassula	0.4	10		71	N-37			
31	Galium	0.4	7		72				
32	Cymbonotus lan	0.4	3		73				
33	Brachycuntan pop (?)	0.4	2		74	E-8			
34	Sida spinosa?	0.4	1		75				
35	Jasmine linear	0.4	2		76				
36	Cyperus gracilis	0.4	7		77				
37	Abutalon	0.4	2		78				
38	Chloris divercatum	0.4	3		79				
39	Maytenus cunninghamii	0.4	1		80				
40	Geranium sp	0.4	2		81				
41	Chloris truncata	0.4	2		82				

Transect Number 320	Number of hits (tally) / BB Transect orientation:	Total hits	%
Native over-storey cover (%)	30, 30, 15, 5, 15, 25, 30, 20, 10, 20,		
Native mid-story cover (%)	10, 5, 0, 0, 0, 20, 20, 10, 10, 10,		
Native ground cover grasses (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	16	32
Native ground cover shrubs (%)	𝍸 𝍸	2	4
Native ground cover other (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	14	28
Exotic plant cover (%)	𝍸 𝍸 𝍸	3	6

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	10, 4 =14
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	2

Cover abundance BioBanking Method in 20 X 20 plot		
Cover in percentage (%) for each individual species	if cover <1%	Entered as 0.4% cover
	If cover 1-5%	Record exact % cover ie 1, 2, 3, 4, 5
	If cover over 5%	Record at 5% intervals
Abundance Rating measure abundance of individuals or shoots of each species	If less than 20	Count individuals, 1,2,3,4, 5, 6, 7,8,9,10,11,12,13,14,15,16,17,18, 19,20
	If over 20 are estimates in intervals	20,50,100,500,1000
	If over 1000 enter number if required	ie 1500

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 1.	10-Aug 16
Site ID: both sides of proforma 2.	BB4
Survey type: 3. Include quadrate size, search area, transect length etc.	BB 50, 20x20
Recorders: 4. AC, DL, TB, PR, KL, SL, MS, SH, AR	
Stratification and patch ID: 5.	—
Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure	Ceantai - East
Photo number:	N)5024 E)5025 S)5026 W)5027

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: T) 50 28 8.

Unique Point ID #: 9. WP 383

	ZONE	EASTING	NORTHING
	56	0235482	6612875
		0	

GPS accuracy: ± metres 10. Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 200

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: Veg removal, grazing

Community age estimate: Collection of timber

11. Ground Cover %: 12.

Weeds %:	Bare soil	10
Canopy —	Litter	0
Sub-canopy —	Timber	5
Shrub —	Rock (type)	10
Ground 100	Vegetation (type)	75
	Total 100%	100

Vegetation community:

13.

Mapped community: Unspecified

Field Community:

Structure and composition ❖ :

14.

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can (T1)	—	—	—
Sub (T2)	—	—	— Scattered Callitris & wulga <1%
Shrub	—	—	—
Ground	0.1 – 0.4	40-60%	Aristida ramosa, Maireana microphylla, Eragrostis australasica, M. radicata, Vittadinia muelleri

❖ 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: BB4

Species	Cover (%)	Abundance (individuals)	Strata/ Growth	Species	Cover (%)	Abundance (individuals)	Strata/ Growth
1 Callitris glaucophylla				42			
2 Wilga				43			
3 Maireana microphylla				44			
4 Hyalosperma radicatum				45			
5 Vittadinia muelleri				46			
6 Enteropogon acicularis				47			
7 Aristida ramosa				48			
8 Trifolium sp				49			
9 Chenopodium silvestre				50			
10 Slender thistle				51			
11 Austrostipa sp.				52			
12 Eragrostis				53			
13 Juncea skeleton				54			
14 Lymbopogon refractus.				55			
15 Chloris truncata				56			
16 Vangated thistle				57			
17 Sida spinosa				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			

Sclerolaena microphylla Scattered

Exotic = 6

Native 11

Transect Number 150	Number of hits (tally) / BB Transect orientation:	Total hits	%
Native over-storey cover (%)	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	—	—
Native mid-story cover (%)	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0	—	—
Native ground cover grasses (%)	𝍸	5	5
Native ground cover shrubs (%)		0	0
Native ground cover other (%)	𝍸 𝍸 ||||	14	28
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 |||	38	76
	𝍸	5	10

Triglochin hypochaeris

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 BioBanking Method in 20 X 20 plot		
Cover in percentage (%) for each individual species	if cover <1%	Entered as 0.4% cover
	If cover 1-5%	Record exact % cover ie 1, 2, 3, 4, 5
	If cover over 5%	Record at 5% intervals
Abundance Rating measure abundance of individuals or shoots of each species	If less than 20	Count individuals, 1,2,3,4, 5, 6, 7,8,9,10,11,12,13,14,15,16,17,18, 19,20
	If over 20 are estimates in intervals	20,50,100,500,1000
	If over 1000 enter number if required	ie 1500

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 11 Aug 2016 (1.)

Site ID: both sides of proforma — BB7 (2.)

Survey type: BB 50, 20x20 (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: — (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Goon bri - West

Photo number: N) 5052 E) 5053 S) 5054 W) 5055

Location recorded with GPS # or Tablet: (7.)

1:100,000 MAP NAME: T) 5056 (8.)

Unique Point ID #: (9.)

	ZONE	EASTING	NORTHING	
	56	0233662	6612386	WP) 386
		0		E) 332

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 300

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: Clearing regrowth

Community age estimate: Cattle grazing recent.

(11.) Ground Cover %: (12.)

Weeds %:		
Canopy	Bare soil	20
	Litter	10
Sub-canopy	Timber	5
Shrub	Rock (type)	5
Ground	Vegetation (type)	60
	Total 100%	100

Vegetation community: (13.)

Mapped community: Ironbark dominated WB/YB/Blakelyi

Field Community:

Structure and composition ❖ : (14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can	6-10m	10-30 %	Eucalyptus Crebra Eucalyptus melliodora Eucalyptus albens
Shrub	0.3-3m	0-10 %	Callitris glaucophylla regrowth
Grnd	0.1-0.4	40-60 %	Austrostipa scabra

Transect Number 25°	Number of hits (tally) BB Transect orientation:	%
Native over-storey cover (%)	25, 20, 25, 25, 15, 25, 5, 5, 25, 20,	
Native mid-story cover (%)	0, 0, 5, 0, 5, 0, 0, 0, 0, 0,	
Native ground cover grasses (%)	||||| ||||| ||||| |||||	
Native ground cover shrubs (%)		
Native ground cover other (%)	|||||	
Exotic plant cover (%)	|||||	

❖ 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

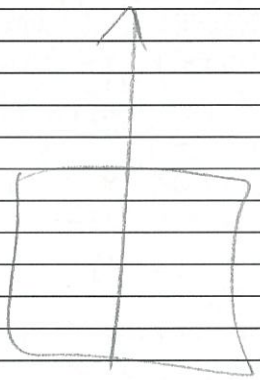
||||| ||||| ||||| ||||| |||

Bare other

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF | **VEGETATION SURVEY PROFORMA P2** | Site ID: B87 | 2.

Species	Presence	Strata	Species	Presence	Srtata
1 Eucalyptus albens	5	1	42		
2 Eucalyptus crebra	30	7	43		
3 Eucalyptus melliodora	10	3	44		
4 Callitris glaucophylla (J)	5	8	45		
5 Acacia decora	2	1	46		
6 Maireana microphylla	2	4	47		
7 Enteropogon acicularis	2	10	48		
8 Austrostipa scabra	20	500	49		
9 Chloris truncata	2	20	50		
10 Oxalis perennans	1	20	51		
11 Stackhousia viminalis	0.4	2	52		
12 Einadia hastata	0.4	15	53		
13 Sida corrugata	0.4	10	54		
14 Cyperus gracilis	2	20	55		
15 Einadia polygonoides	1	10	56		
16 Cyperidae	1	20	57		
17 Desmodium varians	0.4	2	58		
18 Sclerolaena	0.4	3	59		
19 Rostellularia adenodes	1	15	60		
20 Solanum	1	10	61		
21 Aristida vagans	2	20	62		
22 Einadia trigonos	0.4	5	63		
23 Vittadinia	0.4	2	64		
24 Dichondra sp A.	2	50	65		
25 Lomandra multiflora	1	3	66		
26 Swainsona galegifolia	4	20	67		
27 Hypochaeris radicata	2	20	68		
28 Glycine hairy	0.4	2	69		
29 Trifolium	2	20	70		
30 Boerhavia dominii	0.4	2	71		
31 Goodenia hederacea	0.4	3	72		
32 Brunonella australis	0.4	10	73		
33 Chrysocephalum apiculatum	0.4	1	74		
34			75		
35			76		
36			77		
37			78		
38			79		
39			80		
40			81		
41			82		



Transect Number	Number of hits (tally) BB Transect orientation:	%
Native over-storey cover (%)		
Native mid-story cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	12 m
2. Proportion of canopy species regeneration	0.5
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: 11 Aug 2016 (1.)

Site ID: both sides of proforma: 838 (2.)

Survey type: BB, 50, 20×20 (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: — (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Coombi - West

Photo number: N)5058 E)5059 S)5060 W)5061

Location recorded with GPS # or Tablet: (7.)

1:100,000 MAP NAME: T) 5062 (8.)

Unique Point ID #: (9.)

	ZONE	EASTING	NORTHING	
	56	0 283294 7	6611710	WD) 387
		0		E) 307

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect:

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: clearing weeds, grazing

Community age estimate: erosion of water bank

(11.) Ground Cover %: (12.)

Weeds %:		Ground Cover %:	
Canopy	6	Bare soil	5
		Litter	25
Sub-canopy	6	Timber	10
Shrub	6	Rock (type)	0
Ground	100	Vegetation (type)	60
		Total 100%	100

Vegetation community:

(13.)

Mapped community: WB

Field Community: Yellow Blood (Bakely) Woodland

Structure and composition ❖ :

(14.)

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can (T1)	10 - 20 m	20-35 %	E. blakelyi + melliodora
Shrub	0.3 - 3 m	5-10 %	Wilga, pimelea
Grnd	0.1 - 0.8 m	40-80%	Austrostipa Carex appressa

Transect Number 260	Number of hits (tally) BB Transect orientation:	%	
Native over-storey cover (%)	25, 30, 35, 25, 30, 10, 5, 0, 0, 0	160	16
Native mid-story cover (%)	6, 15, 5, 0, 5, 0, 0, 0, 0, 10,	45	4.5 ~~9~~
Native ground cover grasses (%)	𝍸 𝍸 𝍸 𝍸 11	12	24
Native ground cover shrubs (%)	1	1	2
Native ground cover other (%)	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	25	50
Exotic plant cover (%)	𝍸 𝍸	10	20

❖ 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: BB8 | 2.

Species	Presence	Strata	Species	Presence	Srtata
1 Eucalyptus blakelyi	15	4	42		
2 Eucalyptus melliodora	5	1	43		
3 Wilga	15	8	44		
4 Maireana microphylla	4	5	45		
5 Solanum sp	2	5	46		
6 Dichondra sp. A.	5	100	47		
7 Opuntia stricta	1	2	48		
8 Acacia decora	1	2	49		
9 Pimelea non-virgata	2	2	50		
10 Carrichtera glaucophylla	2	1	51		
11 Hypochaeris radicata	1	20	52		
12 Oxalis perrenans	1	20	53		
13 Sida spinosa	0.4	3	54		
14 Plantago (N)	0.4	2	55		
15 Lymbonotus laxus	2	10	56		
16 Convolvulus multiflora	0.4	2	57		
17 Trifolium sp	1	20	58	N - 31	
18 Asperula conferta	1	20	59		
19 Chrysocephalum apiculatum	5	50	60		
20 Swainsona galegifolia	2	15	61		
21 Cyperus gracilis	5	50	62	E - 5	
22 Austrostipa scabra	10	50	63		
23 Carex appressa	5	50	64		
24 Dichanthium sericeum	0.4	1	65		
25 Nangalea thistle	0.4	2	66		
26 Geranium solanderi	0.4	7	67		
27 Austrostipa verticillata		100	68		
28 Sida cunninghamii	0.4	2	69		
29 Vittadinia cuneata	1	~~20~~ 12	70		
30 Einadia hastata	0.4	3	71		
31 Sida corrugata	0.4	1	72		
32 Glycine tabacina	0.4	4	73		
33 Daucus glochidiatus	0.4	2	74		
34 Rumex brownii	1	3	75		
35 O. betchii	1	3	76		
36 Sonchus oleraceus	0.4	2	77		
37			78		
38			79		
39			80		
40			81		
41			82		

Transect Number	Number of hits (tally) BB Transect orientation:	%
Native over-storey cover (%)		
Native mid-story cover (%)		
Native ground cover grasses (%)	PTO	
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	11
2. Proportion of canopy species regeneration	1
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: 11 Aug 1.

Site ID: BB9 (both sides of proforma) 2.

Survey type: BB 20x20, 50 (Include quadrate size, search area, transect length etc.) 3.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR 4.

Stratification and patch ID: 5.

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure

Quarlon - West

Photo number: N) 5063 E) 5064 S) 5065W) 5066

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: T) 5067 8.

Unique Point ID #: 9.

	ZONE	EASTING	NORTHING	
	56	0232804	6611931	WD) 389
		0		E) 322

GPS accuracy: ± metres 10. Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 130°

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: clearing

Community age estimate:

11. Ground Cover %: 12.

Weeds %:		
Canopy	—	Bare soil 10
		Litter 0
Sub-canopy	—	Timber 0
Shrub	—	Rock (type) 10
Ground	100	Vegetation (type) 80
		Total 100% 100

Vegetation community:

13.

Mapped community:

Field Community: WB DNG

Structure and composition ❖ :

14.

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
—	—	—	—
—	—	—	—
ground	0.1 - 0.5	60-100%	Austrodanthonia / Bothriochloa? Hypochaeris radicata.

Transect Number 85°	Number of hits (tally) BB Transect orientation:	%	
Native over-storey cover (%)	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	0	
Native mid-story cover (%)	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	0	
Native ground cover grasses (%)	𝍸 𝍸 𝍸 𝍸 II	22	44
Native ground cover shrubs (%)		—	—
Native ground cover other (%)	𝍸 𝍸 𝍸 I	16	32
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 𝍸 II	32	64

❖ 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

Bare 1

PARSONS BRINCKERHOFF

PARSONS BRINCKERHOFF **VEGETATION SURVEY PROFORMA P2** Site ID: BB9

Species	Presence	Strata	Species	Presence	Srtata
1 Aristida/Bothriochloa?	20	100	42 No head grazing evident.		
2 Hypochaeris radicata	20	100	43		
3 Chrysanthis sieberi	2	10	44		
4 Callitris glaucophylla	5	3	45		
5 Panicum sp	5	20	46		
6 Vittadinia muelleri	20	100	47		
7 Enteropogon acicularis	10	50	48		
8 Oxalis perennans	10	20	49		
9 Maireana microphylla	1	7	50		
10 Sida corrugata	0.4	2	51		
11 Cyperus gracilis	20	100	52		
12 Crassula sieberiana	10	500	53		
13 Cyperus	5	20	54		
14 Turbinn sp	5	50	55		
15 Sida cunninghamii	0.4	2	56		
16 Scleroleana	0.4	2	57		
17			58		
18			59		
19			60		
20			61 N - 14		
21			62		
22			63		
23			64 E - 2		
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) BB Transect orientation:	%
Native over-storey cover (%)		
Native mid-story cover (%)		
Native ground cover grasses (%)	PTO	
Native ground cover shrubs (%)		
Native ground cover other (%)		
Exotic plant cover (%)		

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%

PARSONS BRINCKERHOFF

VEGETATION SURVEY PROFORMA P1

Date: 11 Aug 2016 (1.)

Site ID: both sides of proforma: BB 10 (2.)

Survey type: BB, 20x20, 50 (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Coonbri - West

Photo number: N)5068 E)5069 S)5070 W)5071 & 3

Location recorded with GPS # or Tablet: (7.) 1:100,000 MAP NAME: T)5072 (8.)

Unique Point ID #: (9.)

ZONE	EASTING	NORTHING	
56	0232980	6613292	WP)390
	0		E)364

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, (Mod), Steep Aspect: 150

Landform (Transect) : crest, ridge, upper slope, (mid slope), down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, (?)

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, (skeletal)?

Evidence of disturbance: clearing

Community age estimate:

(11.) Ground Cover %: (12.)

Weeds %:		
Canopy	Bare soil	10
Sub-canopy	Litter	20
Shrub	Timber	10
Ground	Rock (type)	5
	Vegetation (type)	55
	Total 100%	100

Vegetation community: (13.)

Mapped community:

Field Community: Narrow-leaved Ironbark.

Structure and composition ❖ : (14.)

Strata[!]:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
CAN (T1)	0-16m	10-30%	Eucalyptus crebra
Sub (T2)	3-5m	0-10%	Callitris glaucophylla
shrub	0.3-3.5m	10-30%	Wilga Acacia decora. Juv callitris
Grnd	0.1-0.6m	40-60%	Aristida, Austrostipa scabra

Transect Number 90°	Number of hits (tally) BB Transect orientation:	%
Native over-storey cover (%)	10, 0, 0, 0, 0, 0, 20, 25, 30, 25	110 (11.0)
Native mid-story cover (%)	5, 10, 60, 50, 30, 35, 60, 50, 60, 35	375 (37.5)
Native ground cover grasses (%)	5 5 5 5 5	25 (50)
Native ground cover shrubs (%)		—
Native ground cover other (%)	5 1 2	7 (14)
Exotic plant cover (%)		—

Bare 5 5 5 1

❖ 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

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PARSONS BRINCKERHOFF **VEGETATION SURVEY PROFORMA P2** Site ID: BB10

	Species	Presence	Strata		Species	Presence	Srtata
1	Eucalyptus crebra	20	3	42			
2	Callitris glaucophylla	30	20	43			
3	Wilga	5	2	44			
4	Acacia decora	5	20	45			
5	Austrostipa scabra	10	100	46			
6	Dichondra repens	10	100	47			
7	Sida corrugata	0.4	4	48			
8	Dichondra sp A.	1	20	49			
9	Daucus glochidiatus.	1	20	50			
10	Crassula sieberiana	3	50	51			
11	Desmodium brachypodum	1	20	52			
12	Parsonsia	0.4	4	53			
13	Brunonella australis	2	20	54			
14	Einadia polygonoides.	1	15	55			
15	Desmodium varians.	0.4	4	56			
16	Vittadinia	1	10	57			
17	Glycine tabacina	1	10	58			
18	Chellanthes sieberi	2	20	59			
19	Cheilanthes distans	2	20	60			
20	Lomandra multiflora	0.4	3	61			
21	Enteropogon acicularis	5	50	62			
22	O. bettelii	2	20	63			
23	Oxalis perennans.	1	20	64	N - 37		
24	Cassinia quinquefaria	0.4	1	65			
25	Glossogyne bidens	0.4	1	66			
26	Geranium solanderi	0.4	2	67			
27	Cudweed	1	20	68	E - 4		
28	Opuntia stricta	0.4	1	69			
29	Notalaea longifolia	2	2	70			
30	Indigofera adesmiifolia	0.4	1	71			
31	Solanum sp	1	10	72			
32	Digitaria breviglumis	5	50	73			
33	Einadia nutans	0.4	2	74			
34	Plantago (R)	0.4	3	75			
35	Arthropodium	0.4	1	76			
36	Chloris divaricata	2	20	77			
37	Rumex crispus	0.4	2	78			
38	Psydrax oleifolia	0.4	1	79			
39	Pavonia hastata.	0.4	2	80			
40	Carex gaudichaudiana	0.4	2	81			
41	Calotis cuneifolia	0.4	1	82	Hypochaeris radicata	0.4	7

Transect Number	Number of hits (tally) BB Transect orientation:	%
Native over-storey cover (%)		
Native mid-story cover (%)		
Native ground cover grasses (%)		
Native ground cover shrubs (%)	DTO	
Native ground cover other (%)		
Exotic plant cover (%)		

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	31
2. Proportion of canopy species regeneration	1
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%

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VEGETATION SURVEY PROFORMA P1

Date: 11 Aug 2016 (1.)

Site ID: both sides of proforma — BB11 (2.)

Survey type: BB, 20x20, 50 (3.)
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR (4.)

Stratification and patch ID: (5.)

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Coombi - West

Photo number:
N) 5073 E) 5074 S) 5075 W) 5076

Location recorded with GPS # or Tablet: (7.)

1:100,000 MAP NAME: T) 5077 (8.)

Unique Point ID #: (9.)

	ZONE	EASTING	NORTHING	
	56	0232979	6613086	WP) 391
		0		E) 348

GPS accuracy: ± metres (10.)

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 60

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel, ?

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: regrowth callitris

Community age estimate:

(11.) Ground Cover %: (12.)

Weeds %:			
Canopy	0	Bare soil	5
		Litter	25
Sub-canopy	0	Timber	10
Shrub	0	Rock (type)	0
Ground	0	Vegetation (type)	60
		Total 100%	100

Vegetation community:

(13.)

Mapped community:

Field Community: White Box Grassy

Structure and composition ❖ :

(14.)

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can (T1)	8 - 16 m	0-30 %	Eucalyptus albens.
Sub. (T2)	3 - 6 m	0-10 %	Callitris glaucophylla Wilga
Shrub	0 4-3 m	5-10 %	Juv callitris Nicolaitche Acacia decora
Ground	0.1 - 0.6 m	30-50 %	Austrostipe scabra Aristida

❖ 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

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PARSONS BRINCKERHOFF **VEGETATION SURVEY PROFORMA P2** Site ID: BB11

	Species	Cover (%)	Abundance (individuals)	Strata/ Growth		Species	Cover (%)	Abundance (individuals)	Strata/ Growth
1	Eucalyptus albens	20	4		42				
2	Callitris glaucophylla	15	20		43				
3	Wilga	5	3		44				
4	Notelaea longifolia	2	3		45				
5	Acacia decora	2	12		46				
6	Solanum sp	0.4	2		47				
7	Bursaria spinosa	0.4	200	S	48				
8	Austrostipa scabra	15	100		49				
9	Austrostipa ramosa	10	50		50				
10	Oxalis perrenans	0.4	20		51				
11	Dichondra sp A	0.4	20		52				
12	Sonchus oleraceus	0.4	5		53				
13	Geranium solanderi	0.4	30		54				
14	Plantago (N) sp	0.4	2		55				
15	Rumex crispus	0.4	3		56				
16	Einadia hastata	0.4	3		57				
17	O. beteli	1	100	10	58				
18	Convolvulus wallisii	0.4	2		59				
19	Desmodium brachypodium	3	80		60				
20	Austrostipa verticillata	10	50		61				
21	Sida cunninghamii	0.4	3		62				
22	Lily (thin leaved)	0.4	1		63				
23	Cyperus gracilis	2	50		64	E = 6			
24	Chenopodium stelosum	0.4	20		65				
25	Vittadinia cuneata	1	20		66				
26	Desmodium varians	0.4	5		67	N = 34			
27	Glycine tabacina	0.4	3		68				
28	Daucus glochidiatus	0.4	20		69				
29	Hypochaeris radicata	0.4	10		70				
30	Sida corrugata	0.4	3		71				
31	Chloris truncata	5	20		72				
32	Maireana microphylla	1	5		73				
33	Pimelea non-glauca	1	10		74				
34	Sclerolaena	2	4		75				
35	Cynodon dactylon	0.4	10		76				
36	Crassula sieberiana	0.4	20		77				
37	Weed	0.4	2		78				
38	Vittadinia muelleri	1	10		79				
39	Senecio vagus	0.4	3		80				
40	Chenopodium auricomum	0.4	20		81				
41					82				

Transect Number 200	Number of hits (tally) / BB Transect orientation:	Total hits	%
Native over-storey cover (%)	25, 20, 15, 5, 0, 0, 5, 5, 20	10 105	10.5
Native mid-story cover (%)	0, 0, 5, 0, 0, 10, 0, 0, 0, 5	5 20	0 18
Native ground cover grasses (%)	𝍸 𝍸 𝍸

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VEGETATION SURVEY PROFORMA P1

Date: 11 Aug 2016

Site ID: both sides of proforma BB12 2.

Survey type: BB, 20×20, 50 3.
Include quadrate size, search area, transect length etc.

Recorders: AC, DL, (TB), PR, KL, SL, MS, SH, AR 4.

Stratification and patch ID: — 5

Location details: Property name, Lot Plan #, Road Name, Side of Road, land tenure
Coombi - West

Photo number:
N) 5078 E) 5079 S) 5080 W) 5081
T) 5082

Location recorded with GPS # or Tablet: 7 1:100,000 MAP NAME: 8.

Unique Point ID #: 9.

	ZONE	EASTING	NORTHING	
	56	0233129	6612890	WP 392
		0		E 336

GPS accuracy: ± metres 10.

Note: All waypoints should be recorded in map datum WGS 84

Habitat Assessment & other site description notes:

Slope: Gentle, Mod, Steep Aspect: 60

Landform (Transect) : crest, ridge, upper slope, mid slope, down slope, gully, flat, Depression, watercourse, escarpment, terrace

Geology: basalt, granite, conglomerate, sandstone, siltstone, mudstone, shale, alluvium, Limestone, metamorphic, gravel (?)

Nearest Drainage line / catchment:

Soil: sand, loam, clay organic, skeletal?

Evidence of disturbance: clearing, weeds

Community age estimate: grazing

11. Ground Cover %: 12.

Weeds %:		
Canopy	0	Bare soil 5
		Litter 60
Sub-canopy	0	Timber 10
Shrub	0	Rock (type) 5
Ground	100	Vegetation (type) 20
		Total 100% 100

Vegetation community:

13.

Mapped community:

Field Community: Silver-leaved Ironbark

Structure and composition ❖ :

14.

Strata!:	Height: range & median	% foliage cover*:	Dominant spp. and dominance¤:
Can (T1)	6 - 8 m	0-20 %	Eucalyptus melanophloia
Sub (T2)	3 - 6 m	0-10 %	Callitris glaucophylla, wilga
Shrub	0.4 - 2 m	0-5 %	Melaleuca uncinata
Ground	0.1 - 0.5 m	40-60 %	Aristida ramosa, Anthosperma scabra

❖ 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: BB12

	Species	Cover (%)	Abundance (individuals)	Strata/ Growth	Species	Cover (%)	Abundance (individuals)	Strata/ Growth
1	Eucalyptus melaroplon	30	4		42			
2	Callitris glaucophylla	15	20		43			
3	Dichanthium sericeum	15	100		44			
4	Aristida ramosa	15	100		45			
5	Hyppochaeris radicata	2	50		46			
6	Wilga	5	8		47			
7	Swainsona galegifolia	1	3		48			
8	Solanum sp	1	20		49			
9	Dichanthium sp A.	2	50		50			
10	Cyperus gracilus	2	50		51			
11	Pimelea cor-angulata	1	6		52			
12	Rumex crassus brownii	0.4	2		53			
13	Enneapogon lastatus	0.4	10		54			
14	Nostalgeia longifolia	1	2		55			
15	Geranium solanderi	1	20		56			
16	Cymbopogon ambiguus	0.4	4		57			
17	Convolvulus erubescens	0.4	6		58			
18	Glycine tabacina	0.4	10		59			
19	Enneapogon polyphyllus	0.4	10		60			
20	Lindsaea arcuata	2	50		61			
21	Cressa cretica	0.4	2		62			
22	Daucus glochidiatus	1	20		63			
23	Sonchus oleraceus	0.4	5		64			
24	Rhodanthe floribunda	0.4	5		65			
25	D. setchellii	1	10		66			
26	Brunoniella australis	0.4	10		67			
27	Digitaria brownii	2	10		68			
28	Rumex dumosa conglomerata	0.4	7		69			
29	Crassula sieberiana	0.4	20		70			
30	Tribulus sp	1	50		71			
31	weed	1	20		72			
32	Sida cunninghamii	1	20		73			
33	Oxalis perennans	1	20		74			
34	Cheilanthes sieberi	#1	10		75			
35	Ostrea stricta	0.4	1		76			
36	Glycine clandestina	0.4	1		77			
37	Vittadinia toothed	0.4	1		78			
38	Desmodium varians	0.4	1		79			
39	Cymbopogon refractus	0.4	1		80			
40	Eragrostis sp	0.4	1		81	Shrub	1	0.4
41	Petrophagia nanteuilii	0.4	1		82	Chloris divaricata	0.4	10

N = 32.

E = 9

Transect Number 210	Number of hits (tally) / BB Transect orientation:	Total hits	%
Native over-storey cover (%)	25, 5, 0, 0, 0, 0, 0, 0, 0, 0	30	0.3
Native mid-story cover (%)	10, 10, 10, 15, 0, 5, 20, 10, 10, 10, 10	110	11.0
Native ground cover grasses (%)	𝍸 𝍸 𝍸 𝍸	20	40
Native ground cover shrubs (%)		-	-
Native ground cover other (%)	𝍸 𝍸 𝍸 𝍸 1	26	52
Exotic plant cover (%)	𝍸 𝍸 𝍸 𝍸 1	21	42

Larger 50 X 20 m Plot	
1. Length of Woody debris >10cm wide & > 0.5 m long	26, 4, =30
2. Proportion of canopy species regeneration	0
3. Number of trees with hollows > 5 cm	0

Cover abundance BioBanking Method in 20 X 20 plot		
Cover in percentage (%) for each individual species	if cover <1%	Entered as 0.4% cover
	If cover 1-5%	Record exact % cover ie 1, 2, 3, 4, 5
	If cover over 5%	Record at 5% intervals
Abundance Rating measure abundance of individuals or shoots of each species	If less than 20	Count individuals, 1,2,3,4, 5, 6, 7,8,9,10,11,12,13,14,15,16,17,18, 19,20
	If over 20 are estimates in intervals	20,50,100,500,1000
	If over 1000 enter number if required	ie 1500

ATTACHMENT B – FAUNA SPECIES RECORDED

Table B.1 Microchiropteran bat species recorded at Jerralong BOA

MICROCHIROPTERAN BAT SPECIES		NUMBER RECORDED DURING OCTOBER 2016	TSC ACT[1]	EPBC ACT[2]
COMMON NAME	SCIENTIFIC NAME			
Chocolate Wattled Bat	*Chalinolobus morio*	2	-	-
Eastern Falsistrellus	*Falsistrellus tasmaniensis*	2	-	-
Inland Cave Bat	*Vespadelus troughtoni*	3	-	-
Inland Freetail Bat	*Mormopterus petersi*	1	-	-
Inland Freetail Bat	*Mormopterus petersi*	260	-	-
Little Forest Bat	*Vespadelus vulturnus*	1	-	-
Southern Freetail bat	*Mormopterus planiceps*	2	-	-
Yellow-bellied Sheathtail Bat	***Saccolaimus flaviventis***	**1**	**V**	**-**

1) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the TSC Act.
2) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the EPBC Act.

Table B.2 Bird species recorded in the study area

COMMON NAME	SCIENTIFC NAME	TSC ACT[1]	EPBC ACT[2]	NA 1A	NA 1B	NA 2A	NA 2B	NA 7A	NA 7B	OPPORTUNISTIC
Apostlebird	*Struthidea cinerea*	-	-		2	4	1	3	4	
Australian King-Parrot	*Alisterus scapularis*	-	-		3					
Australian Magpie	*Cracticus tibicen*	-	-		7		1		3	
Australian Raven	*Corvus coronoides*	-	-	2		2				
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	-	-				1			
Crested Pigeon	*Ocyphaps lophotes*	-	-		2			1		
Dollarbird	*Eurystomus orientalis*	-	-							
Eastern Rosella	*Platycercus eximius*	-	-		1	2	3	7	5	
Galah	*Cacatua roseicapilla*	-	-			7	3	8		
Grey Butcherbird	*Cracticus torquatus*	-	-					2	3	
Grey-crowned Babbler	***Pomatostomus temporalis***	**V**	**-**							✓
Little Corella	*Cacatua sanguinea*	-	-	2	2					
Little Lorikeet	***Glossopsitta pusilla***	**V**	**-**							✓

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www.wsp.com

COMMON NAME	SCIENTIFC NAME	TSC ACT[1]	EPBC ACT[2]	NA 1A	NA 1B	NA 2A	NA 2B	NA 7A	NA 7B	OPPORTUNISTIC
Magpie-lark	*Grallina cyanoleuca*	-	-			2	3			
Musk Lorikeet	*Glossopsitta concinna*	-	-				8			
Noisy Miner	*Manorina melanocephala*	-	-			4	1	5	8	
Pied Butcherbird	*Cracticus nigrogularis*	-	-			1	2	1		
Red-rumped Parrot	*Psephotus haematonotus*	-	-	1	1		2			
Rufous Songlark	*Cinclorhamphus mathewsi*	-	-		1					
Rufous Whistler	*Pachycephala rufiventris*	-	-	2						
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	-	-	2	3					
Spotted Pardalote	*Pardalotus punctatus*	-	-		1					
Striated Pardalote	*Pardalotus striatus*	-	-		1					
Sulphur-crested Cockatoo	*Cacatua galerita*	-	-	4			1	3		
Superb Fairy-wren	*Malurus cyaneus*	-	-	1	3					
Weebill	*Smicrornis brevirostris*	-	-	1	2					
Western Gerygone	*Gerygone fusca*	-	-	1						
White-faced Heron	*Egretta novaehollandiae*	-	-			1		2		
White-winged Chough	*Corcorax melanorhamphos*	-	-	3						
White-winged Triller	*Lalage sueurii*	-	-	1						
Willie Wagtail	*Rhipidura leucophrys*	-	-	1						
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	-	-	4	2					

1) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the TSC Act.
2) Listed as Vulnerable (V), Endangered (E) or Critically Endangered (CE) under the EPBC Act.

Appendix D

Nioka North and Sunshine BOA Field Survey Report

Idemitsu Pty Ltd

Biodiversity Survey Report for Sunshine and Nioka North

29 May 2015

PARSONS BRINCKERHOFF

Document information
Client: Idemitsu Pty Ltd Title: Biodiversity Survey Report for Sunshine and Nioka North Document No: 2200554A-ENV-REP-001 RevB Date: 29 May 2015

Rev	Date	Details
A	14/04/2015	Original
B	14/05/2015	Draft
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Author, Reviewer and Approver details			
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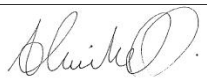
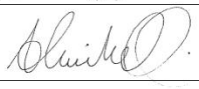
Reviewed by:	Alex Cockerill	Date: 14/05/2015	Signature: 
Approved by:	Alex Cockerill	Date: 29/05/2015	Signature: 

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Glossary

BMP	Biodiversity Management Plan
BNCCA Act	Brigalow and Nandewar Community Conservation Area Act 2005
BOAs	Biodiversity Offset Areas
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
CoA	Conditions of Approval
DBH	Diameter at breast height
DoE	Department of the Environment
DP&I	NSW Department of Planning and Infrastructure
DRE	NSW Department of Trade and Investment – Division of Resources & Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EEC	Endangered Ecological Community
EPL	Environment Protection License
FM Act	Fisheries Management Act 1994
ha	Hectares
LGA	Local Government Area
MOP	Mining Operations Plan
NES	National Environmental Significance
NIWAC	Northern Inland Weeds Advisory Committee
NSW	New South Wales
NV Act	Native Vegetation Act 2003
NW Act	Noxious Weeds Act 1993

RMP	Rehabilitation Management Plan
OEH	NSW Office of Environment and Heritage
Part 3a	Part 3a of Environmental Planning and Assessment Act, 1979
ROM	Run of Mine
TSC Act	Threatened Species Conservation Act 1995
WIRES	Wildlife Information and Rescue Service
WoNS	Weed of National Significance

1. Introduction

This report presents the findings of the baseline flora and fauna field surveys completed at Biodiversity Offset Areas (BOAs) that may be acquired as additional BOAs to offset impacts associated with the Boggabri Coal Project (the Project), managed by Boggabri Coal Pty Limited (Boggabri Coal).

The *Continuation of Boggabri Coal Biodiversity Offset Strategy* (Biodiversity Offset Strategy) {Parsons Brinckerhoff, 2010 #3485} was developed as part of the Project's Environmental Assessment which was granted approval by the Director-General of the Department of Planning and Infrastructure under Schedule 3 of the *Environmental Planning and Assessment Act 1979.* This Biodiversity Offset Strategy outlined five distinct Biodiversity Offset Areas (BOAs) that create direct linkages or key stepping stones for a Regional East-West Wildlife Corridor (refer Figure 1.1):

- Mallee BOA (2,066 ha)
- Merriendi BOA (547 ha)
- Myall Plains BOA (481 ha)
- Namoi BOA (4,229 ha)
- Wirrilah BOA (1,047 ha).

In addition to these five BOAs the Biodiversity Offset Strategy required the acquisition of an additional 1000 ha of BOAs that were to include the *'protection of 650 ha of Box Gum Grassy Woodland ecological community and the restoration of 430 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community as listed under the TSC Act'.*

Since the Project approval Boggabri Coal has acquired two BOAs to fulfil the additional 1000 ha requirement outlined in the Biodiversity Offset Strategy. These two properties include:

- Nioka North BOA (917 ha)
- Sunshine BOA (1,819 ha).

These two biodiversity offsets contain remnant vegetation which will complement and adjoin high quality existing vegetation and will extend the Regional East-West Wildlife Corridor. An important environmental corridor that historically linked Leard State Forest with the Nandewar Range, Namoi River and large vegetation remnants to the west. The Biodiversity Offset Strategy (Parsons Brinckerhoff 2010) aims to recreate habitat linkages within this corridor.

This report outlines the results of the ecological surveys within the offset sites and the condition of the vegetation. The results of this report will be incorporated into the Biodiversity Management Plan (BMP) that has been developed by Boggabri Coal to provide recommendations for the management and restoration of the sites as biodiversity offsets.

1.1 Scope of report

This report is survey report that presents and summaries the terrestrial ecological surveys within of the two biodiversity offset sites. These surveys provide an ecological inventory of the two sites and an assessment of the condition of the vegetation within the sites.

With these objectives in mind, the aims of this report are to:

- Present the results of current surveys.

- Determine and describe the characteristics and condition of the vegetation communities and flora and fauna habitats within the study area.
- Determine the occurrence, or likelihood of occurrence, of threatened species, populations and communities (biodiversity) listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* within the study area.
- Provide recommendations for management for biodiversity conservation.

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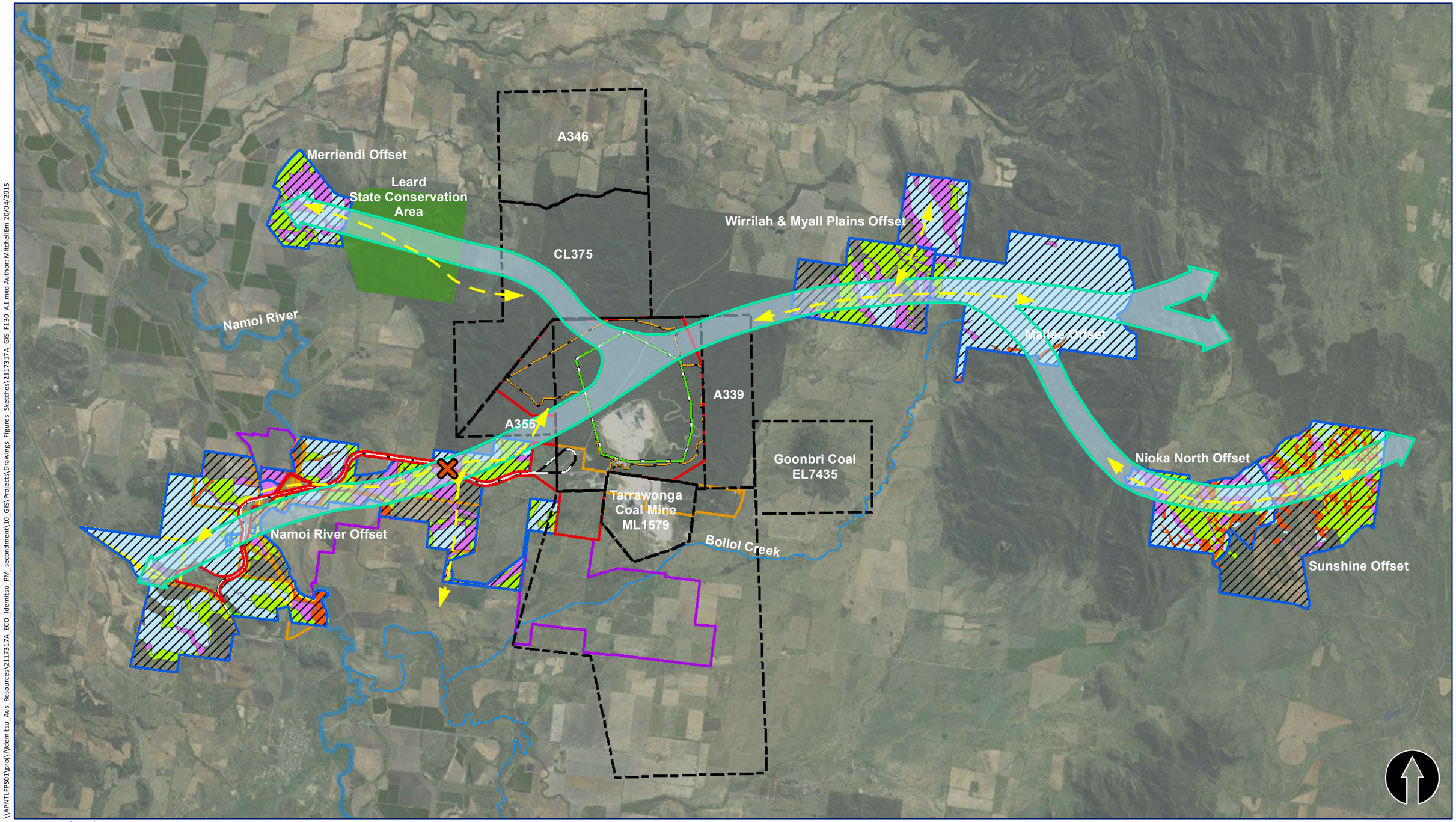


Source: ESRI (2015)

- Proposed Rail Loop
- Project Boundary
- EIS Mine Disturbance (Boggabri Existing)
- Proposed Disturbance Limit (Boggabri Extension)
- Mine Tenement
- Private Ownership within ZOA
- Crown Land
- Boggabri Coal Pty Limited
- Mining Joint Ownership
- Barrier location
- Biodiversity offset property
- Existing Mobile Movement Pathway
- Semi-mobile Movement Pathway

Fauna habitat

- Derived Grassland
- Grassy Woodland on fertile soils
- Riverine Woodland
- Shrubby Woodlands/Open Forest on skeletal soils

0 2 4 6 km

Figure 1.1
Location of the seven biodiversity offset areas and the regional east west wildlife corridor

2. Methods

This chapter details the desk-based and field methods used in surveying the current environment as well as the vegetation condition assessment methods.

2.1 Definitions

For the purpose of this report the following definitions apply:

- **Study area:** is defined as the two BOAs known as Sunshine and Nioka North.
- **Locality:** the area within 10 km of the study area.
- **Region:** a bioregion defined in a national system of bioregionalisation. For this study this is the Brigalow Belt South, Namoi sub-region as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).
- **Remnant Box Gum Woodland –** vegetation communities that are consistent with the Box Gum Woodland community listed under the EPBC Act and /or TSC Act (dependent upon condition) that retain a native over storey.
- **Box Gum Woodland (Derived Native Grassland) -** vegetation communities that are consistent with the Box Gum Woodland community listed under the EPBC Act and /or TSC Act (dependent upon condition) that no longer contains a native over storey. This community generally occurs as a native grassland which contains a native groundcover.

2.2 Contributors and qualifications

The contributors to the preparation of this report, their qualifications and roles are listed in Table 2.1.

Table 2.1 Contributors and their roles

Name	Qualification	Role
Alex Cockerill	BSc (Hons)	Project Manager, Technical Review
Deb Landenberger	BSc (Hons)	Senior Ecologist – reporting, field surveys
Mark Stables	BSc (Hons)	Senior Ecologist – reporting, field surveys
Allan Richardson	BEnvSc (Hons)	Senior Ecologist – reporting, field surveys
Tanya Bangel	BSc (Hons)	Ecologist – reporting, field surveys
Emily Mitchell	Bachelor of Development Studies Cert 4 in Spatial Information Services	GIS Mapping

All work was carried out under the appropriate licences, including a scientific licence as required under Clause 22 of the *National Parks and Wildlife Regulations 2002* and Section 132C of the *National Parks and Wildlife Act 1974,* and an Animal Research Authority issued by the Department of Primary Industries (Agriculture).

2.3 Nomenclature

Names of plants used in this document follow Harden (Harden 1992, 1993, 2000, 2002) with updates from PlantNet (Royal Botanic Gardens 2014). Scientific names are used in this report for species of plant followed

by the common names in brackets. Scientific and common names of plants are listed in Appendix A and Appendix C. Introduced species are identified within the text with an asterisk following the name, for example *Lantana camara**.

Vegetation community names have followed that of the Office of Environment and Heritage vegetation types database (Office of Environment and Heritage 2012) as used in BioMetric 2.0 (Gibbons *et al.* 2008). Corresponding vegetation community names from the local broad scale vegetation mapping projects (Peake 2006) has been provided in Section 3.2.

Names of vertebrates follow the Australian Faunal Directory (2012) maintained by the Commonwealth Department of the Environment (DoE). Common names are used in the report for species of animal. Scientific names are included in species lists found in Appendix C and Appendix D.

2.4 Database searches

Records of threatened species known or predicted to occur in the locality of the project were obtained from a range of databases as detailed in Table 2.2.

Table 2.2 Database searches

Database	Searches	Area searched[1]	Reference
Atlas of NSW Wildlife (BioNet)	13 April 2015 (Flora and fauna)	20 km buffer around the both Nioka North and Sunshine	Office of Environment and Heritage (2015)
NSW Department of Primary Industries threatened Aquatic Fauna Database	13 April 2015	Namoi Catchment Management Authority area	NSW Department of Primary Industries (2015b)
PlantNet	13 April 2015	25 km buffer around Rangari	Royal Botanical Gardens, Sydney (2015)
Protected Matters Search Tool	13 April 2015	10 km buffer around study area	Department of Environment (Department of Environment 2015)
NSW Department of Primary Industries Noxious weed declarations	13 April 2015	Narrabri City Council Control Area	NSW Department of Primary Industries (2015a)

(1) Searches for Nioka North were centred around lat -30.636213, long 150.354595 and for Sunshine around lat -30.63289, lat 150.395236

2.5 Field survey

The field survey was undertaken from 23 March 2015 and 29 March 2015 and 6 April 2015 to 10 April 2015. This survey sought primarily to assess the extent and condition of vegetation and flora and fauna habitat, especially for threatened species and ecological communities.

2.5.1 Weather conditions

The weather conditions during the March/April surveying period generally consisted of mild temperatures and slight rainfall to fine weather (refer to Table 2.3). Fauna survey weather in early April consisted of storm activity resulting in cool overnight temperatures with cool to mild daytime conditions.

Table 2.3 Weather conditions

Date	Temperature °C (min)1	Temperature °C (max)1	Rain (mm)[1]	Wind (max speed (km/ph)/direction)[1]
23 March 2015	15.5	32.0	0.0	13/WNW
24 March 2015	15.3	35.1	0.0	30/NNW
25 March 2015	14.3	29.5	23.8	17/NNW
26 March 2015	8.9	29.3	0.0	13/WSW
27 March 2015	7.5	27.4	0.0	7/S
28 March 2015	6.4	28.8	0.0	6/N
29 March 2015	8.9	29.3	0.0	15/WNW
6 April 2015	11.8	27.9	0.6	22/N
7 April 2015	13.2	22.1	19.4	31/WNW
8 April 2015	6.5	20.2	0.2	11/WNW
9 April 2015	6.0	23.4	0.0	11/SSW
10 April 2015	8.9	24.6	0.0	13/ESE
11 April 2015	12.4	26.2	0.0	9/W
12 April 2015	8.5	25.6	0.0	6/W
13 April 2015	13.0	25.8	0.0	11/E
14 April 2015	12.5	26.3	0.0	13/NW
15 April 2015	12.4	27.8	0.0	11/WNW
16 April 2015	12.8	29.6	0.0	13/NNW
17 April 2015	13.6	29.5	0.0	7/SSW
18 April 2015	13.9	27.0	0.0	22/NNW
19 April 2015	16.3	20.8	13.2	6/NW
20 April 2015	12.3	18.1	0.2	13/NW
21 April 2015	9.5	13.8	17.8	2/NNW
22 April 2015	9.7	18.6	13.6	13NNW
23 April 2015	7.2	22.8	0.2	6/N
24 April 2015	13.2	24.3	0.2	15/NNW
25 April 2015	9.1	23.9	0.0	22/NW
26 April 2015	8.8	19.1	0.0	30/SW
27 April 2015	3.6	19.6	0.0	17/W
28 April 2015	2.0	21.0	0.0	9/ESE
29 April 2015	7.9	23.3	0.0	13/ESE
30 April 2015	11.7	23.3	0.0	22/E

(1) Data obtained from Bureau of Meteorology from Gunnedah Airport AWS NSW (Station 055202).

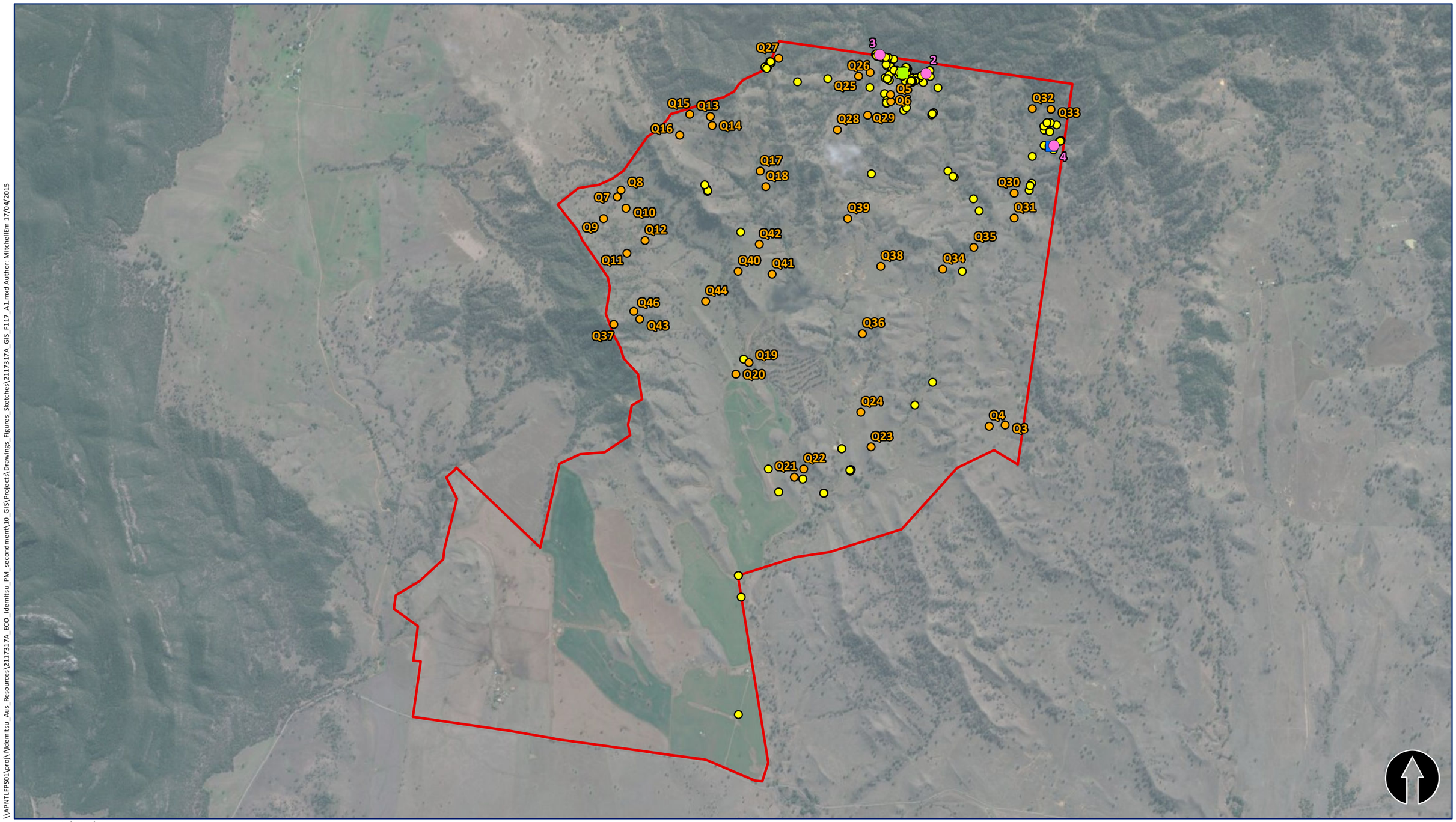
2.5.2 Fauna

Terrestrial vertebrate surveys completed within the ecology survey area consisted of targeted surveys for *Nyctophilus corbeni* (South-eastern Long-eared Bat), habitat quality/condition assessments for local threatened species, remote camera surveys, and opportunistic surveys for threatened fauna species; carried out as described below and where applicable, considered the methodology detailed in the *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (Department of Environment and Conservation 2004) and *Survey guidelines for Australia's threatened bats* (Department of the Environment, Water, Heritage and the Arts 2010).

The threatened fauna survey methodology involved exploratory surveys over the majority of the study area, targeting areas of higher quality habitat and more intact native vegetation communities (refer to Figure 2.1 and Figure 2.2).

Fauna survey site investigations utilised the following methodologies:

- opportunistic diurnal bird surveys
- targeted threatened diurnal bird habitat surveys
- opportunistic spotlight surveys
- remote camera surveys
- fauna habitat assessment
- targeted *N. corbeni* harp trap surveys
- general threated fauna surveys.



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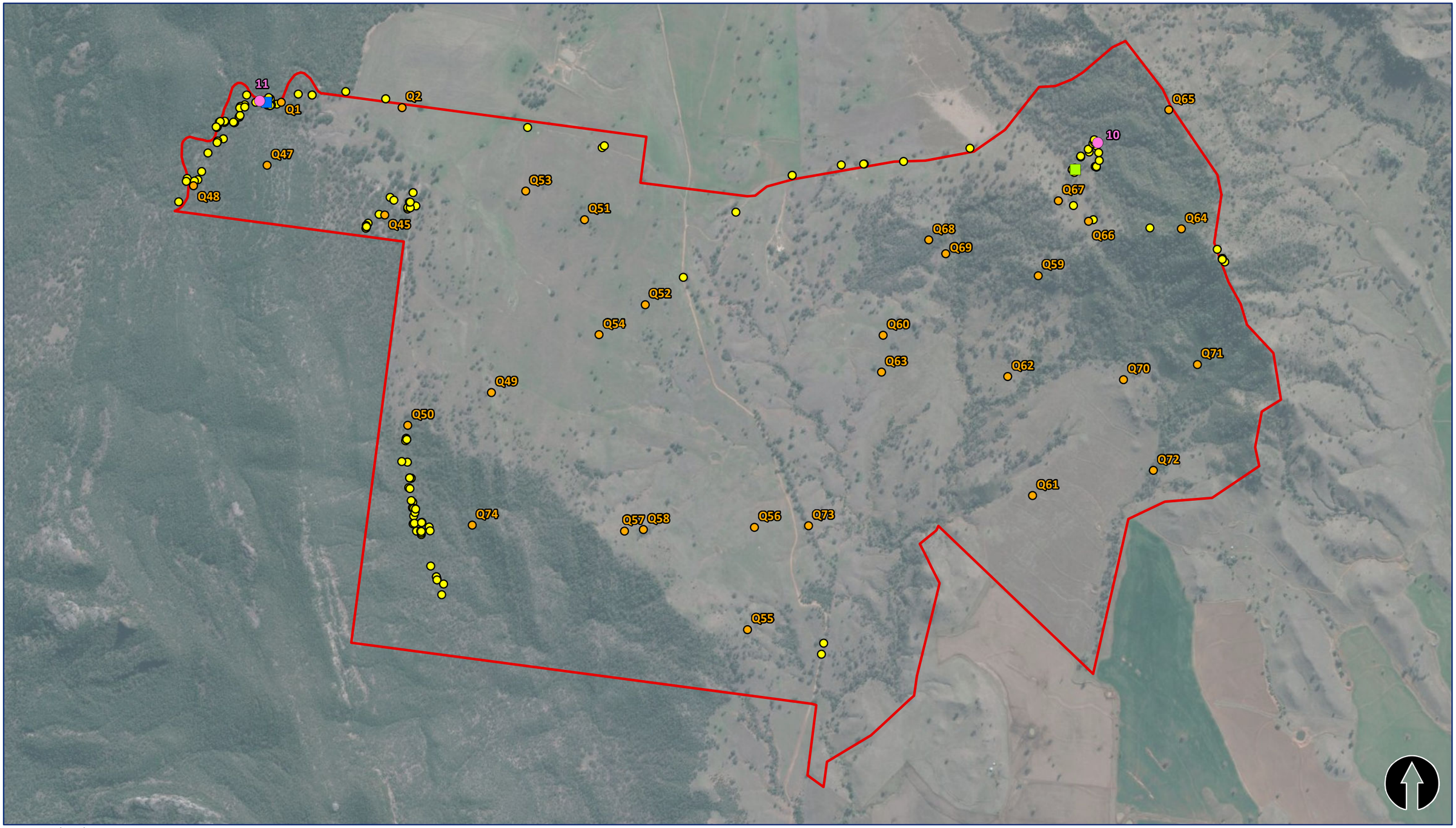
Source: ESRI (2015)

Offset property

Survey techniques

- Camera
- Harp 1
- Harp 2
- Fauna survey locations
- Flora quadrats

Figure 2.1
Flora and fauna survey locations for Sunshine BOA



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Source: ESRI (2015)

0 0.5 1 1.5 km

Offset property

Survey techniques

- Camera
- Harp 1
- Harp 2
- Fauna survey locations
- Flora quadrats

Figure 2.2
Flora and fauna survey locations for Nioka North BOA

A summary of fauna survey effort for threatened species is provided in Table 2.4. All fauna species observed during field surveys were documented and combined into a total species list.

Table 2.4 Summary of threatened fauna survey effort

Species targeted	Survey type	Survey effort and type	Dates surveyed	Habitat searched in ecology survey area
Diurnal bird surveys	Opportunistic surveys.	30 person hours	6-10 Apr 2015	Grassy woodland, Shrubby woodland, Pasture lands, Farm Dams, Riparian woodland
Threatened diurnal birds	Opportunistic surveys and targeted habitat surveys.	30 person hours	6-10 Apr 2015	Grassy woodland, Shrubby woodland, Pasture lands, Farm Dams, Riparian woodland
Targeted threatened microchiropteran bats	Harp trap	8 trap nights	6-9 Apr 2015	Riparian woodland
Targeted threatened native carnivores	Remote cameras	113 trap nights	7-30 Apr 2015	Higher quality Riparian Woodland, Grassy Woodland, and Shrubby woodland
Arboreal mammals	Opportunistic Spotlight surveys	4 person hours	6-9 Apr 2015	Riparian woodland
All threatened species	Opportunistic surveys	4 days	6-10 Apr 2015	Grassy woodland, Shrubby woodland, Pasture lands, Farm Dams, Riparian woodland

2.6 Fauna habitats

Fauna habitat assessments were completed to assess the likelihood of threatened species of animal occurring in the Nioka North and Sunshine properties. Habitat assessments included the assessment and identification of habitat features through targeted meander surveys.

During habitat assessments and targeted meander surveys, opportunistic recordings of species were made through incidental sightings, aural recognition of calls and observations of indirect evidence of species' presence (such as Glossy-black Cockatoo chewed cones, nests/dreys, whitewash, burrows and scats). This provided supplementary information on faunal species presence.

Fauna habitats were assessed generally by examining characteristics such as the structure and floristics of the canopy, understorey and ground vegetation, the structure and composition of the litter layer, and other habitat attributes important for feeding, shelter roosting and breeding. The following criteria were used to evaluate 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 (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 past clearing.

2.6.1 Threatened Microchiropteran bat surveys

Harp traps were employed to target threatened microchiropteran bats, specifically *Nyctophilus corbeni*, at four sites, two in each property. Sites were chosen for their location in relation to mature woodland containing potential roosting hollows and were placed in drainage corridors where bats are likely to move through from roosting to foraging areas. Trap placement targeted natural narrowing of corridors to funnel bats into the traps. Harp trap survey results are presented with other fauna results in Appendix B.

Harp traps were checked in the evening after the crepuscular period when bats move out for foraging and again each subsequent morning.

2.6.2 Diurnal bird surveys

Diurnal bird surveys were conducted throughout the 4 day survey period, with a focus on threatened bird species. All habitats throughout the two properties were assessed and surveyed for threatened woodland bird potential, with greater survey effort apportioned to areas containing important habitat attributes such as structural complexity, old growth community forms, larger patch size or connectivity to large patches and flowering canopy or understorey plants. All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred in the morning when activity was at its peak. Birds were also recorded opportunistically during all other surveys and travelling between sites.

2.6.3 Spotlighting

Spotlighting was utilised to target threatened arboreal mammals in areas of high quality habitat during the checking of harp traps. Spotlighting was completed after dusk targeting old growth woodland areas carrying blossom, which are favoured by Squirrel Gliders. Surveys were completed on foot using powerful headlamps and 100 watt vari-beam spotlights. Sighted animals were identified to the species level.

2.6.4 Remote camera surveys

Remote cameras were employed to target native carnivorous species, particularly the Spotted-tailed Quoll (*Dasyurus maculatus*). Three cameras were used on the Sunshine property (Figure 2.1) along the northern boundary where vegetation communities exhibited least disturbance and were continuous with large patches of high quality vegetation communities to the north. Two cameras were employed with the Nioka North property (Figure 2.2) in large patches of shrubby woodland and grassy riparian woodland respectively. Cameras were set from 7 April to 30 April 2015 on the Sunshine property and 8 April to 30 April 2015 on the Nioka North property.

2.6.5 Herpetofauna active searches

Opportunistic herpetofauna searches were made during all other fauna surveys, although seasonal climatic contexts were not highly suitable for most herpetofauna species.

2.7 Flora

The floristic diversity and possible presence of threatened species was assessed using a combination of random meander and plot-based (quadrat) surveys in accordance with the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft*) (Department of Environment and Conservation 2004). The plot based surveys were conducted in accordance with the BioBanking Assessment Methodology (BBAM) (Office of Environment and Heritage 2014a). This

methodology was followed to allow for potential BioBanking calculations to be performed for any potential offsets that maybe required. This methodology is explained further in section 2.7.3 below.

Random meander surveys were completed along the entire length of the study area, these surveys included the extended proposal 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 meander throughout the site 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.

2.7.1 Desktop analysis of vegetation

The vegetation community boundaries were assessed using aerial photo interpretation. Analysis of the aerial photographs identified past land use practices, disturbance and native vegetation regrowth, changes in vegetation structure and floristics throughout the study area. This provided an initial split of vegetation communities into simple structural and disturbance classifications.

2.7.2 Field verification of existing vegetation mapping

Vegetation within the study area and locality has been previously mapped at a regional scale by the Namoi CMA broadscale vegetation mapping project (Eco Logical Australia 2008, 2013).

Field validation (ground-truthing) of the initial vegetation classification identified from aerial photograph interpretation and existing vegetation mapping project (Eco Logical Australia 2008, 2013) was undertaken to determine the site specific classification of the vegetation structure, dominant canopy species, native diversity and condition.

2.7.2.1 Quadrats site surveys

Seventy Four (quadrat/transect) site surveys (refer Table 2.5, Table 2.6 and Figure 2.3) were completed within the study area as outlined in the methodology contained in the BioBanking Assessment Methodology (Office of Environment and Heritage 2014a) and described below and Figure 2.3 illustrates the plot layout that was used at each site.

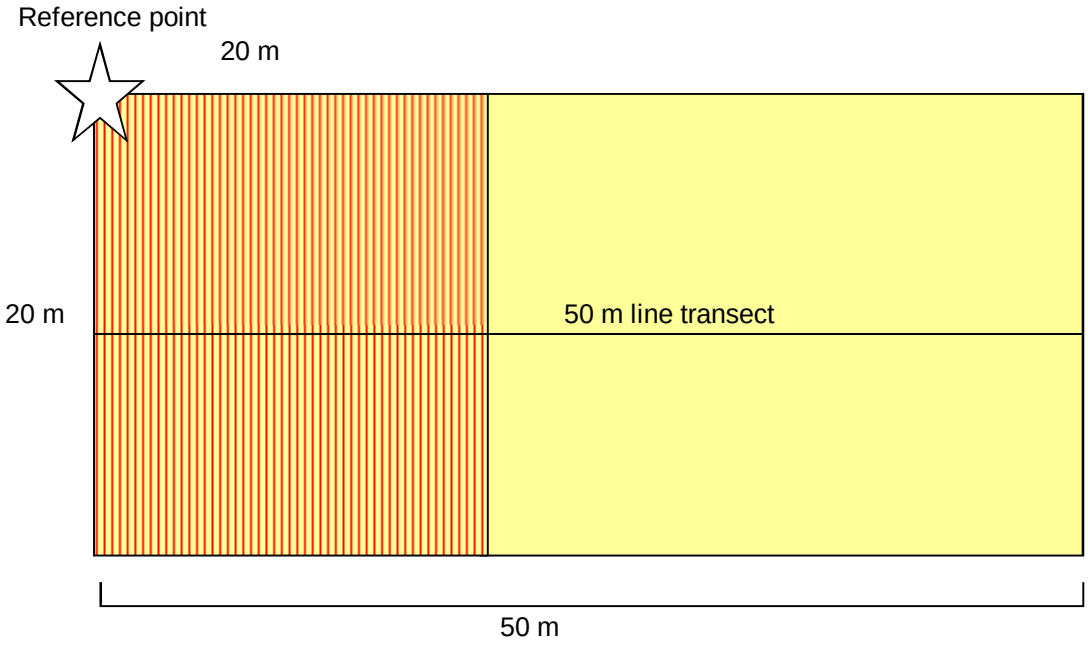


Figure 2.3 Schematic diagram illustrating the layout of the nested 20 m x 50 m and 20 m x 20 m quadrats used for the assessment of condition attributes at each site

The following site attributes were recorded at each site:

- Location (easting – northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition.
- Native and exotic species richness (within a 400 m^2 quadrat): this consisted of recording all species by systematically walking through each 20 m x 20 m quadrat. The cover abundance of each species was estimated.
- Number of trees with hollows (1,000 m^2 quadrat): this was the frequency of hollows within living and dead trees within each 50 m x 20 m quadrat. A hollow was only recorded if:
  - the entrance could be seen
  - the estimated entrance width was at least 5 cm across
  - the hollow appeared to have depth
  - the hollow was at least 1 m above the ground
  - the centre of the tree was located within the sampled quadrat.
- Total length of fallen logs (1,000 m^2 quadrat): this was the cumulative total of logs within each 50 m x 20 m quadrat with a diameter of at least 10 cm and a length of at least 0.5 m.
- Native over-storey cover: this consisted of estimating the percentage cover of the tallest woody stratum present (>1 m and including emergents). The woody stratum included species that were native to NSW and not necessarily those that were locally endemic.
- Native mid-storey cover: this involved estimating the cover of vegetation between the over-storey stratum and a height of one m (i.e. tall shrubs, under-storey trees and tree regeneration).
- Ground cover: this comprised estimating the cover of plants below 1 m in height. The following categories of plants were recorded:
  - native ground cover (grasses): native grasses (Poaceae family native to NSW)
  - native ground cover (shrubs): all woody vegetation below one m in height and native to NSW
  - native ground cover (other): non-woody vegetation (i.e. vascular plants–ferns and herbs) below one m in height and native to NSW
  - exotic plant cover: vascular plants not native to Australia.

- Evaluation of regeneration: this was estimated as the proportion of over-storey species present at the site that was regenerating (i.e. saplings with a diameter at breast height ≤5 cm). The maximum value for this measure was one.

Table 2.5 Location of flora quadrats at Nioka North

BioBanking quadrat/ transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q1	Yellow Box Blakely's Red Gum grassy woodland	244124	6608396
Q2	White Box Grassy Woodland (low condition)	244662	6608373
Q45	Yellow Box Blakely's Red Gum grassy woodland	244584	6607893
Q47	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	244061	6608115
Q48	Yellow Box Blakely's Red Gum grassy woodland	243732	6608024
Q49	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Callitris regrowth)	245061	6607103
Q50	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	244688	6606956
Q51	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	245476	6607873
Q52	Silver-leaved Ironbark heathy woodland (low condition)	245746	6607494
Q53	White Box Grassy Woodland (low condition)	245213	6608000
Q54	White Box Grassy Woodland (low condition)	245541	6607360
Q55	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	246203	6606046
Q56	White Box Grassy Woodland (low condition)	246234	6606502
Q57	White Box Grassy Woodland (moderate condition)	245654	6606486
Q58	White Box Grassy Woodland (moderate condition)	245739	6606492
Q59	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	247499	6607623
Q60	White Box Grassy Woodland (moderate condition)	246808	6607358
Q61	Intensive Agriculture	247474	6606643
Q62	White Box Grassy Woodland (moderate condition)	247363	6607173
Q63	White Box Grassy Woodland (low condition)	246800	6607193
Q64	Rough-barked Apple - White Box shrubby / grassy woodland	248137	6607831
Q65	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	248081	6608362
Q66	White Box Grassy Woodland (moderate condition)	247723	6607866
Q67	White Box Grassy Woodland (moderate condition)	247590	6607957
Q68	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	247011	6607782
Q69	Dwyer's Red Gum Woodland	247087	6607722
Q70	White Box Grassy Woodland (low condition)	247880	6607160

BioBanking quadrat/ transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q71	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Callitris regrowth)	248209	6607227
Q72	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	248013	6606755
Q73	White Box Grassy Woodland (moderate condition)	246474	6606508
Q74	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	244975	6606511

(1) GDA 94: Zone 56.

Table 2.6 Location of flora quadrats at Sunshine property

BioBanking quadrat/ transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q3	White Box Grassy Woodland (moderate condition)	251566	6606857
Q4	White Box Grassy Woodland (low condition)	251435	6606846
Q5	Silver-leaved Ironbark heathy woodland	250627	6609516
Q6	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	250625	6609573
Q7	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	248378	6608730
Q8	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	247880	6607160
Q9	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (shiny bush)	248265	6608554
Q10	White Box Grassy Woodland (moderate condition)	248450	6608637
Q11	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	248457	6608268
Q12	White Box Grassy Woodland (low condition)	248607	6608373
Q13	White Box Grassy Woodland (moderate condition)	249144	6609393
Q14	White Box Grassy Woodland (low condition)	249159	6609319
Q15	White Box Grassy Woodland (moderate condition)	248975	6609411
Q16	White Box Grassy Woodland (low condition)	248892	6609239
Q17	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	249553	6608942
Q18	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	249601	6608816
Q19	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	249461	6607370
Q20	Intensive Agriculture	249354	6607275
Q21	Silver-leaved Ironbark heathy woodland	249832	6606429
Q22	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	249910	6606495
Q23	White Box Grassy Woodland (low condition)	250464	6606676
Q24	White Box Grassy Woodland (low condition)	250381	6606962
Q25	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	250458	6609754
Q26	White Box Grassy Woodland (moderate condition)	250361	6609723

BioBanking quadrat/ transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q27	White Box Grassy Woodland (moderate condition)	249705	6609869
Q28	White Box Grassy Woodland (low condition)	250187	6609282
Q29	Silver-leaved Ironbark heathy woodland	250436	6609403
Q30	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	251639	6608761
Q31	White Box Grassy Woodland (low condition)	251640	6608558
Q32	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	251790	6609458
Q33	White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	251944	6609451
Q34	White Box Grassy Woodland (low condition)	251053	6608137
Q35	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	251310	6608317
Q36	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	250394	6607606
Q37	Dwyer's Red Gum Woodland	248351	6607684
Q38	White Box Grassy Woodland (low condition)	250545	6608160
Q39	White Box Grassy Woodland (low condition)	250273	6608553
Q40	White Box Blakely's Red Gum Rough-barked Apple riparian woodland	249373	6608121
Q41	White Box Grassy Woodland (low condition)	249650	6608096
Q42	White Box Grassy Woodland (low condition)	249545	6608343
Q43	Rough-barked Apple - White Box shrubby / grassy woodland	248563	6607727
Q44	White Box Grassy Woodland (low condition)	249104	6607872
Q46	Rough-barked Apple - White Box shrubby / grassy woodland	248514	6607792

(1) GDA 94: Zone 56.

2.7.3 BioBanking quadrat/transect survey effort

Table 2.7 and Table 2.8 below outlines the survey effort for the BioBanking plots in each native plant community type and their condition.

Table 2.7 BioBanking quadrat/transect survey effort at Nioka North

Plant community type (vegetation condition class)	Number of quadrats	Survey effort (person hours)
Dwyer's Red Gum Woodland	1	1
Rough-barked Apple – White Box shrubby / grassy woodland	1	1
Silver-leaved Ironbark heathy woodland (low condition)	1	1
White Box Blakely's Red Gum Rough-barked Apple riparian woodland [1]	4	4
White Box Grassy Woodland (moderate condition)[1]	7	7
White Box Grassy Woodland (low condition)[2]	6	6

Plant community type (vegetation condition class)	Number of quadrats	Survey effort (person hours)
White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	5	5
White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Callitris regrowth)	2	2
Yellow Box Blakely's Red Gum grassy woodland[1]	3	3
Totals	**30**	**30**

Note:
1. Consistent with Remnant Box Gum Woodland
2. Consistent with Box Gum Woodland (Derive Native Grassland)

Table 2.8 BioBanking quadrat/transect survey effort at Sunshine

Plant community type (vegetation condition class)	Number of quadrats	Survey effort (person hours)
Dwyer's Red Gum Woodland	1	1
Rough-barked Apple – White Box shrubby / grassy woodland	2	2
Silver-leaved Ironbark heathy woodland (low condition)	3	3
White Box Blakely's Red Gum Rough-barked Apple riparian woodland [1]	13	13
White Box Grassy Woodland (moderate condition)[1]	6	6
White Box Grassy Woodland (low condition)[2]	14	14
White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest	2	2
White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Shiny Bush)	1	1
Totals	**42**	**42**

Note:
1. Consistent with Remnant Box Gum Woodland
2. Consistent with Box Gum Woodland (Derive Native Grassland)

2.7.4 Condition and quality assessment of vegetation communities

The overall condition of vegetation was assessed through general observation and comparison against the BioBanking benchmark data (Office of Environment and Heritage 2014b) and the vegetation condition definition as set out in the BioBanking Assessment Methodology (BBAM) operations manual (Office of Environment and Heritage 2014a). The moderate to good condition classes have generally been subject to disturbance in the understorey, but had native regrowth vegetation occurring.

Two categories were used to describe the condition of the vegetation communities are set out below:

- **Good – moderate condition**: The vegetation in this condition class can have vegetation that is in good condition where the vegetation has changed very little over time and displays resilience to weed invasion due to intact groundcover, shrub and canopy layers. This class will be at or above the BioBanking benchmarks (Office of Environment and Heritage 2014b). This condition can also contain vegetation that has retained a native canopy and has a native understorey of greater than 50%. This condition class can include derived native grasslands and can have minor weed incursions with some patches being subject to grazing. This condition equates to BBAM moderate to good condition (Office of Environment and Heritage 2014a).
- **Low condition**: Vegetation has a native canopy less than 50% of the lower benchmark. The understorey is generally dominated by exotic species being greater than 50% exotic cover. The shrub

layer was generally absent from this condition class. Weed invasion can be significant in such remnants. This condition class equates to BBAM low condition (Office of Environment and Heritage 2014a).

Following the BioBanking methodology (Office of Environment and Heritage 2014a), woody vegetation, is considered as low condition vegetation when:

- over-storey per cent foliage cover is <25% of the lower values of the over-storey per cent foliage cover benchmark for that vegetation type, and either:
  - less than 50% of vegetation in the ground layer is indigenous species
  - greater than 90% is cleared.

Following the BioBanking methodology (Office of Environment and Heritage 2014a), low condition for grassland is when:

- less than 50% of the groundcover percent foliage cover of the vegetation is indigenous species
- more than 90% of the groundcover vegetation is cleared.

2.8 Likelihood of occurrence

For this study, likelihood of occurrence of threatened species within the ecology survey area for species recorded or predicted to occur in the locality is defined in Table 2.9.

Table 2.9 Likelihood of occurrence of threatened species

Likelihood	Description
Low	Species considered to have a low likelihood of occurrence include species not recorded during the field surveys that fit one or more of the following criteria: ■ have not been recorded previously in the ecology survey area and surrounds and for which the ecology survey area is beyond the current distribution range ■ rely on specific habitat types or resources that are not present in the ecology survey area ■ are considered locally extinct ■ are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Moderate	Species considered to have a moderate likelihood of occurrence include species not recorded during the field surveys that fit one or more of the following criteria: ■ have infrequently been recorded previously in the ecology survey area and surrounds ■ use habitat types or resources that are present in the ecology survey area, although generally in a poor or modified condition ■ are unlikely to maintain sedentary populations, however, may seasonally use resources within the ecology survey area opportunistically during variable seasons or migration ■ are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
High	Species considered to have a high likelihood of occurrence include species not recorded that fit one or more of the following criteria: ■ have frequently been recorded previously in the ecology survey area and surrounds ■ use habitat types or resources that are present in the ecology survey area, that are abundant and/or in good condition within the ecology survey area ■ are known or likely to maintain resident populations surrounding the ecology survey area ■ are known or likely to visit the site during regular seasonal movements or migration.
Recorded	Any threatened species recorded during field surveys.

2.9 Limitations

2.9.1 Study for benefit of client

This EAR has been prepared for the exclusive benefit of the client and no other party. Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study). Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

2.9.2 Field survey 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. It should be recognised that site conditions, including the presence of threatened species, can change with time. Winter-flowering trees which are attractants of endangered blossom nomads, such as the Regent Honeyeater and Swift Parrot, were flowering during the survey period, but seasonal movements for these species locally were considered to be early.

Fieldwork for this study was completed during autumn with overnight temperatures cooling in response to rainfall events, which may have affected to activity of some species, especially herpetofauna and microchiropteran bats. This is likely to have impacted the activity (and therefore detectability) of some nocturnal species of frogs, reptiles, and small mammals. However, where suitable habitat was observed, a precautionary approach was taken to the potential for species to occur and it was assumed that some species may be present on at least an intermittent basis (see Appendix D for likelihood of occurrence assessment of all threatened species of animal).

The surveys were undertaken in autumn and did no coincide with flowering period of the cryptic orchid *Diuris tricolor* and therefore this species could not be detected at the time of the survey. Methodologies for flora surveys are outlined in Section 2.7, whilst the results are summarised in Section 3 and 4.

2.9.3 Other limitations

To the best of Parsons Brinckerhoff's knowledge, the project presented and the facts and matters described in this study reasonably represent the client's intentions at the time of preparation of the study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the project and of its possible environmental impact.

Parsons Brinckerhoff will not be liable to update or revise this EAR to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the EAR.

3. Existing environment

The Sunshine property and the Nioka North property both lie within the Nandewar Range and form part of the south-eastern portion of the Regional East-West Wildlife Corridor.

The most intact areas of woodland habitat occur in the west and far east of the Noika North BOA, although understorey vegetation exhibits the effects of grazing on the lower slopes. A large remnant intact native vegetation occurs on the ridges in the south west linking Nioka North to larger areas intact native vegetation extending the north and south. Elsewhere throughout the property remnant woodland trees are largely scattered or form residual patches along drainage lines or regrowth covering on hills.

Within the Sunshine BOA much of the woodland occurs in fragmented landscape. The drainage lines contain the best areas of woodland within the property on the lower slopes. Regeneration is present on many parts of the throughout the northern uplands, particularly along ridgetops and drainage lines.

Historically the two BOAs consists of cattle grazing and cropping, with many farms surrounding both of the properties. To the west of Nioka North a ridge line of native vegetation occurs which provides connectivity to a larger tract of native vegetation extending to Mt Kaputar National Park.

Biodiversity values within the BOAs are summarised in Sections 3 and 4 below. A summary of the locality is provided in Table 3.1 below.

Table 3.1 Locality information

Criteria	Location
Council	Narrabri and Gunnedah
CMA	Namoi
CMA sub-region	Liverpool Plains, Peel
Bioregion	Brigalow Belt South, Nandewar
Mitchell landscapes	Sunshine BOA: Liverpool Alluvial Plains, Tamworth – Keepit slopes and Plains Nioka North BOA: Liverpool Alluvial Plains, Tamworth – Keepit slopes and Plains

3.1 Vegetation communities

Desktop analysis of the vegetation mapping for and ground-truthing during surveys found nine vegetation communities present within the study area (refer to Table 3.2 and Figure 3.1 and Figure 3.2).

Table 3.2 Vegetation communities identified in the study area

Vegetation community (Parsons Brinckerhoff 2015)	Biometric Plant Community Types Namoi CMA[1]	Namoi CMA Regional Vegetation Community[2]	Threatened Ecological Community
Grass Woodlands on fertile soils			
White Box Grassy Woodland (moderate condition)	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions [NA226, PCT1383]	RVC 18 White Box grassy woodland, Brigalow Belt South and Nandewar	Remnant Box Gum Woodland listed as an EEC (TSC Act) and/or CEEC (EPBC Act)[3].

Vegetation community (Parsons Brinckerhoff 2015)	Biometric Plant Community Types Namoi CMA[1]	Namoi CMA Regional Vegetation Community[2]	Threatened Ecological Community
Shrubby Woodland/open Forest on Skeletal soils			
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 59 Narrow-leaved Ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar	–
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (Callitris Regrowth)	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 59 Narrow-leaved Ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar	-
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (Shiny Bush)	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 59 Narrow-leaved Ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar	
Rough-barked Apple – White Box Shrubby Woodland/grassland	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 59 Narrow-leaved Ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar	–
Dwyer's Red Gum Woodland	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [NA245, PCT610]	RVC 58 Shrubby woodlands or mallee woodlands on stoney soils, Brigalow Belt South and Nandewar	–
Silver-leaved Ironbark Heathy woodland	White Cypress Pine - Silver-leaved Ironbark shrubby open forest of the Nandewar Bioregion [NA231, PCT1307]	RVC 44 White Box – pine Silver leaved Ironbark shrubby open forests, Brigalow Belt South and Nandewar	–
Riverine Woodlands			
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	RVC 20 Rough-barked Apple – Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	Remnant Box Gum Woodland listed as an EEC (TSC Act) and CEEC (EPBC Act)[3].
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	RVC 20 Rough-barked Apple – Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	-
Yellow Box – Blakely's Red Gum grassy woodland	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [NA237, PCT1329]	RVC 17 Box-gum grassy woodlands, Brigalow Belt South and Nandewar	Remnant Box Gum Woodland listed as an EEC (TSC Act) and CEEC (EPBC Act)[3].
Grasslands			

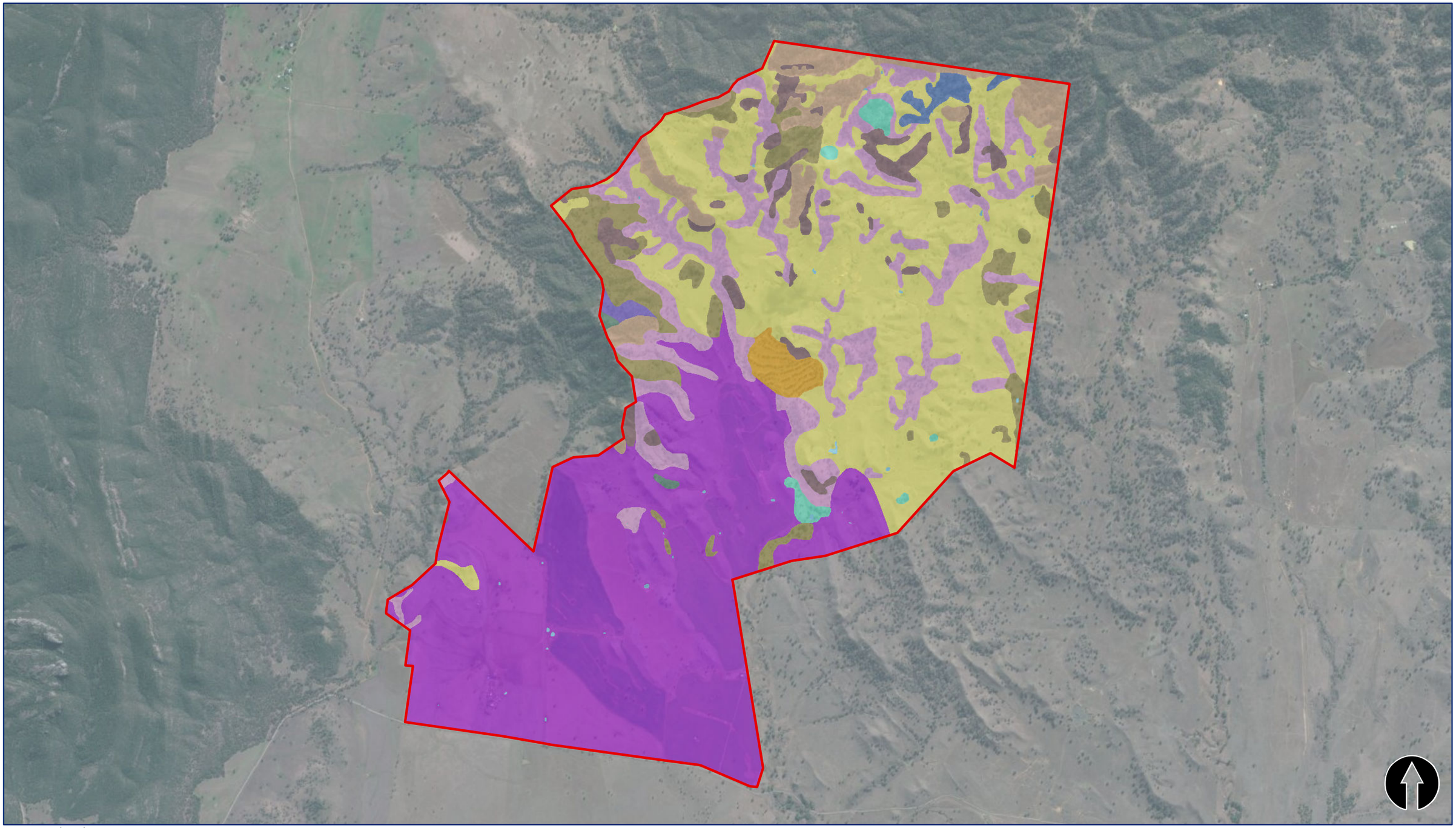
Vegetation community (Parsons Brinckerhoff 2015)	Biometric Plant Community Types Namoi CMA[1]	Namoi CMA Regional Vegetation Community[2]	Threatened Ecological Community
White Box Grassy Woodland (low condition derived native grassland)	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions [NA226, PCT 1383] ' Low condition'	RVC 18 White Box grassy woodland, Brigalow Belt South and Nandewar	Box Gum Woodland (Derived Native Grasslands listed as an EEC (TSC Act)[4].
Intensive agriculture	-	-	-

(1) Office of Environment and Heritage vegetation types database (Office of Environment and Heritage 2012) as used in BioMetric 2.0 (Gibbons *et al.* 2008) [NA biometric BioBanking type number, PCT = Plant Community Type Number]

(2) The Vegetation of the Namoi CMA

(3) Commensurate with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC listed udder the EPBC Act and White box yellow box Blakely's red gum woodland listed under the TSC Act.

(4) Commensurate with the White box yellow box Blakely's red gum woodland listed under the TSC Act only.



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Source: ESRI (2015)

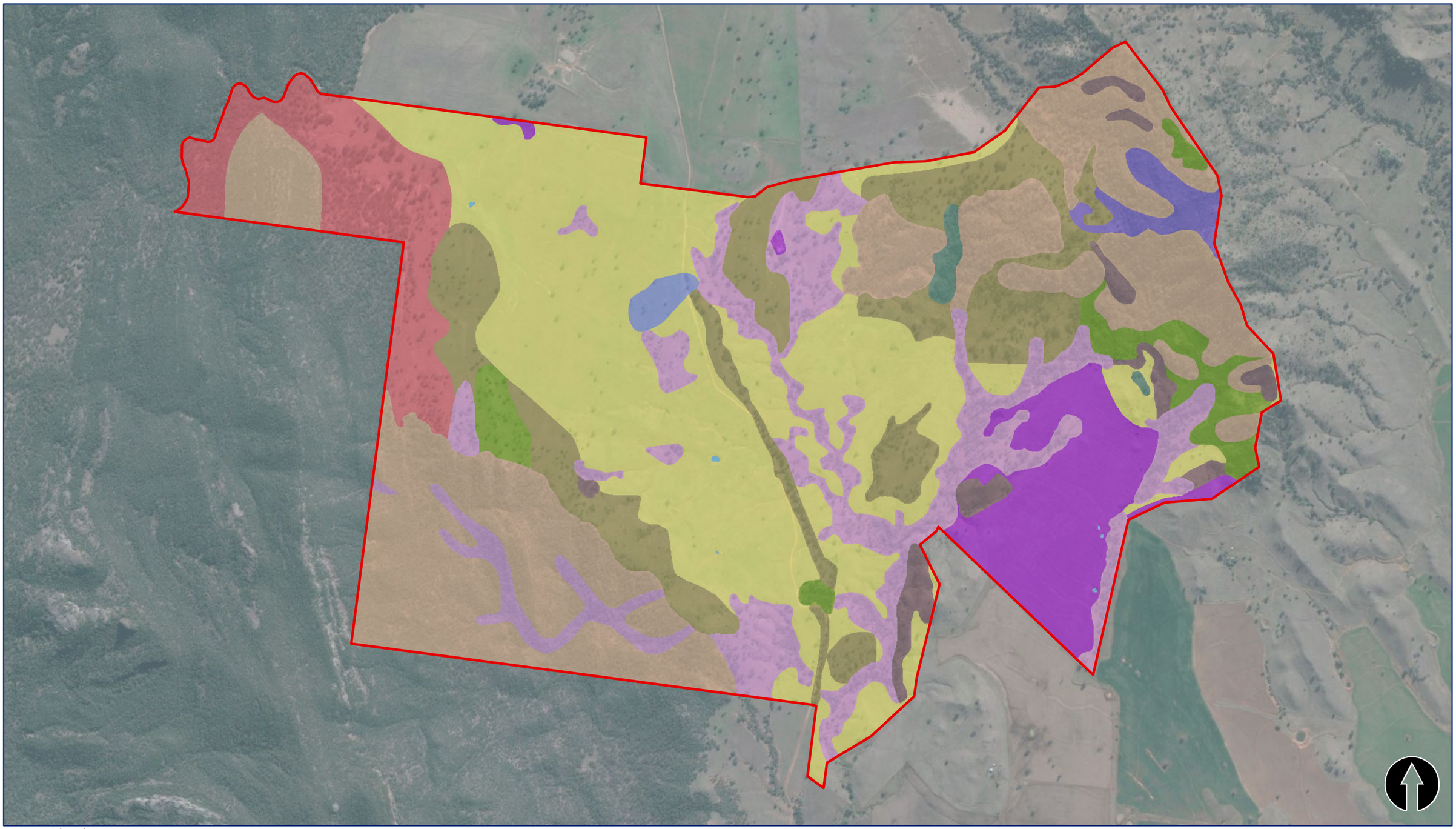
Offset property

Vegetation communities

- Dwyers Red Gum woodland
- Farm dams
- Intensive Agriculture
- Plantation
- Rough-barked Apple - White Box shrubby/grassy woodland
- Silver-leaved Ironbark heathy woodland
- White Box Blakely's Red Gum Rough-barked Apple riparian woodland (EEC)
- White Box Blakely's Red Gum Rough-barked Apple riparian forest (shrubby variant)
- White Box Grassy Woodland (EEC) (low condition)
- White Box Grassy Woodland (EEC) (moderate condition)
- White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Shiny Bush)
- White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest

0 0.5 1 1.5 km

Figure 3.1
Vegetation communities of the Sunshine BOA



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Source: ESRI (2015)

Offset property

Vegetation communities

- Dwyers Red Gum woodland
- Farm dams
- Intensive Agriculture
- Rough-barked Apple - White Box shrubby/grassy woodland
- Silver-leaved Ironbark heathy woodland (low condition)
- White Box Blakely's Red Gum Rough-barked Apple riparian woodland (EEC)
- White Box Grassy Woodland EEC (low condition)
- White Box Grassy Woodland EEC (moderate condition)
- White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Callitris Regrowth)
- White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest (Shiny Bush)
- White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest
- Yellow Box Blakelys Red Gum grassy woodland (EEC)

0 0.5 1 1.5 km

Figure 3.2
Vegetation communities of the Nioka North BOA

3.1.1 White Box Grassy Woodland (moderate condition)

White Box Grassy Woodland has been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the both of the BOAs and consisted of *Eucalyptus albens, E. crebra* with occasional occurrences of *Brachychiton populneus.* The shrub layer was sparse with a native ground cover. The characteristics of this community are summarised in Table 3.3. The community is illustrated in Photo 3.1. Parts of this community are commensurate with the critically endangered White box – Yellow Box – Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act. Further details and condition assessment for this is provided in Section 4.1. A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.4 and is used in the condition assessment of this community. This table shows that the majority of the plots met the BioBanking benchmarks. The exception to this was plots 3 and 51 which had low diversity of natives and a high level of grazing was observed in both these plots.

Table 3.3 White Box Grassy Woodland

White Box-Grassy Woodland	
Conservation status	**High:** Remnant Box Gum Woodland that is consistent with the White box – Yellow Box – Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) and Critically Endangered on EPBC Act. Parts of this community met one or both of these TECs, further assessment is provided in section 4.1.
Condition	**Moderate - Good**. Although there was evidence of cattle grazing and historical logging, diversity of species present and the community was structurally intact. Portions of the understorey was in moderate to low condition due to cattle grazing and difficulty in identifying native species due to drought conditions at the time of the field surveys.
Location	**Nioka North**: Occurred on the lower slopes of the hills throughout the property and encompassed 118.32 ha **Sunshine**: Occurred on the lower slopes of in the north west and north of the property and encompassed 96.25 ha
Strata	**Dominant species**
Canopy	*Eucalyptus albens* (dominant), *Eucalyptus crebra* (subdominant) and *Brachychiton populneus*
Shrub stratum	*Acacia decora, Pimelea microcephala* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Swainsona galegifolia, Aristida calycina, Boerhavia dominii, Austrostipa verticillata, Dichondra sp. A, Austrostipa scabra, Sida cunninghamii, Sida spinosa** and *Panicum effusum.*

Photo 3.1 White Box Grassy Woodland

Table 3.4 Comparison White Box Grassy Woodland quadrat data against vegetation benchmark data (NA226)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grasses	Shrubs	Other				
Benchmark[1]	23	6-25	0-5	30-40	0	3-5	1		30	
Q3	16	2.5	0	48	14	28	3	4	15	Good-Moderate
Q9	35	6	1*	50	0*	38	1	4	14.7	Good-Moderate
Q12	33	8.5	7	44	2	18	2	10	17.7	Good-Moderate
Q13	40	10	25.5	32	28	18	0*	6	12	Good-Moderate
Q15	25	4.5	6	46	0	44	1	6	50.6	Good-Moderate
Q51	11	9	0	38	0*	2	0*	48	17.8	Good-Moderate
Q57	22	13.5	1.5	48	0	18	0*	16	0*	Good-Moderate
Q58	26	35.5	31	42	14	18	0*	4	8.8	Good-Moderate
Q67	25	18	4.5	56	4	16	0*	8	22.5	Good-Moderate
Q73	27	30	4.5	54	4	18	6	8	22.5	Good-Moderate
Q2	12	0*	0	50	0	18	0*	32	0*	Low
Q4	15	0*	0	52	0	14	0*	24	3*	Low
Q10	13	0*	0	72	0	6	0*	22	0*	Low
Q16	18	0*	0	50	0	48	0*	22	4*	Low
Q23	8	0*	0	52	0	2	0*	32	0*	Low
Q24	8	0*	0	38	0	28	0*	34	0*	Low
Q28	16	0*	0	54	4	12	0*	18	0*	Low
Q31	7	0*	0	52	0	2	0*	46	0*	Low
Q34	11	0*	0	50	0	0*	0*	50	0*	Low

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grasses	Shrubs	Other				
Q38	20	0*	0	34	0	6	0*	48	26	Low
Q39	14	0*	0	54	0	0*	0*	56	0*	Low
Q41	7	0*	0	28	0	2	0*	54	12	Low
Q42	4*	0*	0	34	0	0*	0*	42	5.1*	Low
Q44	5*	0*	0	48	0	0*	0*	36	0*	Low
Q53	8	0*	0	56	0	0*	0*	22	23.5	Low
Q54	8	0*	0	48	0	0*	0*	42	0*	Low
Q56	15	0*	0	32	0	6	0*	30	7.8	Low
Q60	14	0*	0	58	0	12	0*	22	0*	Low
Q62	19	0*	0	38	0	16	0*	36	3.4*	Low
Q63	13	0*	0	58	0	0*	0*	42	0*	Low
Q66	10	0*	0	58	0	2	0*	40	0*	Low
Q70	13	0*	0	56	0	0*	0*	32	0*	Low

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA226 White Box Grassy Woodland of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

3.1.2 White Box Grassy Woodland (low condition – derived grassland)

White Box Grassy Woodland has been mapped by the broad scale vegetation mapping project for the Namoi CMA as derived grasslands (Eco Logical Australia 2008, 2013). This community occurred in the both of the BOAs and consisted of only scattered trees and no shrub layer. The groundlayer contained a number of native grasses and herbs. The characteristics of this community are summarised in Table 3.5. The community is illustrated in Photo 3.2. This community met the criteria for listing under the TSC Act definition for White Box Yellow Box Blakely's Red Gum Woodland. This community is not commensurate with the critically endangered White box – Yellow Box – Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act. Further details and condition assessment for this is provided in Section 4.1.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.4 shows that the majority of the plots did not meet the BioBanking benchmarks for Box-gum woodlands.

Table 3.5 Summary of characteristics White Box Grassy Woodland (Derived Grassland)

White Box-Grassy Woodland (low condition – derived grassland)	
Conservation status	**High:** Box Gum Woodland (Derived Native Grassland) that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) This community did not meet the criteria for the federal listing of Box-gum woodland. Further assessment is provided in section 4.1 below.
Condition	Low: The condition of this community met the low condition as set out by the BioBanking methodology, as it occurred as grassland across the two BOA sites.
Location	**Nioka North**: Occurred on the hills and lower slopes in the centre of the property. This community encompassed 270.42 ha **Sunshine**: Occurred on the hills and lower slopes in the northern portion of the property. This community encompassed 564.13 ha
Strata	**Dominant species**
Canopy	Scattered occurrences of *Eucalyptus albens* and *Eucalyptus blakelyi*
Shrub stratum	Scattered shrubs of *Acacia decora, Pimelea microcephala* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Aristida calycina, Austrostipa verticillata, Dichondra sp. A, Austrostipa scabra, Panicum effusum, Chamaesyce drummondii, Sida cunninghamii, Carthamus lanatus*, Sida spinosa** and *Cyperus gracilis.*

Photo 3.2 White Box Grassy Woodland – derived native grassland

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

This community has been mapped by the broad scale vegetation mapping project for the Namoi CMA as Narrow-leaved Ironbark – pine – box woodlands and open forests within both of the BOAs (Eco Logical Australia 2008, 2013). This community occurred in the both of the BOAs on the ridgetops and west facing slopes within the study area. This community consisted of a woodland or open forest canopy with a dense shrub layer of native species and a sparse groundlayer of grasses and herbs. The characteristics of this community are summarised in Table 3.6 whilst the community is illustrated in Photo 3.3. Two additional variants of this community has been mapped in Figure 3.1 and Figure 3.2 with Shiny Bush (Photo 3.5) and a Callitris regrowth (Photo 3.4).

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.7 shows that the majority of the plots meet the BioBanking benchmarks and the community meets moderate condition.

Table 3.6 Summary of characteristics White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest

White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	
Conservation status	**Moderate:** Is not listed as a threatened community, however this community contains habitat for the threatened flora species *Pomaderris queenslandica* and for numerous threatened woodland birds and mammals.
Condition	Two condition classes: **Moderate**: This condition class of this community met all of BioBanking benchmarks and is considered to be in moderate condition. **Low**: This condition class occurred as two variants across the BOAs as follows: **Callitris Regrowth**: this variant occurred within the Nioka North property and has previously been cleared and contains significant Callitris regrowth **Shiny Bush**: This condition class occurred throughout both the BOAs and is an invasion of three native shrub species, *Dodonaea viscosa, Olearia elliptica, Beyeria viscosa*, these areas will need specific management to restore to the moderate condition of this community.
Location	**Nioka North**: The moderate condition of this community occurred in the south west north west, and adjoins the eastern boundary of the property. This condition encompassed 215.59 ha Shiny Bush occurs in two locations in the east and west of the property. This condition encompassed 19.71 ha The Callitris regrowth condition class occurs in the south east and north east of the property. This condition encompassed 27.88 ha **Sunshine**: The moderate condition of this community occurred in the north west and north east of the property. This condition class encompassed 88.12 ha The low condition shiny bush occurred within the hills and lower slopes throughout the northern portion of the property. This condition encompassed 56.99 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus albens, Eucalyptus crebra* and *Callitris glaucophylla*
Shrub stratum	*Dodonaea viscosa, Olearia elliptica, Pimelea microcephala* and *Swainsonia galegifolia*
Ground cover	*Aristida ramosa, Aristida calycina, Sigesbeckia australiensis, Dichondra sp. A, Vittadinia cuneata, Panicum effusum, Desmodium brachypodium, Poa sp., Sida spinosa** and *Cyperus gracilis.*

Table 3.7 Comparison White Box Narrow-leaved Ironbark White Cypress Pine Shrubby open forest quadrat data against vegetation benchmark data (NA225)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grass	Shrubs	Other				
Benchmark[1]	26	6-25	6-25	20-30	3-10	3-5	1		15	
Q25	37	6	8	46	8	24	1	4	14	Good-Moderate
Q26	43	15	12.5	50	4	20	0*	0	44	Good-Moderate
Q27	38	18	64	36	14	16	1	0	17.4	Good-Moderate
Q32	31	15.5	25.5	44	18	18	3	16	22	Good-Moderate
Q33	35	15.5	32	46	6	28	0*	0	39	Good-Moderate
Q47	40	27.5	8.5	40	4	9	0*	0	17.7	Good-Moderate
Q49	18	9.5	0*	38	6	0*	0*	42	9.2	Good-Moderate
Q50	37	26.5	74.5	24	28	20	1	0	48.5	Good-Moderate
Q59	30	33	12	52	8	24	0*	0	0*	Good-Moderate
Q65	31	32	55.5	32	18	24	0*	0	0*	Good-Moderate
Q68	34	32.5	46	28	62	22	3	0	36.1	Good-Moderate
Q71	25	25	2.5	36	2	10	0*	0	0*	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA225 White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.3 **White Box – Narrow-leaved Ironbark – White Cypress Pine Shrubby open forest moderate condition**

Photo 3.4 **White Box – Narrow-leaved Ironbark – White Cypress Pine Shrubby open forest low condition Callitris regrowth**

Photo 3.5 **White Box – Narrow-leaved Ironbark – White Cypress Pine Shrubby open forest low condition Shiny Bush**

3.1.4 Rough-barked Apple – White Box Shrubby Woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred on andesite geologies on the steep slopes and ridge tops of both the BOAs. The canopy consisted of a woodland structure with a moderate to dense shrub layer, with grass trees. The groundlayer contained a number of native grasses and herbs. The characteristics of this community are summarised in Table 3.8. The community is illustrated in Photo 3.6. This community contained a potentially rare *Angophora* species which has been sent to the Royal Botanical Gardens for identification.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.9 and shows that the majority of the plots meet the BioBanking benchmarks and are in moderate condition.

Table 3.8 **Rough-barked Apple – White Box Shrubby Woodland**

Rough-barked Apple – White Box Shrubby Woodland	
Conservation status	**Moderate:** The threatened flora species *Pomaderris queenslandica*
Condition	**Moderate**: The condition of this community met the moderate condition as set out by the BioBanking methodology across the two BOA sites.
Location	**Nioka North**: This community occurred on the west facing slopes on the north eastern boundary of the property. This condition encompassed 11.69 ha **Sunshine**: This community occurred on the east facing slopes on the north western boundary of the property. This condition encompassed 5.06 ha
Strata	**Dominant species**
Canopy	*Eucalyptus albens* and *Angophora floribunda?* And *Callitris glaucophylla*

Rough-barked Apple – White Box Shrubby Woodland	
Shrub stratum	*Acacia decora, Dodonaea viscosa, Xanthorrhoea glauca* subsp. *Angustifolia* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Rytidosperma racemosum, Poa sp., Dichondra sp. A, Vittadinia cuneata, Cymbopogon refractus, Enneapogon gracilis, Desmodium brachypodium, Poa sp., Sida spinosa** and *Cyperus gracilis.*

Photo 3.6 Rough-barked Apple – White Box Shrubby Woodland

Table 3.9 Comparison of Rough-barked Apple – White Box Shrubby Woodland quadrat data against vegetation benchmark data (NA225)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grass	Shrubs	Other				
Benchmark[1]	26	6-25	6-25	20-30	3-10	3-5	1		15	
Q43	32	9	35	56	2	14	1	0	12.4	Good-Moderate
Q46	27	3.5	16	42	0*	22	1	22	5.2	Good-Moderate
Q64	34	8.5	44	50	8	14	0	0	63	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA225 White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

3.1.5 Dwyer's Red Gum Woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the both of the BOAs in small remnant patches mainly on the top of hills and ridgetops and varied in condition. The canopy was that of woodland with a sparse to moderate shrub layer, which depended upon the level of grazing. The groundlayer contained a high number of native grasses and herbs. The characteristics of this community are summarised in Table 3.10. The community is illustrated in Photo 3.7. A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.11 and shows that plot 37 which is heavily grazed contained a limited native diversity, whereas plot 69 contained a high number of native species being higher than the benchmark. The condition of this community was good to moderate in comparison to the benchmarks.

Table 3.10 Summary of characteristics Dwyer's Red Gum Woodland

Dwyer's Red Gum Woodland	
Conservation status	**Moderate:** This community contains habitat for a number of threatened flora and fauna species.
Condition	Good-moderate: The condition of this community met the good-moderate condition as set out by the BioBanking methodology. However the shrublayer was absent in some patches due to grazing
Location	**Nioka North**: Occurs in two patches in the north east of the site and encompasses 4.34 ha. **Sunshine**: Occurs in two remnant patches in the south west and north west of the property. This community encompasses 2.63 ha. The condition of this community was generally canopy only in this property.
Strata	**Dominant species**
Canopy	*Eucalyptus dwyeri* and *Eucalyptus albens*
Shrub stratum	*Dodonaea viscosa*, *Eremophila mitchellii, Santalum lanceolatum Pimelea curviflora var. sericea* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Aristida calycina, Desmodium brachypodium, Dichondra sp. A, Austrostipa scabra, Cymbopogon refractus, Sporobolus creber, Lomandra multiflora and Vittadinia cuneata.*

Table 3.11 Comparison of Dwyer's Red Gum Woodland quadrat data against vegetation benchmark data (NA245)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grass	Shrubs	Other				
Benchmark[1]	30	25-40	6-25	20-30	3-10	3-5	2		20	
Q37	18	8	2	60	0*	10	0	10	52.5	Good-Moderate
Q69	44	11.5	8	64	6	16	0	4	6.2	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA245 Black Cypress Pine - Dwyers Gum low woodland / open forest on rocky ridges mainly of the Nandewar Range: Keith Formation: Dry Sclerophyll Forests (Shrubby sub-formation): Keith Class: Western Slopes Dry Sclerophyll Forests: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.7 Dwyer's Red Gum Woodland at Nioka North

Photo 3.8 Dwyer's Red Gum Woodland at Sunshine, showing grazing effects

3.1.6 Silver-leaved Ironbark heathy woodland

Silver-leaved Ironbark heathy woodland has been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the both of the BOAs as remnant patches. The canopy was varied from woodland to open forest and the shrub layer was dense to sparse depending upon the level of grazing. The groundlayer contained a number of native grasses and herbs. The characteristics of this community are summarised in Table 3.12. The community is illustrated in Photo 3.9 and Photo 3.10.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.13 and is used in the condition assessment of this community. This table shows that the majority of the plots meet the BioBanking benchmarks.

Table 3.12 Summary of characteristics Silver-leaved Ironbark heathy woodland

Silver-leaved Ironbark Heathy Woodland	
Conservation status	**Moderate**: Not a listed community, however provides habitat for numerous threatened flora and fauna species
Condition	Two condition classes **Moderate:** This condition class occurred as two patches on Sunshine and encompassed 13.65 ha **Low**: The condition class occurred on Nioka North and was in low condition as it occurred as grassland with scattered trees and encompassed 4.77 ha
Location	**Nioka North**: occurred as low condition in the centre of the property. **Sunshine**: occurred as moderate condition in the north of the property, with one remanent patch in the south east of the property.
Strata	**Dominant species**
Canopy	*Eucalyptus melanophloia, Eucalyptus albens* and *Callitris glaucophylla.*
Shrub stratum	*Olearia elliptica, Dodonaea viscosa, Acacia decora, Swainsonia galegifolia, Sigesbeckia australiensis* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Rytidosperma racemosum, Chloris ventricosa, Brunoniella australis, Vittadinia cuneata, Cymbopogon refractus, Desmodium brachypodium, Lomandra multiflora,* and *Cyperus gracilis.*

Table 3.13 Comparison of Silver-leaved Ironbark heathy woodland White Box Narrow-leaved Ironbark quadrat data against vegetation benchmark data (NA231)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grass	Shrubs	Other				
Benchmark[1]	23	6-25	0-5	30-40	0	3-5	1		30	
Q5	38	22	21	44	4	26	0*	4	38	Good-Moderate
Q21	22	8	0	46	0	26	12	0	12	Good-Moderate
Q29	29	14.5	42	30	2	32	0*	3	19.2	Good-Moderate
Q52	14	10	0	32	0	4	54	0	0*	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA231 White Cypress Pine - Silver-leaved Ironbark grassy woodland of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: Western Slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.9 Silver-leaved Ironbark heathy woodland – moderate condition at Sunshine

Photo 3.10 Silver-leaved Ironbark heathy woodland – low condition at Nioka North

3.1.7 White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the both of the BOAs within the ephemeral drainage lines. The canopy was that of a woodland structure, with the understorey varying from moderate to sparse in density. The groundlayer contained a number of native grasses and herbs, with pasture weed invasion occurring in some areas. The characteristics of this community are summarised in Table 3.14. The community is illustrated in Photo 3.11. Parts of this community are commensurate with the critically endangered White box - Yellow Box - Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act with all of this mapped community meeting the TSC Act criteria for listing. Further details and condition assessment for this is provided in Section 4.1.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.15 shows that the majority of the plots meet the BioBanking benchmarks for moderate condition.

Table 3.14 Summary of characteristics White Box Blakely's Red Gum – Rough-barked Apple riparian woodland

White Box Blakely's Red Gum – Rough-barked Apple riparian woodland	
Conservation status	**High:** Remnant Box Gum Woodland that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) and Critically Endangered on EPBC Act. Parts of this community met one or both of these TECs, further assessment is provided in section 4.1 below.
Condition	**Good-moderate**: All of the mapped patches of this community met the BioBanking benchmarks for moderate condition.
Location	**Nioka North**: This community occurs in all the riparian areas of the property. This encompasses 121.64 ha **Sunshine**: This community occurs in all the riparian areas of the property. This encompasses 241.94 ha. A small portion of this community had a high density shrub layer and this community occurred on the northern boundary of the property and encompassed 12.24 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus albens, Eucalyptus blakelyi* and *Angophora floribunda*
Shrub stratum	*Psydrax odorata, Acacia decora, Dodonaea viscosa, Pimelea microcephala* and *Notelaea microcarpa*
Ground cover	*Aristida calycina, Austrostipa verticillata, Dichondra sp. A, Lomandra filiformis, Desmodium brachypodium, Austrostipa scabra, Sida spinosa** and *Cyperus gracilis.*

Photo 3.11 White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland

Table 3.15 Comparison of White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland quadrat data against vegetation benchmark data (NA197)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grass	Shrubs	Other				
Benchmark[1]	25	6-25	0-5	30-40	3-10	3-5	1		15	
Q6	43	12.5	10	42	14	18	4	0	5	Good-Moderate
Q7	35	21	23	38	16	16	0*	4	45	Good-Moderate
Q8	17	0*	0	62	0*	16	0*	8	0*	Good-Moderate
Q11	30	13	11.5	42	12	28	3	6	18	Good-Moderate
Q17	43	16.5	4.5	46	6	24	2	10	65	Good-Moderate
Q18	31	13.5	4	52	4	26	2	6	30.8	Good-Moderate
Q19	27	13.5	5.5	48	4	28	1	6	26	Good-Moderate
Q22	35	8.5	0	18	0*	38	1	16	30.1	Good-Moderate
Q30	27	19.5	4.5	48	0*	12	0*	26	0*	Good-Moderate
Q35	38	29.5	2	48	2	16	4	16	65	Good-Moderate
Q36	40	12	2.5	46	8	28	0*	2	53.3	Good-Moderate
Q40	33	9	4	54	0*	6	1	22	34.6	Good-Moderate
Q51	11	9	0	38	0*	2	0*	48	17.8	Good-Moderate
Q55	41	13	4.5	48	2	24	0*	6	0*	Good-Moderate
Q72	42	9.5	5.5	40	4	18	0*	2	33.4	Good-Moderate
Q74	30	19	19.5	38	32	2	2	0	12	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA197 Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: New England Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

3.1.8 Yellow Box – Blakely's Red Gum grassy woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the north west of Nioka North property. The canopy was that of a woodland structure, with the understorey containing a high diversity of native species and a complex floristic structure. The groundlayer contained a large number of native grasses and herbs, with pasture weed invasion occurring in some areas. The characteristics of this community are summarised in Table 3.16. The community is illustrated in Photo 3.12. Parts of this community are commensurate with the critically endangered White box – Yellow Box – Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act with all of this mapped community meeting the TSC Act criteria for listing. Further details and condition assessment for this is provided in Section 4.1.

Table 3.16 Summary of characteristics Yellow Box – Blakely's Red Gum grassy woodland

Yellow Box – Blakely's Red Gum grassy woodland	
Conservation status	**High:** Remnant Box Gum Woodland that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) and Critically Endangered on EPBC Act. This community meets both of these TECs, further assessment is provided in section 4.1 below.
Condition	**Good-moderate**: The condition of this community is high as it had a high number of native species diversity and contained a complex floristic structure. The majority of the BioBanking benchmarks have been exceeded for this community
Location	**Nioka North**: This community occurred in one patch in the north west of this property and encompassed 60.45 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus melliodora, Eucalyptus blakelyi* and scattered occurrences of *Eucalyptus microcarpa.*
Shrub stratum	*Acacia dealbata, Acacia decora, Oncinocalyx betchei, Pimelea microcephala* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Aristida calycina, Austrostipa verticillata, Dichondra sp. A, Austrostipa scabra, Vittadinia cuneata, Calotis lappulacea, Lomandra longifolia, Glycine tabacina, Chamaesyce drummondii, Sida cunninghamii,* and *Cyperus gracilis.*

Photo 3.12 Yellow Box – Blakely's Red Gum grassy woodland at Nioka North

Table 3.17 Comparison of Yellow Box – Blakely's Red Gum grassy woodland quadrat data against vegetation benchmark data (NA237)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				Grass	Shrubs	Other				
Benchmark[1]	23	6-25	0-5	30-40	0	3-5	2		20	
Q1	54	22.5	10.5	52	4	28	1*	0	12	Good-Moderate
Q45	37	22.5	1.5	58	0	24	3	0	41	Good-Moderate
Q48	28	25.5	7.5	52	0	24	0*	0	0*	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA237 Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: Western Slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

3.1.9 Intensive agriculture

This community occurred in the across the majority of the southern lands of the Sunshine property with the paddocks adjoining the Boggabri-Manilla Road being currently used for growing crops. The south eastern portion of the Nioka north property is currently used for grazing and is in poor condition with a high density of exotic species. The grassland was generally exotic species and in some locations exotic species with commonly occurring native grass species dominant in some areas. This community included a small area of plantation which was an experimental study site for the University of New England on the Sunshine property. The characteristics of this community are summarised in Table 3.18. The community is illustrated in Photo 3.13.

Table 3.18 Summary of characteristics of intensive agriculture

Intensive agriculture	
Conservation status	**Not listed**
Condition	**Poor** condition. The vegetation was substantially modified from the pre-1750 woodland or forest community that is likely to have been present in this area. Exotic species dominated the ground layer, although some native species were present were in equal proportions to exotic species in small patches. Scattered remnant trees occur.
Location	**Nioka North**: This community occurred in one patch in the south east of this property and encompassed 62.70 ha. **Sunshine:** This community occurred in generally in the south of the property and encompassed 737.15 ha.
Strata	**Dominant species**
Canopy	Scattered **Schinus areira* and *Eucalyptus albens* trees.
Shrub stratum	Absent
Ground cover	Exotic species included **Carthamus lanatus, *Gomphocarpus fruticosus *Avena fatua, Sida spinosa*, Centaurea calcitrapa*, Hyparrhenia hirta*, Sida rhombifolia, *Sonchus oleraceus, *Richardia sp.* and *Conyza sp.* Native species include *Maireana microphylla, Austrostipa verticillata*, and *Dichanthium sericeum.*

Photo 3.13 Intensive agriculture

Table 3.19 Intensive Agriculture quadrat data and condition

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition[1]
				Grass	Shrubs	Other				
Q61	7	0	0	48	0	0	0	52	0	Low

Notes: 1) Condition based on BioBanking methodology for assessing condition of grassland (Office of Environment and Heritage 2014a).

3.2 Fauna habitat

Both the Nioka North and Sunshine properties contain large areas that have been long dedicated to grazing of cattle. Such areas were often devoid of native understorey cover and plant diversity, which might otherwise encourage the occurrence of small woodland fauna. For the most part, open areas had a sparse occurrence of canopy trees, with some gullies containing patches of trees. Here and there bare hills retained shrubby understorey vegetation, without canopy strata, which provided some ground cover for terrestrial animals and small bird species.

Few areas were considered to be of good habitat value to threatened fauna in the Sunshine property, with exceptions occurring along its northern boundary. Along the northern boundary of the Sunshine property continuous box woodland vegetation to its north, continued over the boundary onto the higher foot-slopes of the property. Such areas had sufficient woodland structure to support a number of threatened woodland bird species and provide habitats for arboreal mammals and threatened bats. Throughout the Sunshine property small isolated patches of trees occurred along drainage lines. But most of these were limited in their ability to support threatened fauna species, due to the fragmented and isolated nature of this vegetation.

Nioka North retained higher quality woodland habitats in its northeast and west. Old growth remnant woodland along the northwest boundary and associated with Mi Hi Creek was of very high habitat value for a suite of threatened woodland fauna, including blossom nomads, arboreal mammals, forest owls, bats and woodland birds. Dry woodland habitats on its south-western flanks were of good quality supporting a number of threatened woodland birds, but limiting others, due to the density of understorey shrubs. Woodland habitats in the northeast were often of high quality due to intact structural integrity, although some areas were devoid of canopy or understorey strata respectively. Such areas, like those in the southwest provided potential habitat for threatened bats, mammals and those threatened woodland birds that are suited to high shrubby understorey densities.

3.3 Flora species recorded

A total of 171 plant species were recorded in the ecology survey area during field surveys of which 143 species (84%) were native and 28 species (16%) were exotic (refer to Appendix A). The most diverse family recorded was Poaceae (grasses) with 31 species, followed by and Asteraceae with 12 species and Fabaceae with 11 species (Appendix A).

One threatened species of plant *Pomaderris queenslandica* was recorded on the north eastern boundary of the Nioka North property (refer Figure 4.1). This species is discussed further in Section 4.2.

3.3.1 Noxious weeds

Of the 28 exotic species that were recorded in the BOAs, three species of plant are listed under the *Noxious Weeds Act 1993* for the Narrabri and Gunnedah Shire Councils weed control area (refer to Table 3.20). None of these species are listed as a Weeds of National Significance (Australian Weeds Committee 2012). Other highly invasive species occurred abundantly, within the intensive agriculture lands within the BOAs and included: *Carthamus lanatus*, Sida spinosa*, Centaurea calcitrapa*, Hyparrhenia hirta*, Sida rhombifolia* and *Plantago lanceolata*.*

Table 3.20 Noxious weeds recorded within the BOAs

Name	Noxious Weeds Act 1993 control category[1]
*Lycium ferocissimum** (African Boxthorn)	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.
Xanthium spinosum (Bathurst Burr)	
*Opuntia stricta** (Prickly Pear)	

(1) Classes of noxious weed and control requirements under the *Noxious Weed Act 1993*; * - denotes an introduced species.

3.4 Fauna Species recorded

Ninety-six (96) fauna species were recorded across the Sunshine and Nioka North properties during surveys conducted in March and early April 2015; including 74 bird species, 16 mammals, 3 reptiles and 3 frogs. Of the 96 species observed during the survey nine were listed as threatened under the TSC Act and no species listed as threatened under the EPBC Act was observed. Threatened species recorded included eight birds; Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Grey-crowned Babbler, Little Lorikeet, Speckled Warbler, Turquoise Parrot and Varied Sittella, and one mammal, the Squirrel Glider.

During the current seasonal conditions the most obvious threatened fauna group were woodland bird species. The most widespread being Speckled Warbler, due to the widespread occurrences of shrubby understorey habitats, which is favoured by this species. Little Lorikeets were also recorded relatively frequently, due to the occurrence of blossom in some of the woodland patches. All other threatened bird species were relatively sparse in their occurrence, due to the limited areas of suitable habitat within the combined properties, however their presence, particularly the Black-chinned Honeyeater, was an indicator that some areas of habitat within the properties are of high value (see Figure 3.3 and Figure 3.4).

Two Squirrel Gliders were observed in old growth riparian habitat in the northwest of Nokia North (see Figure 3.4). The occurrence of large Yellow Box and White Box in this area was considered to be of high quality for nectarivorous fauna and may be used intermittently by threatened fauna, including endangered bird species, such as the Swift Parrot and Regent Honeyeater. Flowering White box near the northern boundary of Sunshine was attracting a moderate diversity of honeyeater species, and Little and Musk Lorikeets.

There was a low number of bat species recorded, limited to a single species, the Lesser Long-eared Bat (*Nyctophilus geoffroyi*), but cool climatic conditions during the survey period appeared to reduce the activity of both microchiropteran bats and herpetiles.

3.4.1 Feral animals

Eight species of introduced animal were recorded during the survey period, including 7 mammals and a single bird, the Common Starling.

Domestic cattle were present on both Nioka North and Sunshine and a small number of horses were also being run on Sunshine. Feral introduced animals including goats, pigs, foxes, cats and rabbits were also recorded during the survey. Pig sign and encounters, in particular, were frequent throughout the properties.

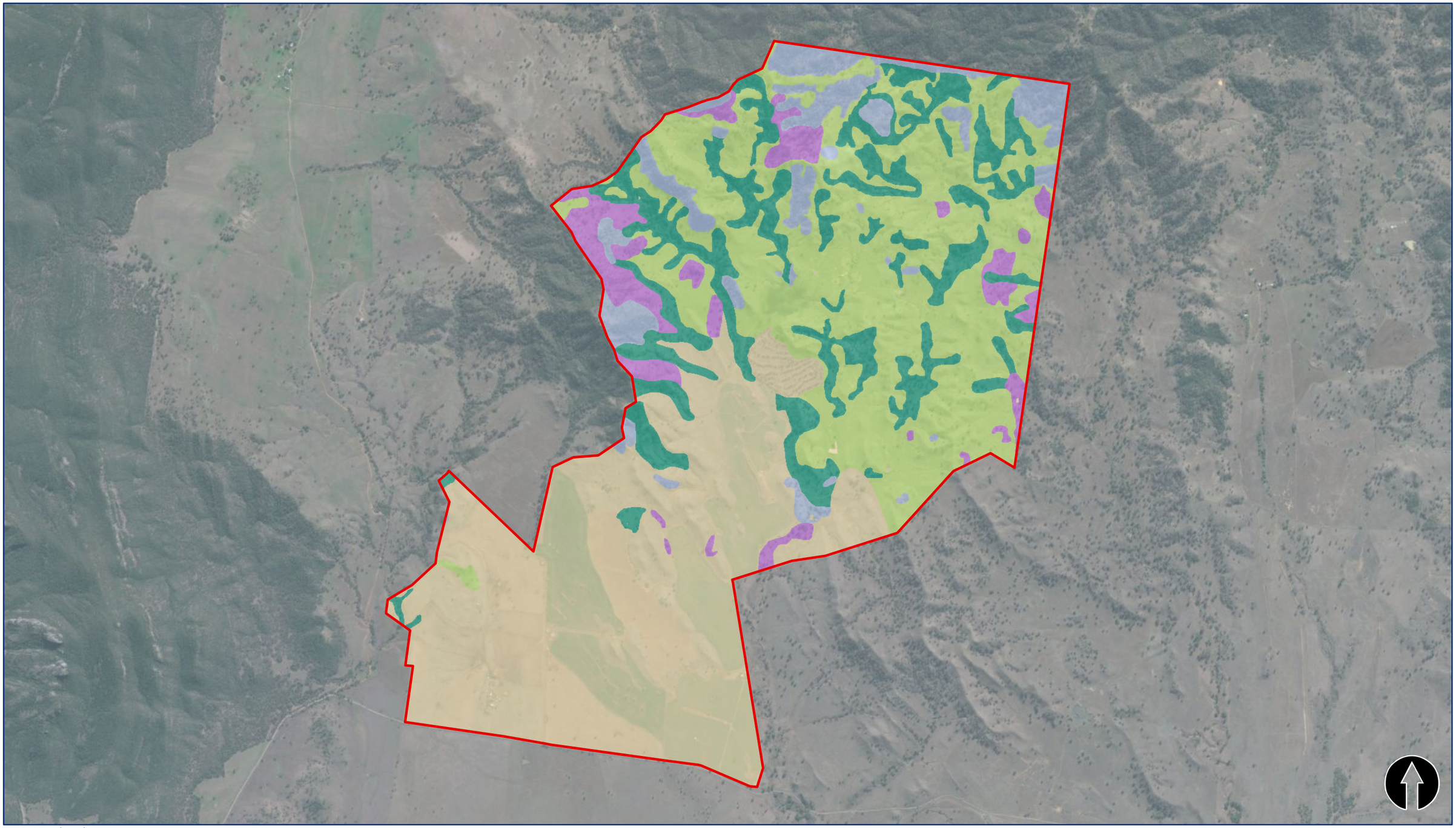
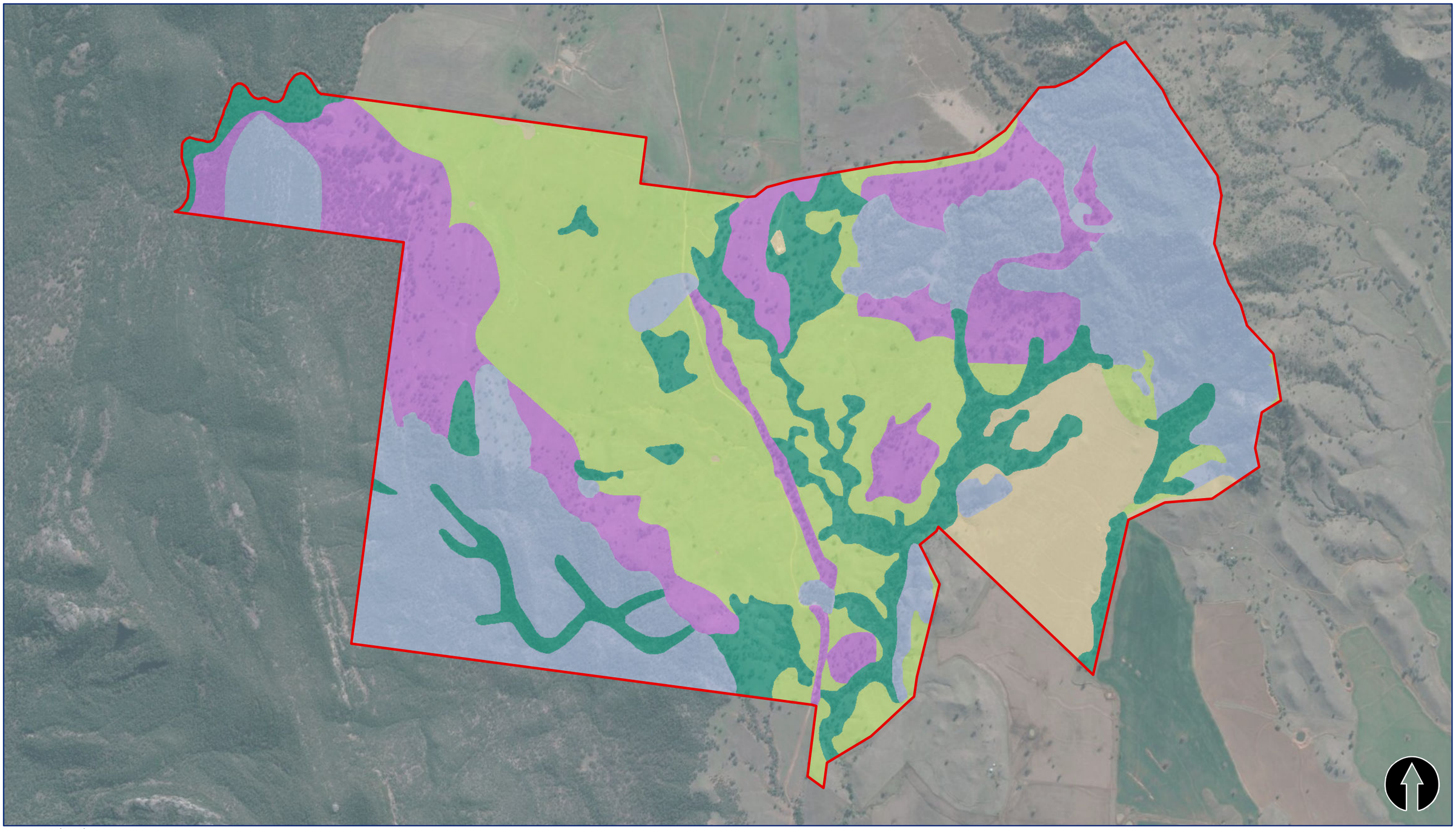


Figure 3.3
Fauna habitat of the Sunshine BOA



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Source: ESRI (2015)

Offset property

Fauna habitat

- Derived grassland
- Grassy Woodland on Fertile Soils
- Intensive Agriculture and Farm Dams
- Riverine Woodland
- Shrubby Woodland/Open Forest on Skeletal Soils

0 0.5 1 1.5 km

Figure 3.4
Fauna habitat of the Nioka North BOA

4. Threatened biodiversity

4.1 Threatened ecological communities

Threatened ecological communities (critically endangered, endangered and vulnerable) are listed under the TSC Act, EPBC Act and the *Fisheries Management Act 1994* (FM Act).

Results from the database searches indicated that 12 threatened communities (Table 4.1) were predicted to occur within the vicinity of the BOAs. One threatened ecological community was recorded within both of the BOAs. This threatened ecological community was commensurate with four vegetation communities recorded within the BOAs. Further discussion on this community is provided Section 4.1.1 and the locations of the Box-gum woodlands are shown in Figure 4.1.

Table 4.1 Threatened ecological communities predicted to occur in the vicinity of the BOAs

Threatened ecological community	TSC Act[1]	EPBC Act[2]	FM Act[3]	Recorded at Nioka North	Recorded at Sunshine
Aquatic Ecological community in the natural drainage system of the lowland catchment of the Darling river	-	-	E	No	No
Cadellia pentastylis (Ooline) community in the Brigalow Belt South Bioregions	E	-	-	No	No
Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions	E	E	-	No	No
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and North Coast Bioregions	E	-	-	No	No
Howell Shrublands in the New England Tableland and Nandewar bioregions	E	-	-	No	No
Inland Grey Box Grassy Woodlands and derived native grasslands of south-eastern Australia	E	E	-	No	No
Mt Kaputar high elevation and dry rainforest land snail and slug community in the Nandewar and Brigalow Belt south Bioregions	E	-	-	No	No
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	E	CE	-	No	No
New England Peppermint Grassy Woodland	CE	CE	-	No	No
Semi-evergreen Vine Thicket in the Brigalow Belt south and Nandewar bioregions	E	E	-	No	No
Weeping Myall Woodlands	E	E	-	No	No
White Box Yellow Box Blakely's Red Gum Grassy Woodland and derived native grassland	E	CE	-	Yes	Yes

(1) CE = listed as critically endangered community, E = Listed as endangered ecological community on the TSC Act.
(2) CE = listed as Critically Endangered community, E = listed as endangered ecological community on the EPBC Act.
(3) E = listed as Endangered Ecological community on the FM Act.

4.1.1 White Box Yellow Box, Blakely's Red Gum woodland

Conditions for the detection of native flora species to assist in identification were harsh due to drought conditions for the last 3 years and a grasshopper plague which was occurring at the time of the survey. It is highly likely that an additional survey after significant rain will result in some of the White Box Grassy Woodland (low condition – derived grassland) meeting the EPBC Act listing for the Remnant Box Gum Woodland.

4.1.1.1 Commonwealth listed White Box, Yellow Box, Blakely's Red Gum woodland and derived native grassland

Four communities, and associated derived grasslands, within the BOAs have some of the characteristics of the federally listed White Box Yellow Box Blakely's Red Gum grassy woodland and Derived Native Grassland (hereafter referred to as Box Gum Woodland):

- **White Box Grassy Woodland (moderate condition)** – This community has White Box as a dominant species within the canopy layer and contained a sparse shrub layer and grassy ground layer and therefore this community has been considered in Table 4.2 to determine if it meets the criteria for EPBC Act Remnant Box Gum Woodland.
- **White Box grassy woodland (low condition derived grassland)** – This community had scattered white box species present and generally occurred as grassland between areas of grassy woodland. Therefore this grassland community has been considered further in an assessment to determine if some of the patches meet the derived grassland criteria for the EPBC Act listed community in Table 4.2.
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland** – this community occurred in the riparian area of both BOAs. The dominant canopy species were White Box, Blakely's Red Gum and Rough-barked Apple. Therefore this community has been considered in Table 4.2 to determine if it meets the criteria for EPBC Act Remnant Box Gum Woodland.
- **Yellow Box Blakely's Red Gum grassy Woodland this community** – occurred in the riparian area in the north west of Nioka North. The dominant canopy species were Blakely's Red Gum and Yellow Box. Therefore this community has been considered in Table 4.2 to determine if it meets the criteria for EPBC Act Remnant Box Gum Woodland.
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland (Shrubby variant)** – A portion of this community on the Sunshine property has been mapped as a shrubby variant and this condition class did not meet the criteria for listed as Box Gum as it was greater than 30% shrub layer.

The process for determining if the above four communities meet the detailed Box Gum Woodland identification guidelines is provided in Figure 4.1 and is described in more detail in Table 4.2.

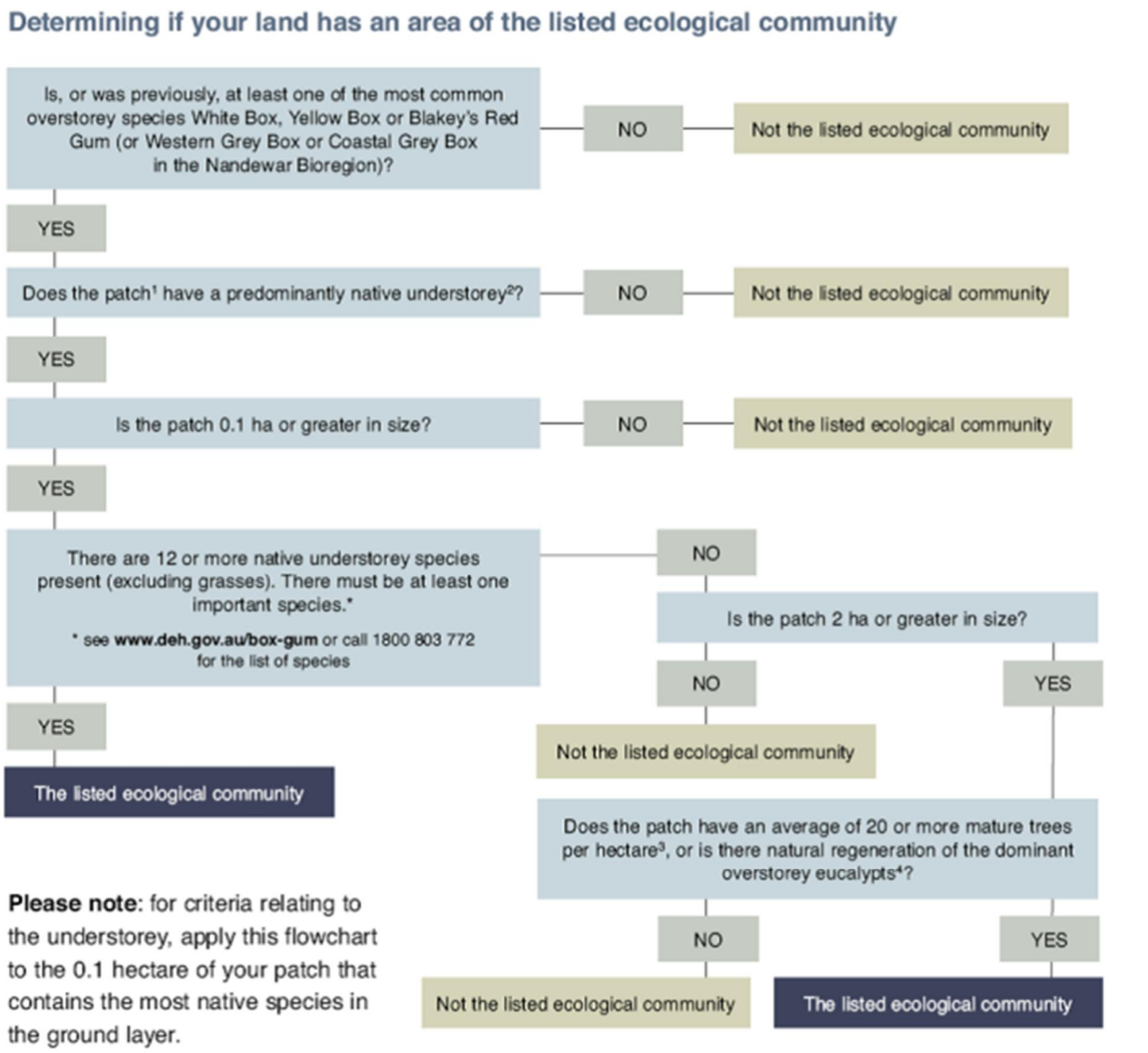
In addition to the identification guidelines presented below, the advice of the Threatened Species Scientific Committee (Environment Australia 2000) and final determination (Department of Environment and Heritage 2004) for this community were considered in determining the presence of Box-Gum Woodlands.

Shrub layer

In determining the presence of BoxGum 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). The first four of the communities above all had a shrub layer density is low (generally less than 10%) and as such is consistent with the sparse open shrub layer of the EPBC Act community.

Two additional communities, Rough-barked Apple – White Box shrubby Woodland and White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest both have White Box present in the canopy layer

however both of these communities have a shrub layer greater than 30% and therefore do not meet the criteria for the federal listed of Box Gum Woodlands.



[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 4.1 Identification of Box Gum Woodland

Table 4.2 Summary table of EPBC determination of Box Gum Woodlands for each patch

Step	EPBC Criteria for determining Box-Gum Woodlands[1]	White Box Grassy Woodland		White Box Blakely's Red gum Rough-barked Apple riparian woodland[2]	Yellow Box Blakely's Red Gum grassy woodland
		Woodland variant (moderate condition)	Derived grassland variant (low condition)		
1	**Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?**	**Yes**. This community had white box species present in the majority of patches. This included **plots 3, 9, 12, 13, 15, 51, 57, 58, 67, 73**	There was evidence of regeneration of eucalypts parts of the areas mapped as derived grassland. Juvenile White Box species were present in some of the plots. Therefore the, low condition white box grassy woodland may have previously contained White box species	**Yes**. White Box and Blakely's Red Gum were common in the overstorey. This included **plots 6, 7, 8, 11, 17, 18, 19, 22, 30, 35, 36, 40, 51, 55, 72**	**Yes**. Blakely's Red Gum and Yellow Box were common species in the overstorey. This included **plots 1, 45, 48**
2	**Does the patch have a predominantly native understorey?**	**Yes** All areas mapped as moderate- good condition were dominated by native understorey of native grasses.	**Yes in part** Some of the patches of grassland were dominated by native understorey.	**Yes** All areas mapped as moderate- good condition were dominated by native understorey of native grasses.	**Yes** The patch mapped was dominated by native understorey of native grasses.
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 derived grassland are greater than 0.1 ha	**Yes**, all areas of this community are greater than 0.1 ha.	**Yes**, the patch of this community is greater than 0.1 ha.
4	**Are there 12 or more native understorey species present (excluding grasses), with at least one important species?**	**Yes**. Quadrat data showed that some remnant patches included 12 or more native understorey species with at least one important species. This included **plots 9, 12, 13, 15, 57, 58, 67, 73**	**No.** None of the plots within derived grassland had 12 or more native species (excluding grasses) and an important species	**Yes**. Quadrat data showed that some remnant patches included 12 or more native understorey species with at least one important species. This included **plots 6, 7, 8, 11, 17, 18, 19, 22, 35, 36, 40, 51, 55, 72**	**Yes**. Quadrat data showed that the patch included 12 or more native understorey species with at least one important species. This included **plots 1, 45, 48**
5	**Is the patch 2 ha or greater in size?**	**Yes**. The majority of patches are greater than 2 ha.	**Yes**. The majority of patches are greater than 2 ha.	**Yes**. The majority of patches are greater than 2 ha.	**Yes**. The majority of patches are 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**. The patches had less than 20 mature trees per hectare some of the plots had regeneration of 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.	**Yes**. The majority of patches greater than 2 ha have more than 20 mature trees per hectare and/or have natural regeneration of eucalypts.

Step	EPBC Criteria for determining Box-Gum Woodlands[1]	White Box Grassy Woodland		White Box Blakely's Red gum Rough-barked Apple riparian woodland[2]	Yellow Box Blakely's Red Gum grassy woodland
		Woodland variant (moderate condition)	Derived grassland variant (low condition)		
END	**Does patch meet final determination of the listed community (Department of the Environment and Heritage 2006)?**	**Yes**, The majority of the patches that occur within Nioka North meet the criteria for EPBC Box Gum Woodland. The majority of the patches that occur within Sunshine meet the criteria for EPBC Box gum woodland.	**No.** The derived grassland patches in both Nioka North and Sunshine did not have 12 or more native species (excluding grasses), and patches generally lacked regeneration of dominant eucalypt overstorey.	**Yes**, The majority of the patches that occur within Nioka North meet the criteria for EPBC Box Gum Woodland. The majority of the patches that occur within the north western portion of the Sunshine property meet the criteria for EPBC Box gum woodland.	**Yes**. The patch that occurred within Nioka North property meets the criteria for the federal listing of Box-gum Woodland.

(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 ha 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.

(2) This assessment excludes the shrubby variant of this vegetation community as mapped on Figure 3.1

4.1.1.2 TSC Act listed 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 (NSW Scientific Committee 2002).

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:

1. Whether the site is within the area defined in the determination.
2. Whether the characteristic trees of the site are (or are likely to have been) White Box, Yellow Box or Blakely's Red Gum.
3. Whether the site is mainly grassy.
4. Whether any of the listed characteristic species occur (including as part of the seedbank in the soil).
5. 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).

Six vegetation communities that occur within both of the BOAs have the potential to be commensurate with the TSC Act listed Box-Gum Woodland with four meeting the criteria above. The reasons for this are outlined below:

- **White Box Grassy Woodland (moderate condition)** – This community meets the first four criteria above therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Remnant Box Gum Woodland
- **White Box grassy woodland (low condition derived grassland)** – This community had scattered white box species present and generally occurred as grassland between areas of grassy woodland. This community meets 1, 2, 3 & 5 of the above criteria and therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Box Gum Woodland (Derived Native Grasslands).
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland** – this community occurred in the riparian area of both BOAs. The dominant canopy species were White Box, Blakely's Red Gum and Rough-barked Apple. Therefore this community meets the first four criteria above therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Remnant Box Gum Woodland
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland (Shrubby variant)** – this community occurred in the northern portion of the riparian area of Sunshine. The dominant canopy species were Blakely's Red Gum and Rough-barked Apple. Therefore this community meets the first two criteria above, however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland.
- **Yellow Box Blakely's Red Gum grassy Woodland this community** – occurred in the riparian area in the north west of Nioka North. The dominant canopy species were Blakely's Red Gum and Yellow Box. Therefore This community meets the first four criteria above therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Remnant Box Gum Woodland
- **Rough-barked Apple – White Box shrubby Woodland** – This community meets criteria 1 and 2, however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland
- **White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest** – This community meets criteria 1 and 2, however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland

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 2002b).

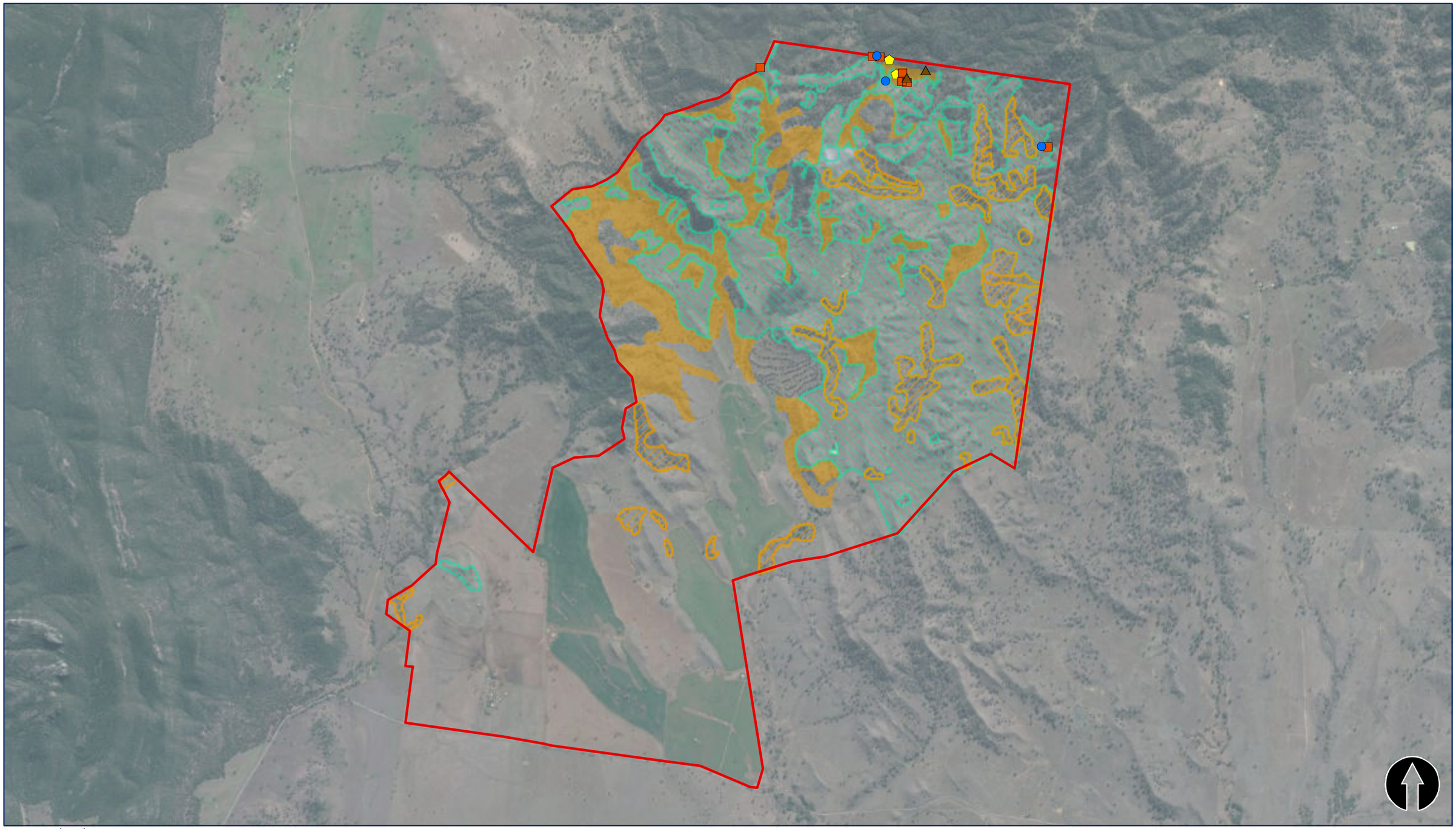
To determine the potential for assisted regeneration within each patch, an assessment according to one of the five condition criteria identified by the Box-Gum identification guidelines was completed (Table 4.3). This assessment was based on the results of the sampled plot with the greatest native diversity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

Some of the small remnants of woodland and scattered trees (e.g. some of the areas in the south and north of Sunshine) 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). However, all of the patches sampled contained areas with some native groundcover species and potential for regeneration.

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

TSC Act condition criteria for determining White Box, Yellow Box, Blakely's Red Gum Woodland	General comment	White Box Grassy Woodland		White Box Blakely's Red gum Rough-barked Apple riparian woodland1	Yellow Box Blakely's Red Gum grassy woodland
		Woodland (moderate condition)	Derived grassland (low condition)		
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	No	Yes – the community had a high diversity of natives (50+) and a multi aged overstorey
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 some of the patches of this community meet this condition class within both of the BOAs	No	Yes some of the patches of this community meet this condition class within both of the BOAs	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	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 Grassy Woodland (low condition) community mapped within both the BOAs.	No	No
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).	Yes some of the patches within both of the BOAs meet this condition class	No	Yes some of the patches within both of the BOAs meet this condition class	No
Does patch meet one of the five condition criteria for classification of the vegetation as the listed community? (condition class)		Yes (class two and class five)	Yes all the derived grassland meet this condition class(Class four)	Yes (class two and class five)	Yes (Class five) This community was in very good condition

(1) This assessment excludes the shrubby variant of this vegetation community as mapped on Figure 3.1 on the Sunshine BOA.



\\APNTLFPS01\proj\\Idemitsu_Aus_Resources\2117317A_ECO_Idemitsu_PM_secondment\10_GIS\Projects\Drawings_Figures_Sketches\2117317A_GIS_F123_A1.mxd Author: MitchellEm 29/04/2015

Source: ESRI (2015)

Offset property

Threat-listed fauna

- Brown Treecreeper
- Little Lorikeet
- Speckled Warbler
- Turquoise Parrot

Threatened ecological communities

- Box Gum Woodland (Derived Grassland) (TSC Act)
- Box Gum Woodland (TSC Act)
- Box Gum Woodland (EPBC Act and TSC Act)

0 0.5 1 1.5 km

Figure 4.2
Threat-listed species and threatened ecological communities within the Sunshine BOA

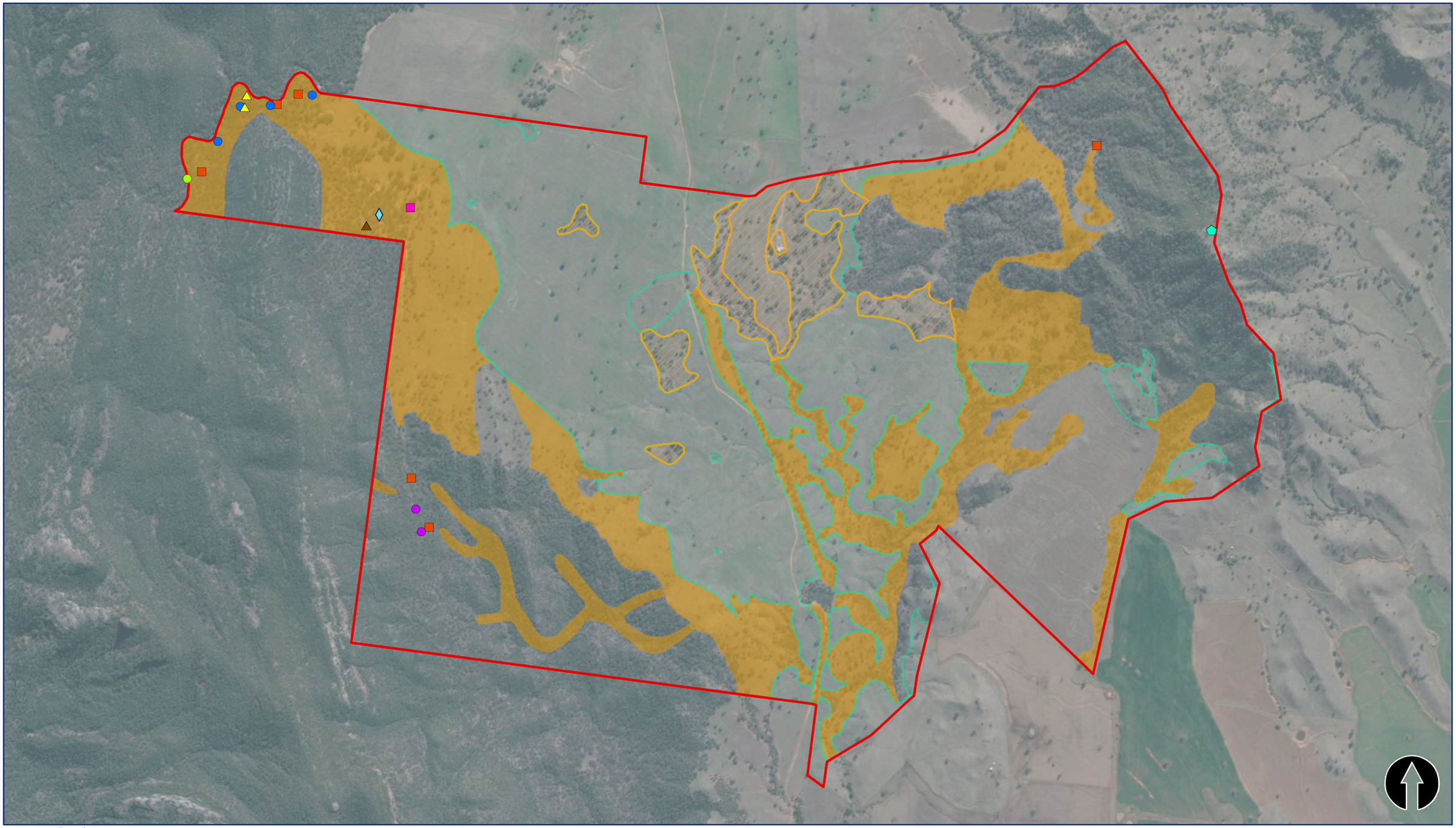


Figure 4.3
Threat-listed species and threatened ecological communities within the Nioka North BOA

4.2 Threatened flora

Based on the database searches (Table 2.2), a total of 13 threatened flora species listed under the TSC Act and/or the EPBC Act have been recorded previously or are predicted to occur within the locality of the BOAs. Details of these species and their habitat requirements are provided in Appendix C.

One threatened flora species of plant, *Pomaderris queenslandica* has been recorded in the north east of the Nioka North BOAs. One individual was recorded, however there is likely to be additional individuals as due to the dry conditions the plant was stressed and had been subject to grazing by herbivores (refer Photo 4.1). Based on the presence of suitable habitat, and additional seven species are considered to have a moderate likelihood of occurrence (Table 4.4).

Table 4.4 Threatened flora species recorded or with potential habitat within the BOAs

Common name	Scientific name	EPBC Act[1]	TSC Act[2]	Recorded?
Donkey Orchid	*Diuris tricolor*	-	V	No[3]
Bluegrass	*Dichanthium setosum*	V	V	No
Finger Panic Grass	*Digitaria porrecta*	E	E	No
Scant Pomaderris	*Pomaderris queenslandica*	-	E	Yes at Nioka North
Hawkweed	*Picris evae*	V	V	No
A Leek Orchid	*Prasophyllum sp. Wybong (C. Phelps ORG 5269)*	E	-	No
-	*Tylophora linearis*	E	E	No
Austral Toadflax	*Thesium australe*	-	V	No

(1) Listed as vulnerable (V), endangered (E) or critically endangered (CE) under the EPBC Act.
(2) Listed as an vulnerable (V), endangered (E) or critically endangered (CE) under the TSC Act.
(3) Survey completed outside of September flowering period.

The remaining threatened species of plant are considered to have a low likelihood of occurrence based on the availability of habitat. Full details of species requirements and reasons for not considering further are provided in Appendix C.

Photo 4.1 *Pomaderris queenslandica*

4.3 Threatened fauna

Based on the database searches (Table 2.2), a total of 32 threatened fauna species listed under the TSC Act and/or the EPBC Act have been recorded previously or are predicted to occur within the locality of the BOAs. Details of these species and their habitat requirements are provided in Appendix C.

Nine species of fauna listed as threatened under the TSC Act were recorded across the combined properties including eight birds and one mammal. Threatened bird species recorded included; Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Grey-crowned Babbler, Little Lorikeet, Speckled Warbler, Turquoise Parrot and Varied Sittella, with the single threatened mammal, being the Squirrel Glider.

Speckled Warbler was the most widespread threatened bird,

due to most remnant vegetation patches containing shrubby understoreys, which they prefer for cover and breeding purposes.

Little Lorikeet was also observed relatively commonly, due to the occurrence of White Box blossom during the survey period. Two Squirrel Gliders were also observed in association with White Box blossom on Nioka North and in some winter-flowering seasons, it is possible that Swift Parrots and Regent Honeyeaters may also use these higher value woodland habitats for foraging purposes.

All other woodland bird species were more or less limited to single observations (sometimes multiples of likely the same individuals on consecutive days), however the recording of multiple individuals of Turquoise Parrot, Grey-crowned Babbler, Brown Treecreeper, Varied Sittella and Black-chinned Honeyeater, suggest that these species are relatively well established in the locations they were observed.

A single Diamond Firetail was heard during the survey period, although it unlikely that a single individual occurs within the properties in isolation. Although not observed, there is sufficient mistletoe throughout the properties to attract Painted Honeyeaters during peak fruiting seasons.

No large forest owls were observed during the survey period, however the higher quality fauna habitats within the properties are likely to represent part of the home range of both the Barking and Masked Owls.

No threatened birds of prey were observed within the properties, however such species range over large areas and suitable habitats onsite were not large enough to support such species in isolation. Nevertheless it is considered likely that the properties may represent part of the home or seasonal range of a number of local threatened raptor species, including Spotted Harrier, Little Eagle, Square-tailed Kite and Black Falcon.

No threatened micro bats were observed during the survey period, however recent rainfall events appeared to cool ambient temperatures and reduce the activity of small bats. It is considered very likely that the majority of threatened bats recorded in the locality would utilise habitats within the properties for foraging purposes on an intermittent basis. Although there is no cave-roosting habitat for the Large-eared Pied Bat (*Chalinolobus dwyeri*) or the Eastern Cave Bat (*Vespadelus troughtoni*) within the properties, it is considered likely that hollow-dwelling threatened micro bats would roost regularly across both properties where trees contain suitable hollow-tree roosting habitat including isolated trees within pasture lands.

A number of locally occurring threatened fauna species, such as the Koala and Spotted-tailed Quoll are not considered to use habitats within the properties in isolation, however the juxtaposition of extensive suitable habitats to the north of Sunshine and west of Nioka North suggest that both these species may use high quality habitats continuous with offsite habitat on at least an intermittent basis.

Although no fauna species listed as threatened under the EPBC Act were observed during the surveys, there is suitable habitat onsite to attract a number of locally occurring EPBC Act listed animals on a seasonal or intermittent basis; including, Swift Parrot, Regent Honeyeater, Large-eared Pied Bat, Koala and Spotted-tailed Quoll.

4.4 Migratory species

Ten species listed as migratory on the EPBC Act have been recorded as having potential habitat within the locality of the BOAs based on the EPBC Act protected matters database search (Table 2.2).

There is limited potential for EPBC Act Migratory species to occur within the properties, since many such species are coastal in their movements and layover sites or are attracted to significant inland water bodies as stopover sites, and these do not occur onsite. One terrestrial migratory species was observed onsite, being the Rainbow Bee-eater. Although the season in which bee-eaters were observed suggests that they were in transit at the time of the observation, riparian substrates and banks on the properties appear suitable for the establishment of breeding territories by this species.

A further two species of migratory birds were not recorded but are considered to have habitat within the BOAs these included Cattle Egret and Eastern Great Egret (Appendix D).

5. Conclusions

5.1 Vegetation extent

The two biodiversity offset sites have significant native vegetation containing threatened ecological communities and habitat for threatened biodiversity (Table 5.1). Collectively the two properties contained **638.60 ha of Remnant Box Gum Woodland** and **834.55 ha of Box Gum Woodland (Derived Native Grassland).** Separately the two properties contained:

- **Nioka North –** 300.41 ha of Remnant Box Gum Woodland and 270.42 ha of Box Gum Woodland (Derived Native Grassland).
- **Sunshine –** 338.19 ha of Remnant Box Gum Woodland and 564.13 ha of Box Gum Woodland (Derived Native Grassland).

Table 5.1 Extent of Vegetation within the Biodiversity Offset Areas

Vegetation community	Vegetation extent within Noika North (ha)	Vegetation extent within Sunshine (ha)	Combined extent (ha)
White Box Grassy Woodland (moderate condition)[1]	99.23	66.31	165.54
White Box Grassy Woodland (moderate condition)[2]	19.09	29.94	49.03
White Box Grassy Woodland (low condition derived native grassland)[3]	270.42	564.13	834.55
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	215.59	88.12	303.71
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (Callitris Regrowth)	27.88	0.0	27.88
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest (Shiny Bush)	19.71	56.99	76.7
Rough-barked Apple – White Box Shrubby Woodland/grassland	11.69	5.06	16.75
Dwyer's Red Gum Woodland	4.34	2.63	6.97
Silver-leaved Ironbark Heathy woodland	4.77	13.31	18.08
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland[1]	92.43	153.93	246.36
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland[2]	29.21	88.01	117.22
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)[4]	0.0	12.24	12.24
Yellow Box – Blakely's Red Gum grassy woodland[1]	60.45	0.0	60.45
Intensive Agriculture	62.70	739.02	801.72
Total vegetation	**917.51**	**1819.69**	**2737.2**
Total native vegetation communities	**854.81**	**1079.98**	**1934.79**

Vegetation community	Vegetation extent within Noika North (ha)	Vegetation extent within Sunshine (ha)	Combined extent (ha)
Total Remnant Box Gum Woodland[1, 2]	**300.41**	**338.19**	**638.60**
Total Box Gum Woodlands (Derived Native Grasslands)[3]	**270.42**	**564.13**	**834.55**

(1) Commensurate with Critically Endangered Ecological Community, White Box Yellow Box Blakely's Red Gum Grassy Woodland and derived native grassland as listed under the EPBC Act.

(2) Commensurate with Endangered Ecological Community of White Box Yellow Box Blakely's Red Gum Woodland as listed on the TSC Act.

(3) Commensurate with Endangered Ecological Community of White Box Yellow Box Blakely's Red Gum Woodland as listed on the TSC Act, derived native grassland variant (i.e. Class 5).

(4) This community is not commensurate with Box Gum Woodland communities listed on the TSC Act or the EPBC Act, as it is too shrubby.

Both of the BOAs contain large areas of Box Gum Woodland (Derived Native Grassland) that meet the endangered ecological community as listed on the TSC Act and have high potential to be rehabilitated to a higher quality Remnant Box Gum Woodland.

5.2 Threatened flora and fauna

One threatened species of plant, *Pomaderris queenslandica* is listed as endangered on the TSC Act was recorded at Nioka North. A further seven threatened flora species are considered to have habitat within the both BOAs, being *Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Picris evae, Tylophora linearis* and *Thesium australe.*

Nine species of fauna list as threatened under the TSC Act were recorded across the combined properties including eight birds and one mammal. Threatened bird species recorded included; Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Grey-crowned Babbler, Little Lorikeet, Speckled Warbler, Turquoise Parrot and Varied Sittella, with the single threatened mammal, being the Squirrel Glider.

A further 14 species have potential to occur within both BOAs and these include, Barking Owl, Masked Owl, Spotted Harrier, Little Eagle, Square-tailed Kite, Black Falcon Eastern Cave Bat, Eastern Bent-wing Bat, Large-eared Pied Swift Parrot, Regent Honeyeater, Large-eared Pied Bat, Koala and Spotted-tailed Quoll.

6. References

Australian Weeds Committee 2012, *Weeds of National Significance*, viewed 8 June 2012 2012, <http://www.weeds.org.au/WoNS/>.

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

Department of Environment 2015, *Protected Matters Search Tool*, <http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/protected>.

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 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 Primary Industries 2015a, *Noxious Weed Declarations Web Site*, <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed>.

Department of Primary industries 2015b, *Threatened Aquatic Fauna Database Search*, Department of Fishing and Aquaculture.

Department of Sustainability Environment Water Population and Communities 2012, *Census of Australian Vertebrates*, <http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/index.html>.

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.

Eco Logical Australia 2008, *A Vegetation Map for the Namoi Catchment Management Authority*, An unpublished report prepared for Namoi Catchment Management Authority, December 2008.

Eco Logical Australia 2013, *Refinement of vegetation mapping in the Namoi Catchment: Extant and pre-European*, Prepared for the Namoi CMA, May 2013.

Environment Australia 2000, *Grassy white box woodlands listing advice*, Environment Australia, Canberra.

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.

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.

Keith, D 2004, *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT* Department of Environment and Conservation, Hurstville.

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, *White Box Yellow Box Blakely's Red Gum (Box-Gum) woodland: fact-sheet for NSW*, 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.

Office of Environment and Heritage 2012, *Vegetation Types Database*.

Office of Environment and Heritage 2014a, *BioBanking Assessment Methodology 2014*, Sydney.

Office of Environment and Heritage 2014b, *Vegetation Benchmarks Database*, October, 2014, <http://www.environment.nsw.gov.au/BioBanking/VegTypeDatabase.htm>.

Office of Environment and Heritage 2015, *BioNet the Atlas of NSW Wildlife Database Search*, <http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx>.

Parsons Brinckerhoff 2010, *Continuation of Boggabri Coal Mine - Biodiversity Offset Strategy*, Singleton, NSW.

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>>.

Royal Botanic Gardens 2015, *Plant Information Network System of The Royal Botanic Gardens and Domain Trust Version 2.0*, viewed 8 January 2015, <http://plantnet.rbgsyd.nsw.gov.au/>.

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

Appendix A

Plant Species Recorded

Table 1 Species of plant recorded within the study area

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Acanthaceae	*Brunoniella australis*	Blue Trumpet			Y
Acanthaceae	*Rostellularia adscendens*				Y
Adiantaceae	*Cheilanthes distans*	Bristly Cloak Fern			Y
Adiantaceae	*Cheilanthes sieberi*	Mulga Fern			Y
Amaranthaceae	*Alternanthera pungens*	Khaki Weed			N
Amaranthaceae	*Amaranthus deflexus*	Spreading Amaranth			N
Anacardiaceae	*Schinus molle*	Pepper Tree			N
Anthericaceae	*Caesia parviflora*	Pale Grass-lily			Y
Anthericaceae	*Dichopogon fimbriatus*	Nodding Chocolate Lily			Y
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort			Y
Apocynaceae	*Alstonia constricta*	Quinine Bush			Y
Apocynaceae	*Parsonsia eucalyptophylla*	Gargaloo			Y
Asclepiadaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush			N
Asphodelaceae	*Bulbine alata*	Native Leek			Y
Asteraceae	*Bidens pilosa*	Cobbers Pegs			N
Asteraceae	*Bidens subalternans*	Greater Beggars Ticks			N
Asteraceae	*Brachyscome ciliaris var. subintegrifolia*	Variable Daisy			Y
Asteraceae	*Brachyscome multifida*	Cut-leaved Daisy			Y
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy			Y
Asteraceae	*Carthamus lanatus*	Saffron Thistle			N
Asteraceae	*Cassinia laevis*	Cough Bush			Y
Asteraceae	*Chondrilla juncea*	Skeleton Weed			N
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting			Y
Asteraceae	*Cirsium vulgare*	Spear Thistle			N
Asteraceae	*Conyza sp.*				N
Asteraceae	*Euchiton sphaericus*	Annual Cudweed			Y
Asteraceae	*Glossocardia bidens*	Cobblers Tack			Y
Asteraceae	*Olearia elliptica*	Sticky Daisy Bush			Y
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood			Y
Asteraceae	*Schkuhria pinnata var. abrotanoides*	Dwarf Marigold			N

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Asteraceae	*Sigesbeckia australiensis*	Cobber Weed			Y
Asteraceae	*Sonchus oleraceus*	Common Sowthistle			N
Asteraceae	*Vittadinia cuneata*	Fuzzweed			Y
Asteraceae	*Vittadinia muelleri*	Narrow-leaf New Holland Daisy			Y
Asteraceae	*Xanthium spinosum*	Bathurst Burr			N
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine			Y
Brassicaceae	*Lepidium africanum*	Common Peppercress			N
Cactaceae	*Opuntia stricta*	Prickly Pear			N
Campanulaceae	*Wahlenbergia gracilis*	Sprawling or Australian Bluebell			Y
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell			Y
Campanulaceae	*Wahlenbergia stricta*	Tall Bluebell			Y
Caryophyllaceae	*Petrorhagia nanteuilii*	Childling Pink			N
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak			Y
Chenopodiaceae	*Einadia hastata*	Berry Saltbush			Y
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush			Y
Chenopodiaceae	*Einadia polygonoides*				Y
Chenopodiaceae	*Einadia trigonos*	Fishweed			Y
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush			Y
Chenopodiaceae	*Rhagodia spinescens*	Hedge Saltbush			Y
Chenopodiaceae	*Sclerolaena birchii*	Galvinized Burr			Y
Chenopodiaceae	*Sclerolaena calcarata*	Redburr			Y
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort			Y
Commelinaceae	*Commelina cyanea*	Native Wandering Jew			Y
Convolvulaceae	*Dichondra repens*	Kidney Weed			Y
Convolvulaceae	*Dichondra sp.* A				Y
Cupressaceae	*Callitris endlicheri*	Black Cypress Pine			Y
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine			Y
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge			Y
Euphorbiaceae	*Beyeria viscosa*	Pinkwood			Y
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed			Y
Euphorbiaceae	*Phyllanthus sp.*				Y
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil			Y

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil			Y
Fabaceae (Faboideae)	*Glycine clandestina*	Twining Glycine			Y
Fabaceae (Faboideae)	*Glycine tabacina*				Y
Fabaceae (Faboideae)	*Hovea lanceolata*				Y
Fabaceae (Faboideae)	*Indigofera adesmiifolia*	Tick Indigo			Y
Fabaceae (Faboideae)	*Medicago polymorpha*	Burr Medic			N
Fabaceae (Faboideae)	*Swainsona galegifolia*	Smooth Darling Pea			Y
Fabaceae (Mimosoideae)	*Acacia dealbata*	Green Wattle			Y
Fabaceae (Mimosoideae)	*Acacia decora*	Western Golden Wattle			Y
Fabaceae (Mimosoideae)	*Acacia homalophylla*	Yarran			Y
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle			Y
Fabaceae (Mimosoideae)	*Acacia salicina*	Cooba			Y
Geraniaceae	*Geranium molle subsp. molle*	Cranesbill Geranium			N
Lamiaceae	*Ajuga australis*	Austral Bugle			Y
Lamiaceae	*Marrubium vulgare*	Horehound			N
Linaceae	*Linum marginale*	Native Flax			Y
Lomandraceae	*Lomandra filiformis subsp. filiformis*				Y
Lomandraceae	*Lomandra glauca*	Pale Mat-rush			Y
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			Y
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush			Y
Loranthaceae	*Amyema miquelii*	Box Mistletoe			Y
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow			N
Malvaceae	*Sida corrugata*	Corrugated Sida, Variable Sida			Y
Malvaceae	*Sida cunninghamii*				Y
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne			N
Malvaceae	*Sida spinosa*				N
Myoporaceae	*Myoporum montanum*	Western Boobialla			Y
Myrtaceae	*Angophora floribunda*	Rough-barked Apple			Y
Myrtaceae	*Angophora spp.*	Narrow-leaved Apple			Y
Myrtaceae	*Eucalyptus albens*	White Box			Y
Myrtaceae	*Eucalyptus blakelyi*	Blakely's Red Gum			Y

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark			Y
Myrtaceae	*Eucalyptus dwyeri*	Dwyer's Red Gum			Y
Myrtaceae	*Eucalyptus melanophloia*	Silver-leaved Ironbark			Y
Myrtaceae	*Eucalyptus melliodora*	Yellow Box			Y
Myrtaceae	*Eucalyptus microcarpa*	Western Grey Box			Y
Nyctaginaceae	*Boerhavia dominii*	Tarvine			Y
Oleaceae	*Jasminum lineare*	Desert Jasmine			Y
Oleaceae	*Notelaea linearis*				Y
Oleaceae	*Notelaea microcarpa var. microcarpa*				Y
Onagraceae	*Epilobium billardiereanum subsp. cinereum*				Y
Orchidaceae	*Cymbidium canaliculatum*	Tiger Orchid			Y
Oxalidaceae	*Oxalis perennans*	Grassland Wood-sorrel			Y
Oxalidaceae	*Oxalis sp.*				Y
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn			Y
Pittosporaceae	*Pittosporum angustifolium*	Weeping Pittosporum			Y
Pittosporaceae	*Rhytidosporum sp.*				Y
Plantaginaceae	*Plantago cunninghamii*	Clay Plantain			Y
Plantaginaceae	*Plantago debilis*	Shade Plantain			Y
Plantaginaceae	*Plantago gaudichaudii*	Narrow Plantain			Y
Poaceae	*Aristida calycina var. calycina*	Dark Wire-grass			Y
Poaceae	*Aristida leptopoda*	White Speargrass			Y
Poaceae	*Aristida ramosa*	Cane Wire-grass			Y
Poaceae	*Austrostipa scabra*	Speargrass			Y
Poaceae	*Austrostipa verticillata*				Y
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass			N
Poaceae	*Bothriochloa decipiens*	Red Grass			Y
Poaceae	*Bothriochloa macra*	Red Grass			Y
Poaceae	*Bromus catharticus*	Prairie Grass			N
Poaceae	*Chloris truncata*	Windmill Grass			Y
Poaceae	*Chloris ventricosa*	Tall Chloris			Y
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass			Y

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Poaceae	*Cynodon dactylon*	Common Couch			Y
Poaceae	*Dichanthium sericeum*	Queensland Bluegrass			Y
Poaceae	*Digitaria breviglumis*				Y
Poaceae	*Digitaria brownii*	Cotton Panic Grass			Y
Poaceae	*Digitaria divaricatissima*	Umbrella Grass			Y
Poaceae	*Digitaria sp.*				Y
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass			Y
Poaceae	*Elymus scaber*				Y
Poaceae	*Enneapogon gracilis*	Slender Nineawn			Y
Poaceae	*Enneapogon intermedius*				Y
Poaceae	*Eragrostis laniflora*	Woollybutt			Y
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass			Y
Poaceae	*Eragrostis sp.*				Y
Poaceae	*Hyparrhenia hirta*	Coolatai Grass			N
Poaceae	*Panicum effusum*	Poison or Hairy Panic			Y
Poaceae	*Paspalidium distans*	Spreading Panic-grass			Y
Poaceae	*Paspalidium sp.*				Y
Poaceae	*Poa labillardieri*	Tussock			Y
Poaceae	*Poa sieberiana*	Grey Tussock-grass			Y
Poaceae	*Rytidosperma racemosum*				Y
Poaceae	*Sporobolus creber*	Slender Rats Tail Grass			Y
Poaceae	*Themeda australis*	Kangaroo Grass			Y
Polygonaceae	*Rumex brownii*	Swamp Dock			Y
Portulacaceae	*Portulaca oleracea*	Pigweed			Y
Ranunculaceae	*Clematis aristata*	Mountain Clematis			Y
Rhamnaceae	*Alphitonia excelsa*	Red Ash			Y
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris		E	Y
Rubiaceae	*Asperula conferta*	Common Woodruff			Y
Rubiaceae	*Canthium odoratum*	Shiny-leaved Canthium			Y
Rubiaceae	*Galium gaudichaudii*				Y
Rubiaceae	*Opercularia hispida*	Hairy Stinkweed			Y
Rutaceae	*Geijera parviflora*	Wilga			Y
Sapindaceae	*Dodonaea viscosa*	Sticky Hop-bush			Y

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Native
Scrophulariaceae	*Veronica persica*	Creeping Speedwell			N
Solanaceae	*Lycium ferocissimum*	African Boxthorn			N
Solanaceae	*Solanum cinereum*	Narrawa Burr			Y
Solanaceae	*Solanum linnaeanum*	Apple of Sodom			N
Solanaceae	*Solanum prinophyllum*	Forest Nightshade			Y
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia			Y
Sterculiaceae	*Brachychiton populneus*	Kurrajong			Y
Thymelaeaceae	*Pimelea curviflora var. sericea*				Y
Thymelaeaceae	*Pimelea neo-anglica*	Poison Pimelea			Y
Urticaceae	*Urtica incisa*	Stinging Nettle			Y
Verbenaceae	*Oncinocalyx betchei*				Y
Xanthorrhoeaceae	*Xanthorrhoea glauca subsp. angustifolia*				Y
Zygophyllaceae	*Tribulus micrococcus*	Yellow Vine, Spineless Caltrop			Y

Notes:
1:*Environmental Protection and Biodiversity Conservation Act 1999*;
2:*Threatened Species Conservation Act 1995:* E = Endangered

Appendix B

Animal Species Recorded

Table 1 Species of animal recorded within the study area

Common Name	Scientific Name	Native	Observation Type[1]	EPBC Act Status[2]	TSC Act Status[3]
Birds					
Apostlebird	*Struthidea cinerea*	Y	O	-	-
Australasian Pipit	*Anthus novaeseelandiae*	Y	O	-	-
Australian King-Parrot	*Alisterus scapularis*	Y	O	-	-
Australian Magpie	*Cracticus tibicen*	Y	O	-	-
Australian Raven	*Corvus coronoides*	Y	O	-	-
Australian Wood Duck	*Chenonetta jubata*	Y	O	-	-
Black-chinned Honeyeater	*Melithreptus gularis*	Y	O	-	V
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	Y	O	-	-
Blue-faced Honeyeater	*Entomyzon cyanotis*	Y	O	-	-
Brown Falcon	*Falco berigora*	Y	O	-	-
Brown Treecreeper	*Climacteris picumnus*	Y	O	-	V
Brown-headed Honeyeater	*Melithreptus brevirostris*	Y	O	-	-
Buff-rumped Thornbill	*Acanthiza reguloides*	Y	O	-	-
Common Bronzewing	*Phaps chalcoptera*	Y	O	-	-
Common Starling	*Sturnus vulgaris*	N	O	-	-
Crested Pigeon	*Ocyphaps lophotes*	Y	O	-	-
Crested Shrike-tit	*Falcunculus frontatus*	Y	O	-	-
Double-barred Finch	*Taeniopygia bichenovii*	Y	O	-	-
Eastern Rosella	*Platycercus eximius*	Y	O	-	-
Eastern Yellow Robin	*Eopsaltria australis*	Y	O	-	-
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	Y	O	-	-
Fuscous Honeyeater	*Lichenostomus fuscus*	Y	O	-	-
Galah	*Eolophus roseicapilla*	Y	O	-	-
Golden Whistler	*Pachycephala pectoralis*	Y	O	-	-
Grey Butcherbird	*Cracticus torquatus*	Y	O	-	-
Grey Fantail	*Rhipidura albiscapa*	Y	O	-	-
Grey Shrike-thrush	*Colluricincla harmonica*	Y	O	-	-
Grey Teal	*Anas gracilis*	Y	O	-	-
Grey-crowned Babbler	*Pomatostomus temporalis*	Y	O	-	V
Jacky Winter	*Microeca fascinans*	Y	O	-	-
Laughing Kookaburra	*Dacelo novaeguineae*	Y	O	-	-
Little Lorikeet	*Glossopsitta pusilla*	Y	O	-	V

Common Name	Scientific Name	Native	Observation Type[1]	EPBC Act Status[2]	TSC Act Status[3]
Magpie-lark	*Grallina cyanoleuca*	Y	O	-	-
Masked Lapwing	*Vanellus miles*	Y	O	-	-
Mistletoebird	*Dicaeum hirundinaceum*	Y	O	-	-
Musk Lorikeet	*Glossopsitta concinna*	Y	H	-	-
Nankeen Kestrel	*Falco cenchroides*	Y	O	-	-
Noisy Friarbird	*Philemon corniculatus*	Y	O	-	-
Noisy Miner	*Manorina melanocephala*	Y	O	-	-
Pacific Black Duck	*Anas superciliosa*	Y	O	-	-
Peaceful Dove	*Geopelia placida*	Y	O	-	-
Pied Butcherbird	*Cracticus nigrogularis*	Y	O	-	-
Pied Currawong	*Strepera graculina*	Y	O	-	-
Red Wattlebird	*Anthochaera carunculata*	Y	O	-	-
Red-rumped Parrot	*Psephotus haematonotus*	Y	O	-	-
Restless Flycatcher	*Myiagra inquieta*	Y	O	-	-
Rufous Whistler	*Pachycephala rufiventris*	Y	O	-	-
Speckled Warbler	*Pyrrholaemus sagittatus*	Y	O	-	V
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	Y	O	-	-
Spotted Pardalote	*Pardalotus punctatus*	Y	O	-	-
Striated Pardalote	*Pardalotus striatus*	Y	O	-	-
Striped Honeyeater	*Plectorhyncha lanceolata*	Y	O	-	-
Sulphur-crested Cockatoo	*Cacatua galerita*	Y	O	-	-
Superb Fairy-wren	*Malurus cyaneus*	Y	O	-	-
Turquoise Parrot	*Neophema pulchella*	Y	O	-	V
Varied Sittella	*Daphoenositta chrysoptera*	Y	O	-	V
Variegated Fairy-wren	*Malurus lamberti*	Y	O	-	-
Wedge-tailed Eagle	*Aquila audax*	Y	O	-	-
Weebill	*Smicrornis brevirostris*	Y	O	-	-
Welcome Swallow	*Hirundo neoxena*	Y	O	-	-
Whistling Kite	*Haliastur sphenurus*	Y	O	-	-
White-browed Scrubwren	*Sericornis frontalis*	Y	O	-	-
White-eared Honeyeater	*Lichenostomus leucotis*	Y	O	-	-
White-naped Honeyeater	*Melithreptus lunatus*	Y	O	-	-
White-plumed Honeyeater	*Lichenostomus penicillatus*	Y	O	-	-
White-throated Treecreeper	*Cormobates leucophaea*	Y	O	-	-

Common Name	Scientific Name	Native	Observation Type[1]	EPBC Act Status[2]	TSC Act Status[3]
White-winged Chough	*Corcorax melanorhamphos*	Y	O	-	-
Willie Wagtail	*Rhipidura leucophrys*	Y	O	-	-
Yellow Thornbill	*Acanthiza nana*	Y	O	-	-
Yellow-faced Honeyeater	*Lichenostomus chrysops*	Y	O	-	-
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Y	O	-	-
Yellow-tufted Honeyeater	*Lichenostomus melanops*	Y	O	-	-
Mammals					
Cat	*Felis catus*	N	O	-	-
Cattle	*Bos taurus*	N	O	-	-
Common Brushtail Possum	*Trichosurus vulpecula*	Y	O	-	-
Common Ringtail Possum	*Pseudocheirus peregrinus*	Y	O	-	-
Common Wallaroo	*Macropus robusta*	Y	O	-	-
Eastern Grey Kangaroo	*Macropus giganteus*	Y	O		
Fox	*Vulpes vulpes*	N	O	-	-
Goat	*Capra hircus*	N	O	-	-
Horse	*Equus ferus caballus*	N	O	-	-
Little Long-eared Bat	*Nyctophilus geoffroyi*	Y	O	-	-
Pig	*Sus scrofa*	N	O	-	-
Rabbit	*Oryctolagus cuniculus*	N	O	-	-
Red-necked Wallaby	*Macropus rufigriseus*	Y	O	-	-
Short-beaked Echidna	*Tachyglossus aculeatus*	Y	O	-	-
Squirrel Glider	*Petaurus norfolcensis*	Y	O	-	V
Swamp Wallaby	*Wallabia bicolor*	Y	O	-	-
Reptiles					
Eastern Brown Snake	*Pseudonaja textilis*	Y	O	-	-
Eastern Striped Skink	*Ctenotus robustus*	Y	O	-	-
Nobbi Dragon	*Amphibolurus nobbi*	Y	O	-	-
Frogs					
Eastern Banjo Frog	*Limnodynastes dumerilii*	Y	O	-	-
Common Eastern Froglet	*Crinia signifera*	Y	H	-	-
Dusky Gungan	*Uperoleia fusca*	Y	H	-	-

Notes:
1:O = Observed, H = Heard
2:*Environmental Protection and Biodiversity Conservation Act 1999*;
3:*Threatened Species Conservation Act 1995:* V = Vulnerable

Appendix C

Threatened Species of Plant

Table 1 Threatened species of plant known and/or predicted to occur within the study area

Family Name	Species Name	Common Name	EPBC Act Status	TSC Act Status	Habitat	Data Source	Likelihood of occurrence
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).	EPBC Protected Matters Search, PlantNet	**Moderate.** Suitable habitat in scrubby and open woodland that was recorded within the study area.
Asteraceae	*Picris evae*	Hawkweed	V	V	The main habitat is open Eucalypt forest including a canopy of Eucalyptus melliodora, E. crebra, E. populnea, E. albens, Angophora subvelutina, Allocasuarina torulosa , and/or Casuarina cunninghamiana with a Dichanthium grassy understory. Known in NSW north from the Inverell area, in the north-western slopes and plains regions. It has been collected near Inverell Oxley Park and also from Dangar Falls in the Oxley Wild Rivers National Park in the northern tablelands of NSW. (Royal Botanic Gardens 2005).	BioNet NSW Atlas search Namoi CMA - Peel sub-region	**Moderate**. Potential habitat in the grassy woodlands within the study area.
Brassicaceae	*Stenopetalum velutinum*	Velvet Thread-petal		E4	*Stenopetalum velutinum* is an annual woody herb with basal leaves. It is greyish green in colour and plants are densely hairy. It grows to approximately 7 cm in height and has yellow-green to brown flowers. It is known to grow on sandy soils with Buffel Grass. This species is known to occur in QLD, WA, NT and South Australia, however it is presumed extinct in NSW (Office of Environment and Heritage 2015).	BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
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 Protected Matters Search	Low. No suitable habitat was recorded within the study area.
Orchidaceae	*Diuris tricolor*	Pine Donkey Orchid		V	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2004), or in grassy Callitris woodland (Bishop 2000). 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 2007). 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).	Local knowledge	**Moderate.** Suitable habitat in the form of shrubby woodlands and forests that were recorded within the study area.
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 Protected Matters Search	**Moderate.** Suitable habitat in the form of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands that were recorded within the study area.
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 2005).	BioNet NSW Atlas search Namoi CMA - Peel sub-region	**Moderate.** Suitable habitat in the form of grasslands and grassy woodlands that occur on the basalt hills in the north of the study area.
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 2006a).	Atlas of NSW Wildlife, PlantNet	**Moderate.** Suitable habitat in the form of grasslands and grassy woodlands that were recorded within the study area.
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 2006b; Royal Botanic Gardens 2005).	EPBC Protected Matters Search	Low. No suitable habitat was recorded within the study area.
Proteaceae	*Hakea pulvinifera*		E	E1	Known from single population near Namoi River below Keepit Dam where it grows on a hard rocky hillside (Department of Environment and Conservation 2005).	Atlas of NSW Wildlife, PlantNet	Low. No suitable habitat was recorded within the study area.

Family Name	Species Name	Common Name	EPBC Act Status	TSC Act Status	Habitat	Data Source	Likelihood of occurrence
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris		E	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).	Local knowledge	**Recorded.** Recorded within Rough-barked Apple- White Box shrubby/grassy woodland on Nioka North. Additional habitat was also recorded on site in the form of on White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest.
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 Protected Matters Search	**Moderate.** Suitable habitat in the form of riverine woodlands that were recorded within the study area.
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 2006c).	EPBC Protected Matters Search, PlantNet	Low. No suitable habitat was recorded within the study area.

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 Protected Matters Search = 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 Rangari

Appendix C 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.

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 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 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 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, *Prasophyllum sp. Wybong (C.Phelps ORG 5269) in Species Profile and Threats Database*, Department of Sustainability Environment Water Population and Communities, Canberra,

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.

Office of Environment and Heritage 2015, *Threatened Species, populations and communities profiles database*, <http://www.environment.nsw.gov.au/threatenedspecies/>.

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,

Appendix D

Threatened Species of Animal

Table 1 Threatened species of animal known and/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
Amphibians						
Litoria booroolongensis	Booroolong Frog	E	E1 (NSW)	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 Protected Matters Search	Low: No local records.
Birds						
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).	Atlas of NSW Wildlife, EPBC Protected Matters Search	Moderate. Suitable foraging habitat for this species occurs on Nioka North and Sunshine. Potential breeding habitat occurs on Nioka North.
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 Protected Matters Search	Low. A far dispersing species in the warmer months, which may forage above the sites. There are no suitable terrestrial habitats for these species on either site.
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 Protected Matters Search	Moderate. Suitable foraging habitat for this species occurs on Nioka North and Sunshine.
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 Protected Matters Search	Moderate. Suitable foraging habitat for this species occurs on Nioka North and Sunshine.
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 *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 Wildlife	Recorded. Occurs throughout shrubby woodlands on both properties.
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 Wildlife	Recorded. Sparsely occurs in higher quality woodland on both properties.
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 2010).	Atlas of NSW Wildlife	Recorded. Recorded in shrubby woodland on Nioka North, but suitable habitat occurs in good quality woodland habitat within Sunshine as well.
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 Protected Matters Search	Low. No suitable wetland habitats occur on the Nioka North and Sunshine properties.
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 Wildlife	Recorded. Occurs widely where blossom was available on both properties.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence
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 Wildlife	Moderate. Likely to occur sparsely in good quality woodland on both properties when mistletoes are fruiting.
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 Protected Matters Search	Low. May flyover during dispersive movement, but no suitable habitat onsite.
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 Wildlife	High. Likely that the properties represent part of the home range of local individuals.
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).	EPBC Protected Matters Search	Low. A far dispersing species in the warmer months, which may forage above the sites. There are no suitable terrestrial habitats for these species on either site.
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 Protected Matters Search	Moderate. Highly dispersive species in response to variations in blossom distribution
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)	Atlas of NSW Wildlife	Moderate. Suitable habitat exists on both properties, although habitat on Nioka North is better and more extensive.
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).	EPBC Protected Matters Search	Recorded. Migrating individuals observed on Sunshine, riparian substrates and banks provide potential breeding habitat on both properties.
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 Protected Matters Search	Low. An upland species in NSW that is rare west of the great divide.
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 Wildlife	Recorded. A number of individuals recorded in woodland at Sunshine, but su
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).	Local knowledge	Moderate. Suitable habitat unlikely to support local pairs in isolation, but may represent part of home range for local individuals.
Pandion cristatus (syn. *P. haliaetus*)	Eastern Osprey	M	V	Generally a coastal species, occurring in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers to far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish (Pizzey & Knight 2007).	EPBC Protected Matters Search	Low. No suitable habitat on site.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence
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 Wildlife	Recorded. Family group observed on Nokia North, but suitable habitat occurs on both properties.
Rhipidura rufifrons	Rufous Fantail	M		Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range (Pizzey & Knight 2007).	EPBC Protected Matters Search	Low. Likely only as accidental occurrences, habitat unsuitable.
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 mudflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	EPBC Protected Matters Search	Low. Habitat unsuitable.
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 Wildlife	Recorded. Observed in woodland on Sunshine, but suitable habitat occurs on both properties.
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 Wildlife	Moderate. Suitable habitat along woodland edges and in open woodland on both properties.
Fish						
Ambassis agassizii	Olive Perchlet		E2	Inhabits rivers, creeks, ponds and swamps in both eastern (coastal) and western (Murray-Darling) drainage lines. This species is usually found in slow flowing or still water, often in proximity to overhanging vegetation, snags and boulders during the day. At night they disperse to feed on micro-crustaceans and insects (Department of Primary Industries 2009).	Fisheries	Low. No suitable habitat.
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).	Fisheries	Low. No suitable habitat.
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 Protected Matters Search	Low. No suitable habitat.
Mogurnda adspersa	Purple Spotted Gudgeon		E1	Purple spotted gudgeons occur in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. Purple spotted gudgeons are now extremely rare in inland NSW, having been recorded from this area only once since 1983. Purple spotted gudgeons are found in slow-moving or still waters of rivers, creeks and billabongs, often amongst weeds, rocks or large woody debris (snags)(Department of Trade and Investment Regional Infrastructure and Services 2011).	Fisheries	Low. No suitable habitat.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence
Invertebrates						
Notopala sublineata	River Snail		E1	The river snail once occurred in flowing rivers throughout the Murray-Darling system, where it was found along the banks attached to logs and rocks or crawling in the mud. Artificially introduced hard surfaces now provide habitat for the species with populations being recorded as surviving in irrigation pipelines throughout the Murray and Darling systems (Ponder *et al.* 2002). The pipeline environment is thought to promote microbial production and organic accumulation which is a highly nutritious food source for the species (NSW Department of Primary Industries 2007)	Fisheries	Low. No suitable habitat.
Mammals						
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 2011). Breeding habitat (maternity roosts) is located in roof domes in sandstone caves (Office of Environment and Heritage 2011). Thought to forage below the forest canopy for small flying insects (Churchill 1998).	Atlas of NSW Wildlife, EPBC Protected Matters Search	Moderate. Woodland habitats provide potential breeding habitats for this species, but there are no roosting habitats on either property.
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 1999d). 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 1999b, 1999d).	Atlas of NSW Wildlife, EPBC Protected Matters Search	Moderate. Neither property have sufficient suitable habitat to support this species in isolation from surrounding habitat, but roaming individuals are likely to occur on an intermittent basis.
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; 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).	EPBC Protected Matters Search	Moderate. Woodlands on both properties provide foraging and roosting habitats for this species.
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 1999c).	Atlas of NSW Wildlife	Recorded. Two individuals were observed in riparian forest on Nioka North, but limited suitable habitat occurs.
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).	Atlas of NSW Wildlife, EPBC Protected Matters Search	Low. No suitable habitat.
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 1999a, 2003b). Hawks Nest and Tea Gardens Population and population in the Pittwater LGA listed as Endangered under the NSW TSC Act.	Atlas of NSW Wildlife, EPBC Protected Matters Search	Moderate. Suitable foraging habitat in woodland across both properties.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lily pillies. It roosts in the branches of large trees in forests or mangroves (Churchill 2008; NSW National Parks and Wildlife Service 2001)	EPBC Protected Matters Search	Moderate. Suitable foraging habitat in woodland and isolated trees across both properties.

Scientific name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Habitat	Data source[3]	Likelihood of occurrence
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 Wildlife	High. Woodlands on both properties provide foraging and roosting habitats for this species.
Reptiles						
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 Protected Matters Search	Low. No local records although habitat within the properties may be suitable for this species.
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).	Local Knowledge	Moderate – preferred habitat recorded.
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 2002; Royal Botanic Gardens 2005).	Atlas of NSW Wildlife, EPBC Protected Matters Search	Low. No local records although habitat within the properties may be suitable for this species

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 Protected Matters Search = 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 Threatened and protected species records viewer

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

Department of Primary Industries 2009, *Profiles for species, populations & ecological communities. Olive Perchlet, Ambassis agassizii*, NSW Department of Primary Industries, <http://pas.dpi.nsw.gov.au/Species/Species_Profile.aspx?SpeciesListingID=19>.

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.

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 Department of Primary Industries 2007, *Recovery plan for the endangered river snail (Notopala sublineata)*, NSW Department of Primary Industries.

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

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

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

NSW National Parks and Wildlife Service 1999d, *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 2001, *Grey-headed Flying Fox threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002, *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 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.

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

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.

Ponder, W, Hutchings, P & Chapman, R 2002, *Overview of the conservation of Australian marine invertebrates*, Australian Museum, 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.

Appendix E

Braefield BOA Field Survey Report

Idemitsu Resources Australia Pty Ltd

Biodiversity Survey Report for Braefield

2 June 2015

PARSONS BRINCKERHOFF

Document information

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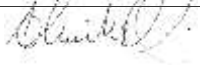
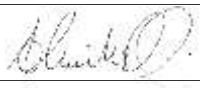
Reviewed by:	Alex Cockerill	Date: 18/05/2015	Signature: 
Approved by:	Alex Cockerill	Date: 02/06/2015	Signature: 

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Appendix D Threatened species of animal

Abbreviations

BMP	Biodiversity Management Plan
BNCCA Act	*Brigalow and Nandewar Community Conservation Area Act 2005*
BOAs	Biodiversity Offset Areas
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
CoA	Conditions of Approval
DBH	Diameter at breast height
DoE	Department of the Environment
DP&I	NSW Department of Planning and Infrastructure
DRE	NSW Department of Trade and Investment – Division of Resources & Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EEC	Endangered Ecological Community
EPL	Environment Protection License
FM Act	*Fisheries Management Act 1994*
ha	Hectares
LGA	Local Government Area
MOP	Mining Operations Plan
NES	National Environmental Significance
NIWAC	Northern Inland Weeds Advisory Committee
NSW	New South Wales
NV Act	*Native Vegetation Act 2003*
NW Act	*Noxious Weeds Act 1993*

RMP	Rehabilitation Management Plan
OEH	NSW Office of Environment and Heritage
Part 3a	Part 3a of *Environmental Planning and Assessment Act, 1979*
ROM	Run of Mine
TSC Act	*Threatened Species Conservation Act 1995*
WIRES	Wildlife Information and Rescue Service
WoNS	Weed of National Significance

1. Introduction

This report presents the findings of the baseline flora and fauna field surveys completed at Biodiversity Offset Areas (BOAs) that may be acquired as additional BOAs to offset impacts associated with the Boggabri Coal Project (the Project), managed by Boggabri Coal Pty Limited (Boggabri Coal).

The *Continuation of Boggabri Coal Biodiversity Offset Strategy* (Biodiversity Offset Strategy) (Parsons Brinckerhoff 2010) was developed as part of the Project's Environmental Assessment which was granted approval by the Director-General of the Department of Planning and Infrastructure under Schedule 3 of the *Environmental Planning and Assessment Act 1979.* This Biodiversity Offset Strategy outlined five distinct Biodiversity Offset Areas (BOAs) that create direct linkages or key stepping stones for a Regional East-West Wildlife Corridor (refer Figure 1.1):

- Mallee BOA (2,066 ha)
- Merriendi BOA (547 ha)
- Myall Plains BOA (481 ha)
- Namoi BOA (4,229 ha)
- Wirrilah BOA (1,047 ha).

In addition to these five BOAs the Biodiversity Offset Strategy required the acquisition of an additional 1000 ha of BOAs that were to include the *'protection of 650 ha of Box Gum Grassy Woodland ecological community and the restoration of 430 ha of Derived Native Grassland (Box Gum Grassy Woodland) ecological community as listed under the TSC Act'.*

Since the Project approval Boggabri Coal has acquired two BOAs to fulfil the additional 1000 ha requirement outlined in the Biodiversity Offset Strategy. These two properties include:

- Nioka North BOA (917 ha)
- Sunshine BOA (1,819 ha).

The Braefield property has been surveyed in the intention of acquiring it as a third BOA to fulfil the remaining areas of Box Gum Woodland and Derived Native required (of the 1000 ha). The Braefield property contains over 1600 ha of native vegetation. The property contains high quality remnant vegetation, particularly in the north, which will complement and adjoin high quality existing vegetation and will extend the Regional East-West Wildlife Corridor. An important environmental corridor that historically linked Leard State Forest with the Nandewar Range, Namoi River and large vegetation remnants to the west. The Biodiversity Offset Strategy (Parsons Brinckerhoff 2010) aims to recreate habitat linkages within this corridor.

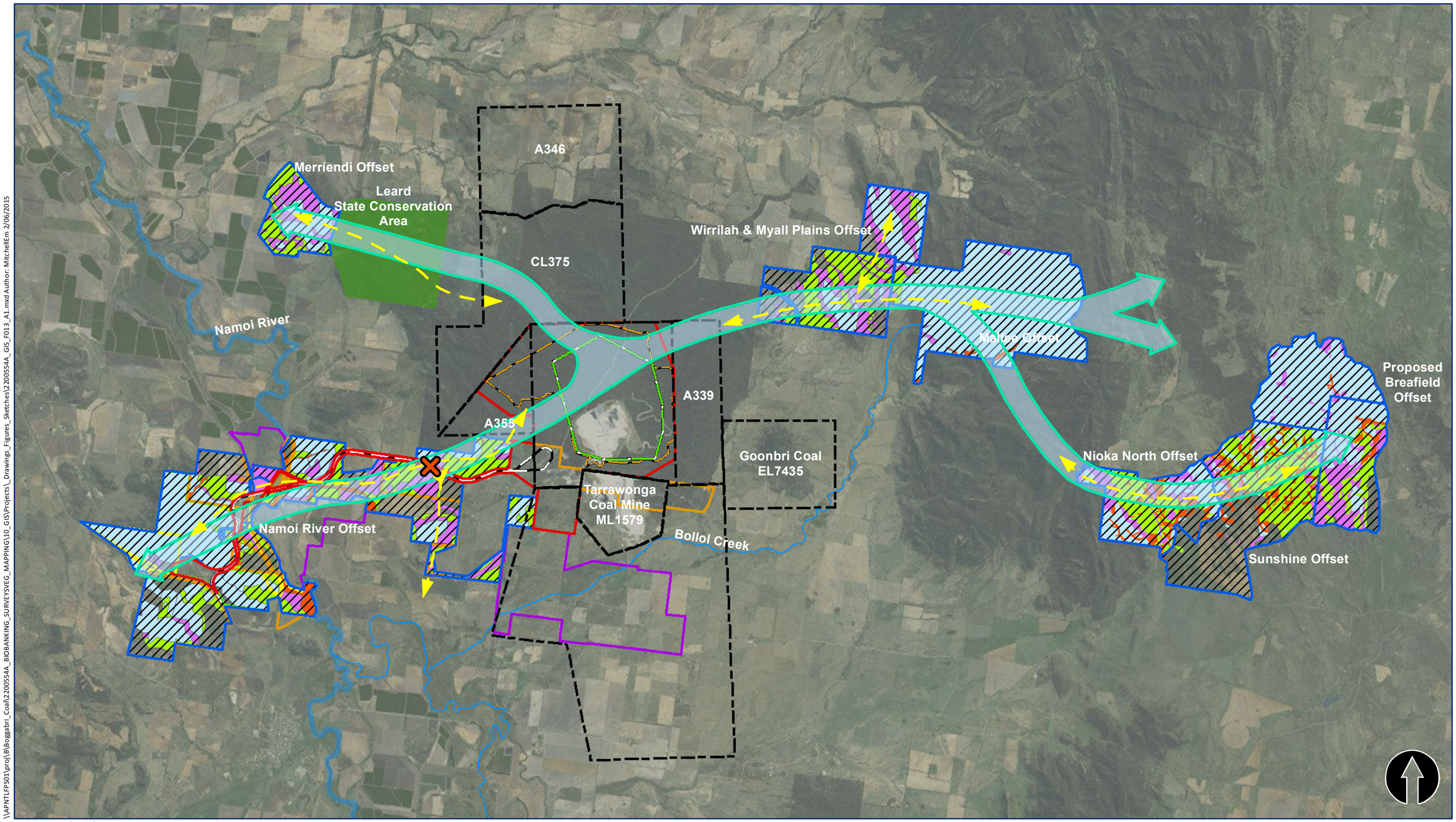
This report outlines the results of the ecological surveys within the potential offset site including the condition of the vegetation. If Braefield is acquired as a biodiversity offset the results of this report will be incorporated into the Biodiversity Management Plan (BMP) that has been developed by Boggabri Coal to provide recommendations for the management and restoration of the sites as biodiversity offsets.

1.1 Scope of report

This report is survey report that presents and summaries the terrestrial ecological surveys within the potential Braefield biodiversity offset site. These surveys provide an ecological inventory of the site and an assessment of the condition of the vegetation within the sites.

With these objectives in mind, the aims of this report are to:

- Present the results of current surveys.
- Determine and describe the characteristics and condition of the vegetation communities and flora and fauna habitats within the study area.
- Determine the occurrence, or likelihood of occurrence, of threatened species, populations and communities (biodiversity) listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* within the study area.
- Provide recommendations for management for biodiversity conservation.



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Source: ESRI (2015)

- Proposed Rail Loop
- Project Boundary
- EIS Mine Disturbance (Boggabri Existing)
- Proposed Disturbance Limit (Boggabri Extension)
- Mine Tenement
- Private Ownership within ZOA
- Crown Land
- Boggabri Coal Pty Limited
- Mining Joint Ownership
- Barrier location
- Biodiversity offset property
- Existing Mobile Movement Pathway
- Semi-mobile Movement Pathway

Fauna habitat

- Derived Grassland
- Grassy Woodland on fertile soils
- Riverine Woodland
- Shrubby Woodlands/Open Forest on skeletal soils

0 2 4 6 km

Figure 1.1
Location of the nine biodiversity offset areas and the regional east west wildlife corridor

2. Methods

This chapter details the desk-based and field methods used in surveying the current environment as well as the vegetation condition assessment methods.

2.1 Definitions

For the purpose of this report the following definitions apply:

- **Study area:** is defined as the potential BOA known as Braefield (refer Figure 2.1 and Figure 2.2).
- **Locality:** the area within 10 km of the study area.
- **Region:** a bioregion defined in a national system of bioregionalisation. For this study this is the Brigalow Belt South, Namoi sub-region as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).
- **Northern section:** northern section of the Braefield property that consists almost entirely of remnant vegetation owned by W. Keen (Lot 93, DP754946) (refer Figure 2.1).
- **Southern section:** southern section of Braefield property where areas have been subjected to agricultural grazing owned by B. Keen (Lots 75, 106 and 107, DP754946,) (refer Figure 2.2).
- **Remnant Box Gum Woodland:** vegetation communities that are consistent with the Box Gum Woodland community listed under the EPBC Act and /or TSC Act (dependent upon condition) that retain a native over storey.
- **Box Gum Woodland (Derived Native Grassland):** vegetation communities that are consistent with the Box Gum Woodland community listed under the EPBC Act and /or TSC Act (dependent upon condition) that no longer contains a native over storey. This community generally occurs as a native grassland which contains a native groundcover.

2.2 Contributors and qualifications

The contributors to the preparation of this report, their qualifications and roles are listed in Table 2.1.

Table 2.1 Contributors and their roles

Name	Qualification	Role
Alex Cockerill	BSc (Hons)	Project Manager, Technical Review
Deb Landenberger	BSc (Hons)	Senior Ecologist –field surveys, reporting
Allan Richardson	BEnvSc (Hons)	Senior Ecologist – field surveys, reporting
Nathan Cooper	BEnvSc. Grad Dip Ornith	Senior Ecologist – field surveys, reporting
Tanya Bangel	BSc (Hons)	Ecologist - field surveys, reporting
Emily Mitchell	Bachelor of Development Studies Cert 4 in Spatial Information Services	GIS Mapping

All work was carried out under the appropriate licences, including a scientific licence as required under Clause 22 of the *National Parks and Wildlife Regulations 2002* and Section 132C of the *National Parks and Wildlife Act 1974,* and an Animal Research Authority issued by the Department of Primary Industries (Agriculture).

2.3 Nomenclature

Names of plants used in this document follow Harden (Harden 1992, 1993, 2000, 2002) with updates from PlantNet (Royal Botanic Gardens 2015). Scientific names are used in this report for species of plant followed by the common names in brackets. Scientific and common names of plants are listed in Appendix A and Appendix C. Introduced species are identified within the text with an asterisk following the name, for example *Lantana camara**.

Vegetation community names have followed that of the Office of Environment and Heritage Plant Community Types (PCTs) vegetation types database (Office of Environment and Heritage 2014b) and as used in BioMetric 2.0 (Gibbons *et al.* 2008). Corresponding vegetation community names from the local broad scale vegetation mapping project of the Namoi CMA (Eco Logical Australia 2008, 2013) has been provided in Section 3.2.

Names of vertebrates follow the Australian Faunal Directory (2015) maintained by the Commonwealth Department of the Environment (DoE). Common names are used in the report for species of animal. Scientific names are included in species lists found in Appendix C and Appendix D.

2.4 Database searches

Records of threatened species known or predicted to occur in the locality of the project were obtained from a range of databases as detailed in Table 2.2.

Table 2.2 Database searches

Database	Searches	Area searched[1]	Reference
Atlas of NSW Wildlife (BioNet)	28 April 2015 (Flora and fauna)	10 km buffer around Braefield	Office of Environment and Heritage (2015a)
NSW Department of Primary Industries threatened Aquatic Fauna Database	28 April 2015	Namoi Catchment Management Authority area	NSW Department of Primary Industries (2015b)
PlantNet	28 April 2015	25 km buffer around Rangari	Royal Botanical Gardens, Sydney (2015)
Protected Matters Search Tool	28 April 2015	10 km buffer around study area	Department of Environment (Department of Environment 2015)
NSW Office of Environment and Heritage CMA Threatened Species Search	28 April 2015	Namoi CMA – Peel Sub - region	(Office of Environment and Heritage 2015b)
NSW Department of Primary Industries Noxious weed declarations	28 April 2015	Narrabri City Council Control Area	NSW Department of Primary Industries (2015a)

(1) Searches for Braefield were centred around lat -30.63211, lat 150.409534

2.5 Field survey

The field survey was undertaken from 20 April 2015 to 30 April 2015. This survey sought primarily to assess the extent and condition of vegetation and flora and fauna habitat, especially for threatened species and ecological communities.

2.5.1 Weather conditions

The weather conditions during the April surveying period generally consisted of mild temperatures and to fine weather (refer Table 2.3). During the first three days of survey the study area experienced considerable amounts of rainfall. Weather conditions cleared and became warm progressively throughout the survey period.

Table 2.3 Weather conditions

Date	Temperature °C (min)[1]	Temperature °C (max)[1]	Rain (mm)[1]	Wind (max speed (km/ph)/direction)[1]
20 April 2015	12.3	18.1	0.2	37 / SSE
21 April 2015	9.5	13.8	17.8	35 / NNW
22 April 2015	9.7	18.6	13.6	28 / WSW
23 April 2015	7.2	22.8	0.2	20 / WNW
24 April 2015	13.2	24.3	0.2	33 / NW
25 April 2015	9.1	23.9	0	52 / WSW
26 April 2015	8.8	19.1	0	43 / SW
27 April 2015	3.6	19.6	0	28 / W
28 April 2015	2.0	21.0	0	35 / SSE
29 April 2015	7.9	23.3	0	41 / SSE
30 April 2015	11.7	23.3	0	43 / ESE

(1) Data obtained from Bureau of Meteorology from Gunnedah Airport AWS NSW (Station 055202).

2.5.2 Fauna

Terrestrial vertebrate surveys consisted of habitat quality/ condition assessments and opportunistic surveys for local threatened fauna species. Surveys were completed as described below and where applicable, considered methodologies detailed in the *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)* (Department of Environment and Conservation 2004) and *Survey guidelines for Australia's threatened birds* (Department of Environment Water Heritage and the Arts 2010).

The threatened fauna survey methodology involved exploratory surveys over the majority of the study area, targeting areas of higher quality habitat and more intact native vegetation communities (refer Figure 2.1 and Figure 2.2). Climatic variables (cool overnight temperatures and moderate rainfall) together with property remoteness and limited access reduced the efficacy of completing targeted microchiropteran bat surveys on an animal welfare basis.

Fauna survey site investigations utilised the following methodologies:

- opportunistic diurnal bird surveys
- targeted threatened diurnal bird habitat surveys
- fauna habitat assessment
- herpetofauna active searches
- Koala scat searches.

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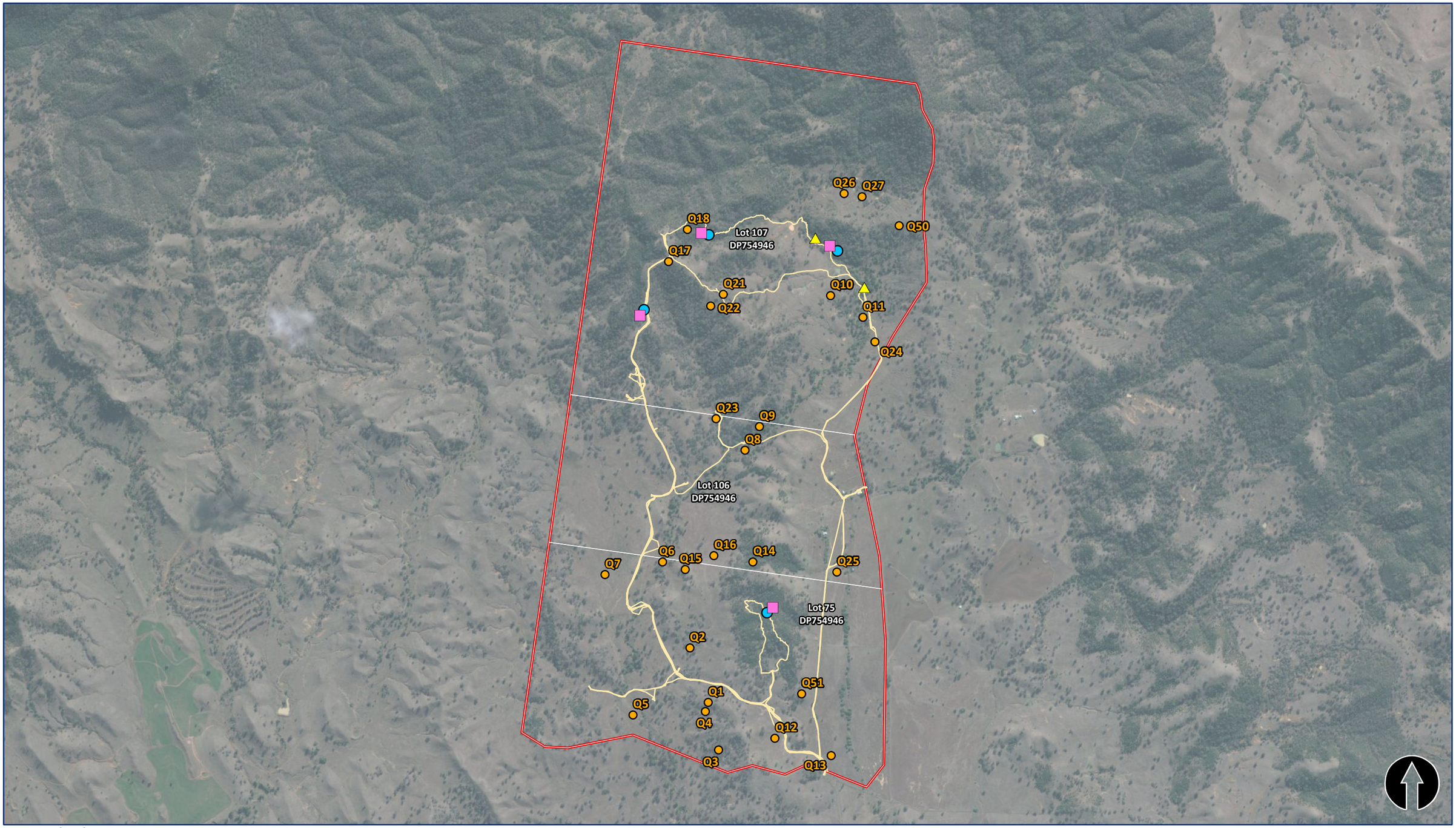
Q54
Q53
Q46
Lot 93
DP754946
Q38
Q39
Q35
Q36
Q37
Q34
Q30
Q29
Q41
Q19
Q20
Q40
Q42
Q43
Q28
Q32
Q33
Q44
Q45
Q48
Q47
Q49
Q52
Q31

Source: ESRI (2015)

Offset property
Cadastre
Flora quadrats
Habitat assessment
Herpetofauna active search
Koala scat search
Targeted threatened diurnal bird search

0 0.5 1 1.5 km

Figure 2.1
Flora and fauna survey
locations for Breafield (northern) BOA



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Source: ESRI (2015)

Offset property
Cadastre
Flora quadrats
Habitat assessment
Herpetofauna active search
Koala scat search
Targeted threatened diurnal bird search

0 0.5 1 1.5 km

Figure 2.2
Flora and fauna survey locations for Breafield (southern) BOA

A summary of fauna survey effort for threatened species is provided in Table 2.4. All fauna species observed during field surveys were documented and combined into a total species list (refer Appendix B).

Table 2.4 Summary of threatened fauna survey effort

Species targeted	Survey type	Survey effort and type	Dates surveyed	Habitat searched in ecology survey area
Diurnal bird surveys	Opportunistic surveys.	80 person hours	20-21 April 2015 27-29 April 2015	Grassy woodland, Shrubby woodland, Pasture lands, Farm Dams, Riparian woodland
Threatened diurnal birds	Opportunistic surveys and targeted habitat surveys.	80 person hours	20-21 April 2015 27-29 April 2015	Grassy woodland, Shrubby woodland, Pasture lands, Farm Dams, Riparian woodland
All threatened species	Opportunistic surveys	5 days	20-21 April 2015 27-29 April 2015	Grassy woodland, Shrubby woodland, Pasture lands, Farm Dams, Riparian woodland

2.6 Fauna habitats

Fauna habitat assessments were completed to assess the likelihood of threatened species of animal occurring in the Braefield properties. Habitat assessments included the assessment and identification of habitat features through targeted meander surveys.

During habitat assessments and targeted meander surveys, opportunistic recordings of species were made through incidental sightings, aural recognition of calls and observations of indirect evidence of species' presence (such as Glossy-black Cockatoo chewed cones, nests/dreys, whitewash, burrows and scats). This provided supplementary information on faunal species presence.

Fauna habitats were assessed generally by examining characteristics such as the structure and floristics of the canopy, understorey and ground vegetation, the structure and composition of the litter layer, and other habitat attributes important for feeding, shelter, roosting and breeding. The following criteria were used to evaluate 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 (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 past clearing.

2.6.1 Targeted threatened bird surveys

Diurnal bird surveys were completed over the five day survey period, with a focus on threatened species. All habitats throughout the two properties were assessed and surveyed for threatened woodland bird potential, with greater survey effort apportioned to areas containing important habitat attributes such as structural complexity, old growth community forms, larger patch size or connectivity to large patches and flowering canopy or understorey plants.

All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed throughout the day, with particular emphasis afforded to peak activity periods; being morning and afternoon. Birds were also recorded opportunistically during all other surveys and travelling between sites.

2.6.2 Herpetofauna active searches

Herpetofauna active searches involved looking for active specimens, turning over suitable ground shelter, such as fallen timber and exposed rocks, racking debris, and peeling decorticating bark. Specimens were either identified visually, by aural recognition of call (frogs only) or were collected and identified using nomenclature outlined in *A Field Guide to Reptiles of New South Wales* (Swan *et al.* 2004).

Herpetofauna surveys were completed over a 30 minute period with all ground shelter returned to their original position. Opportunistic herpetofauna searches were made during all other fauna surveys, although seasonal climatic contexts were not highly suitable for most herpetofauna species.

2.6.3 Koala scat searches

Targeted searches for the Koala consisted of inspecting feed trees for signs of usage including scratchings and scat searches. Koala feed tree species identified in the study area included Blakely's Red Gum (*Eucalyptus blakelyi*) and White Box (*E. albens*). At each survey location, scat searches were completed between the drip-line of the canopy and the trunk of approximately 20 trees.

2.7 Flora

The floristic diversity and possible presence of threatened species was assessed using a combination of random meander and plot-based (quadrat) surveys in accordance with the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft*) (Department of Environment and Conservation 2004). The plot based surveys were conducted in accordance with the BioBanking Assessment Methodology (BBAM) (Office of Environment and Heritage 2014a). This methodology was followed to allow for potential BioBanking calculations to be performed for any potential offsets that maybe required. This methodology is explained further in section 2.7.3 below.

Random meander surveys were completed along the entire length of the study area, these surveys included the extended proposal 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 meander throughout the site 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.

2.7.1 Desktop analysis of vegetation

The vegetation community boundaries were assessed using aerial photo interpretation. Analysis of the aerial photographs identified past land use practices, disturbance and native vegetation regrowth, changes in

vegetation structure and floristics throughout the study area. This provided an initial split of vegetation communities into simple structural and disturbance classifications.

2.7.2 Field verification of existing vegetation mapping

Vegetation within the study area and locality has been previously mapped at a regional scale by the Namoi CMA broadscale vegetation mapping project (Eco Logical Australia 2008, 2013).

Field validation (ground-truthing) of the initial vegetation classification identified from aerial photograph interpretation and existing vegetation mapping project (Eco Logical Australia 2008, 2013) was undertaken to determine the site specific classification of the vegetation structure, dominant canopy species, native diversity and condition.

2.7.2.1 Quadrats site surveys

Fifty four (quadrat/transect) site surveys (refer Table 2.5, Figure 2.1 and Figure 2.2) were completed within the study area as outlined in the methodology contained in the BioBanking Assessment Methodology (Office of Environment and Heritage 2014a) and described below and illustrated in Figure 2.3.

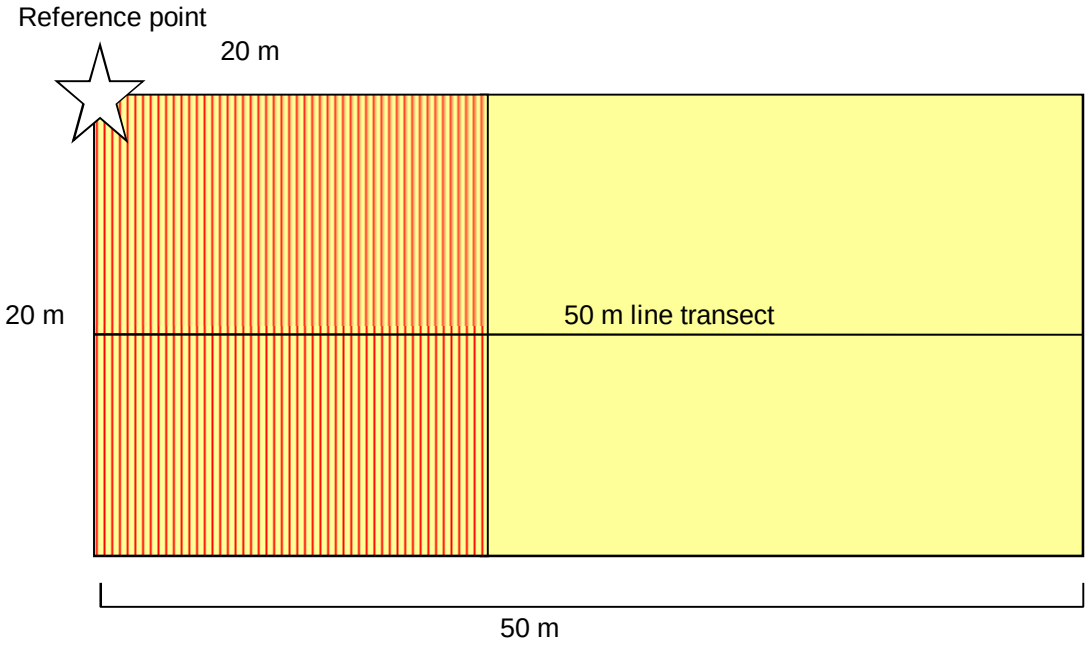


Figure 2.3 Schematic diagram illustrating the layout of the nested 20 m x 50 m and 20 m x 20 m quadrats used for the assessment of condition attributes at each site

The following site attributes were recorded at each site:

- Location (easting – northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition.
- Native and exotic species richness (within a 400 m^2 quadrat): this consisted of recording all species by systematically walking through each 20 m x 20 m quadrat. The cover abundance of each species was estimated.
- Number of trees with hollows (1,000 m^2 quadrat): this was the frequency of hollows within living and dead trees within each 50 m x 20 m quadrat. A hollow was only recorded if:
  - the entrance could be seen

- the estimated entrance width was at least 5 cm across
- the hollow appeared to have depth
- the hollow was at least 1 m above the ground
- the centre of the tree was located within the sampled quadrat.

- Total length of fallen logs (1,000 m^2 quadrat): this was the cumulative total of logs within each 50 m x 20 m quadrat with a diameter of at least 10 cm and a length of at least 0.5 m.
- Native over-storey cover: this consisted of estimating the percentage cover of the tallest woody stratum present (>1 m and including emergents). The woody stratum included species that were native to NSW and not necessarily those that were locally endemic.
- Native mid-storey cover: this involved estimating the cover of vegetation between the over-storey stratum and a height of one m (i.e. tall shrubs, under-storey trees and tree regeneration).
- Ground cover: this comprised estimating the cover of plants below 1 m in height. The following categories of plants were recorded:
  - native ground cover (grasses): native grasses (Poaceae family native to NSW)
  - native ground cover (shrubs): all woody vegetation below one m in height and native to NSW
  - native ground cover (other): non-woody vegetation (i.e. vascular plants–ferns and herbs) below one m in height and native to NSW
  - exotic plant cover: vascular plants not native to Australia.
- Evaluation of regeneration: this was estimated as the proportion of over-storey species present at the site that was regenerating (i.e. saplings with a diameter at breast height ≤5 cm). The maximum value for this measure was one.

Table 2.5 Location of flora quadrats

BioBanking quadrat/transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q1	Tumbledown Red Gum Grassy Woodland	252830	6606719
Q2	Yellow Box – Blakely's Red Gum grassy woodland	252715	6607057
Q3	White Box Grassy Woodland (moderate condition)	252894	6606422
Q4	White Box Grassy Woodland (moderate condition)	252811	6606663
Q5	White Box Grassy Woodland (low condition derived native grassland)	252361	6606640
Q6	Yellow Box – Blakely's Red Gum grassy woodland	252546	6607592
Q7	White Box Grassy Woodland (low condition derived native grassland)	252188	6607513
Q8	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	253058	6608288
Q9	White Box – White Cypress Pine shrubby open forest	253149	6608434
Q10	Tumbledown Red Gum Grassy Woodland	253592	6609249
Q11	White Box – Melaleuca Riverine Forest	253793	6609115
Q12	White Box Grassy Woodland (low condition derived native grassland)	253245	6606495
Q13	White Box Grassy Woodland (low condition derived native grassland)	253595	6606389

BioBanking quadrat/transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q14	White Box – White Cypress Pine shrubby open forest (Callitris Regrowth)	253108	6607592
Q15	White Box Grassy Woodland (moderate condition)	252686	6607545
Q16	White Box Grassy Woodland (low condition derived native grassland)	252865	6607632
Q17	White Box – White Cypress Pine shrubby open forest	252583	6609461
Q18	White Box – White Cypress Pine shrubby open forest	252700	6609660
Q19	White Box Grassy Woodland (moderate condition)	252816	6610905
Q20	White Box – White Cypress Pine shrubby open forest	252860	6610914
Q21	White Box Grassy Woodland (moderate condition)	252924	6609257
Q22	White Box – White Cypress Pine shrubby open forest	252845	6609185
Q23	White Box Grassy Woodland (moderate condition)	252879	6608484
Q24	White Box Grassy Woodland (moderate condition)	253868	6608962
Q25	White Box Grassy Woodland (low condition derived native grassland)	253631	6607529
Q26	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	253676	6609884
Q27	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	253788	6609864
Q28	White Box – White Cypress Pine shrubby open forest	251517	6610724
Q29	New England Blackbutt Rough-barked Apple Shrubby Open Forest	251620	6610872
Q30	White Box – White Cypress Pine shrubby open forest	251559	6610900
Q31	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	251138	6609810
Q32	White Box Grassy Woodland (moderate condition)	250873	6610694
Q33	Tumbledown Red Gum Grassy Woodland	250997	6610737
Q34	White Box Grassy Woodland (moderate condition)	251086	6611090
Q35	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	251222	6611494
Q36	White Box Grassy Woodland (moderate condition)	250983	6611284
Q37	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	250788	6611046
Q38	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	252283	6611671
Q39	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	252287	6611597
Q40	White Box Grassy Woodland (moderate condition)	252444	6610892
Q41	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	252494	6610939

BioBanking quadrat/transect ID	Plant community type (vegetation condition class)	Easting[1]	Northing[1]
Q42	Tumbledown Red Gum Grassy Woodland	252559	6610795
Q43	White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	252627	6610812
Q44	White Box - Dwyer's Red Gum – Mana Gum shrubby woodland	249643	6610659
Q45	White Box - Dwyer's Red Gum – Mana Gum shrubby woodland	249679	6610636
Q46	White Box - Dwyer's Red Gum – Mana Gum shrubby woodland	250187	6611808
Q47	White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	249724	6610053
Q48	White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	250386	6610090
Q49	White Box – White Cypress Pine shrubby open forest	250259	6609964
Q50	Tumbledown Red Gum Grassy Woodland	254019	6609683
Q51	White Box Grassy Woodland (moderate condition)	253411	6606771
Q52	White Box – White Cypress Pine shrubby open forest	250994	6609862
Q53	White Box – White Cypress Pine shrubby open forest	250264	6612320
Q54	White Box Grassy Woodland (moderate condition)	251103	6612625

(1) GDA 94: Zone 56.

2.7.3 BioBanking quadrat/transect survey effort

Table 2.6 below outlines the survey effort for the BioBanking plots in each plant community type and their condition.

Table 2.6 BioBanking quadrat/transect survey effort

Plant community type (vegetation condition class)	Number of quadrats	Survey effort (person hours)
White Box Grassy Woodland (moderate)[1]	13	13
Yellow Box – Blakely's Red Gum Grassy Woodland[1]	2	2
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland[1]	6	6
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	4	4
Tumbledown Red Gum Grassy Woodland	5	5
White Box – White Cypress Pine shrubby open forest (including Callitris Regrowth and Shiny Bush variations)	11	11
White box – Melaleuca riverine forest	1	1
White Box - Dwyer's Red Gum – Mana Gum shrubby woodland	3	3
New England Blackbutt Rough-barked Apple shrubby open forest	1	1
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	2	2

Plant community type (vegetation condition class)	Number of quadrats	Survey effort (person hours)
White Box Grassy Woodland (low)[2]	6	6
Intensive agriculture - other	0	0
Totals	**54**	**54**

Note:
1. Consistent with Remnant Box Gum Woodland
2. Consistent with Box Gum Woodland (Derive Native Grassland)

2.7.4 Condition and quality assessment of vegetation communities

The overall condition of vegetation was assessed through general observation and comparison against the BioBanking benchmark data (Office of Environment and Heritage 2014c) and the vegetation condition definition as set out in the BioBanking Assessment Methodology (BBAM) operations manual (Office of Environment and Heritage 2014a). The moderate to good condition classes have generally been subject to disturbance in the understorey, but had native regrowth vegetation occurring.

Two categories were used to describe the condition of the vegetation communities are set out below:

- **Good – moderate condition:** The vegetation in this condition class can have vegetation that is in good condition where the vegetation has changed very little over time and displays resilience to weed invasion due to intact groundcover, shrub and canopy layers. This class will be at or above the BioBanking benchmarks (Office of Environment and Heritage 2014c). This condition can also contain vegetation that has retained a native canopy and has a native understorey of greater than 50%. This condition class can include derived native grasslands and can have minor weed incursions with some patches being subject to grazing. This condition equates to BBAM moderate to good condition (Office of Environment and Heritage 2014a).
- **Low condition:** Vegetation has a native canopy less than 50% of the lower benchmark. The understorey is generally dominated by exotic species being greater than 50% exotic cover. The shrub layer was generally absent from this condition class. Weed invasion can be significant in such remnants. This condition class equates to BBAM low condition (Office of Environment and Heritage 2014a).

Following the BioBanking methodology (Office of Environment and Heritage 2014a), woody vegetation, is considered as low condition vegetation when:

- over-storey per cent foliage cover is <25% of the lower values of the over-storey per cent foliage cover benchmark for that vegetation type, and either:
  - less than 50% of vegetation in the ground layer is indigenous species
  - greater than 90% is cleared.

Following the BioBanking methodology (Office of Environment and Heritage 2014a), low condition for grassland is when:

- less than 50% of the groundcover percent foliage cover of the vegetation is indigenous species
- more than 90% of the groundcover vegetation is cleared.

2.8 Likelihood of occurrence

For this study, likelihood of occurrence of threatened species within the ecology survey area for species recorded or predicted to occur in the locality is defined in Table 2.7..

Table 2.7 Likelihood of occurrence of threatened species

Likelihood	Description
Low	Species considered to have a low likelihood of occurrence include species not recorded during the field surveys that fit one or more of the following criteria: ■ have not been recorded previously in the ecology survey area and surrounds and for which the ecology survey area is beyond the current distribution range ■ rely on specific habitat types or resources that are not present in the ecology survey area ■ are considered locally extinct ■ are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Moderate	Species considered to have a moderate likelihood of occurrence include species not recorded during the field surveys that fit one or more of the following criteria: ■ have infrequently been recorded previously in the ecology survey area and surrounds ■ use habitat types or resources that are present in the ecology survey area, although generally in a poor or modified condition ■ are unlikely to maintain sedentary populations, however, may seasonally use resources within the ecology survey area opportunistically during variable seasons or migration ■ are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
High	Species considered to have a high likelihood of occurrence include species not recorded that fit one or more of the following criteria: ■ have frequently been recorded previously in the ecology survey area and surrounds ■ use habitat types or resources that are present in the ecology survey area, that are abundant and/or in good condition within the ecology survey area ■ are known or likely to maintain resident populations surrounding the ecology survey area ■ are known or likely to visit the site during regular seasonal movements or migration.
Recorded	Any threatened species recorded during field surveys.

2.9 Limitations

2.9.1 Study for benefit of client

This EAR has been prepared for the exclusive benefit of the client and no other party. Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study). Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

2.9.2 Field survey 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. It should be recognised that site conditions, including the presence of threatened species, can change with time. Winter-flowering trees which are attractants of endangered blossom nomads, such as the Regent Honeyeater and Swift Parrot, were flowering during the survey period, but seasonal movements for these species locally were considered to be early.

Fieldwork for this study was completed during mid-autumn with daytime and overnight temperatures cooling in response to climatic events, which may have affected the activity (and therefore detectability) of some species; particularly herpetofauna and microchiropteran bats. However, where suitable habitat was observed, a precautionary approach was taken to the potential for species to occur and it was assumed that some species may be present on at least an intermittent basis (see Appendix D for likelihood of occurrence assessment of all threatened species of animal).

The surveys were undertaken in autumn and did no coincide with flowering period of the cryptic orchid *Diuris tricolor* and therefore this species could not be detected at the time of the survey. Methodologies for flora surveys are outlined in Section 2.7, whilst the results are summarised in Section 3 and 4.

Due to the nature of the northern section of the property (i.e. large area of remnant vegetation limited tracks) access was limited. As a result of limited access not all areas of the property were accessed. In areas where vegetation could be accessed it was extrapolated from a distance based on surrounding vegetation, geological, topographical, geomorphological and previous land use characteristics of the area.

2.9.3 Other limitations

To the best of Parsons Brinckerhoff's knowledge, the project presented and the facts and matters described in this study reasonably represent the client's intentions at the time of preparation of the study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the project and of its possible environmental impact.

Parsons Brinckerhoff will not be liable to update or revise this EAR to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the EAR.

3. Existing environment

The Braefield property lies within the Nandewar Range and forms part of the south-eastern portion of the Regional East-West Wildlife Corridor.

The most intact area of vegetation and habitat occurs in the northern section of the Braefield property leading up to a ridge that extends to both the north and south. The southern section of the property retains intact areas of woodland, however the understorey vegetation exhibits the effects of grazing particularly on the lower slopes. Elsewhere throughout the property remnant woodland trees are largely scattered or form residual patches along drainage lines or regrowth which cover some hills.

The northern section of the property adjoins large areas of remnant vegetation to the east and west. This provides connectivity to a larger tract of native vegetation along the Nandewar Range and extends north to Mt Kaputar National Park. Due to the biodiversity values present on site and its connectivity to other remnant vegetation the property forms part of the Regional East-West Wildlife Corridor which historically linked Leard State Forest, Nandewar Range, Namoi River and other vegetation to the west (Parsons Brinckerhoff 2012).

Historical land uses of the property have included cattle grazing, sheep grazing and cropping, with many farms surrounding the property. Areas within both sections of the property have been subjected to numerous restoration and land management trials over the past 50 years. Specifically, thinning of dense vegetation, seeding trials, construction of dams and deep ripping to form contour banks have been undertaken to increase biodiversity, improve vegetation and habitat condition and to control erosion.

Biodiversity values within the Braefield property are summarised in Sections 3 and 4 below. A summary of the locality is provided in Table 3.1 below.

Table 3.1 Locality information

Criteria	Location
Council	Gunnedah Shire
CMA	Namoi
CMA sub-region	Liverpool Plains, Peel
Bioregion	Brigalow Belt South, Nandewar
Mitchell landscapes	Liverpool Alluvial Plains, Tamworth – Keepit slopes and Plains

3.1 Vegetation communities

Desktop analysis of the vegetation mapping for and ground-truthing during surveys found ten vegetation communities present within the study area (refer Table 3.1, Figure 3.1 and Figure 3.2).

Table 3.2 Vegetation communities identified in the study area

Vegetation community (PB 2015)	Biometric Plant Community Types Namoi CMA[1]	Namoi CMA Regional Vegetation Community[2]	Threatened Ecological Community
Grass Woodlands on fertile soils			
White Box Grassy Woodland (moderate condition)	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions [NA226, PCT1383]	RVC 18 White Box grassy woodland, Brigalow Belt South and Nandewar	Remnant Box Gum Woodland listed as an EEC (TSC Act) and CEEC (EPBC Act)[3].
Shrubby Woodland/open Forest on Skeletal soils			
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 59 Narrow-leaved Ironbark – pine – box woodlands and open forests, Brigalow Belt South and Nandewar	–
White Box – White Cypress Pine shrubby open forest	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 44 White Box – pine – Silver-leaved Ironbark shrubby open forests, Brigalow Belt South and Nandewar	–
White Box – White Cypress Pine shrubby open forest (Callitris Regrowth)	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 44 White Box – pine – Silver-leaved Ironbark shrubby open forests, Brigalow Belt South and Nandewar	–
White Box – White Cypress Pine shrubby open forest (Shiny Bush)	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA225, PCT1308]	RVC 44 White Box – pine – Silver-leaved Ironbark shrubby open forests, Brigalow Belt South and Nandewar	–
Tumbledown Red Gum Grassy Woodland	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions [NA410, PCT427]	RVC 44 White Box – pine – Silver-leaved Ironbark shrubby open forests, Brigalow Belt South and Nandewar	–
White Box - Dwyer's Red Gum – Manna Gum shrubby woodland	Black Cypress Pine Dwyer's Red Gum low woodland/open forest on rocky ridges mainly on the Nandewar Range [NA245, PCT610]	RVC 58 Shrubby woodlands or mallee woodland on stoney soils, Brigalow Belt South and Nandewar	–
New England Blackbutt Rough-barked Apple Shrubby Open Forest	Nandewar Box - New England Blackbutt - Red Stringybark shrub/grass open forest in the Kaputar area of the Nandewar Bioregion [NA162, PCT542]	RVC 51 New England Blackbutt – stringybark open forest, Nandewar and western New England Tablelands	–

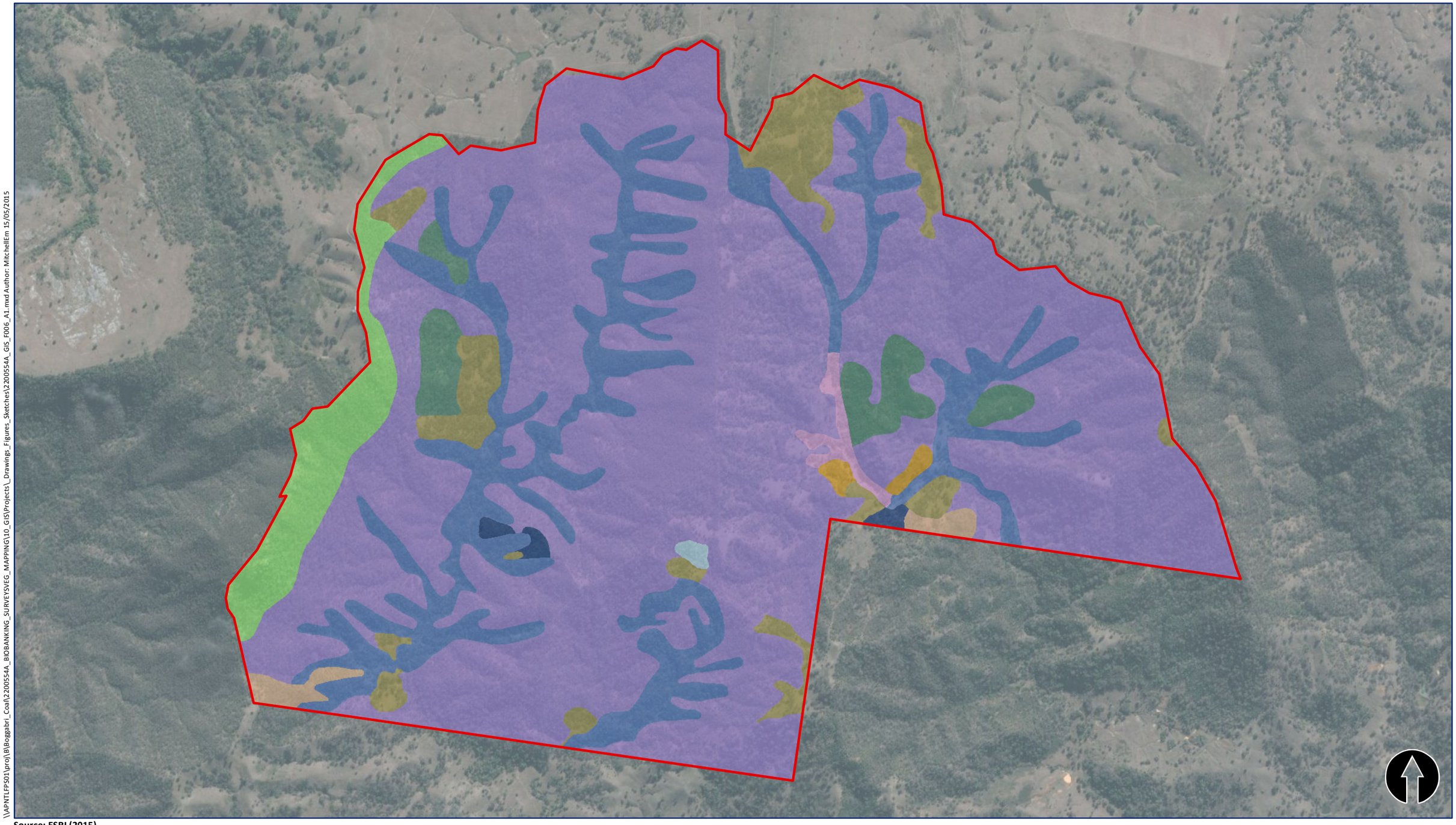
Vegetation community (PB 2015)	Biometric Plant Community Types Namoi CMA[1]	Namoi CMA Regional Vegetation Community[2]	Threatened Ecological Community
Riverine Woodlands			
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	RVC 20 Rough-barked Apple – Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	Remnant Box Gum Woodland listed as an EEC (TSC Act) and CEEC (EPBC Act)[3].
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion [NA197, PCT1118]	RVC 20 Rough-barked Apple – Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	-
Yellow Box – Blakely's Red Gum grassy woodland	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [NA237, PCT1329]	RVC 17 Box-gum grassy woodlands, Brigalow Belt South and Nandewar	Remnant Box Gum Woodland listed as an EEC (TSC Act) and CEEC (EPBC Act)[3].
White Box – Melaleuca Riverine Forest	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion [NA237, PCT1329]	RVC 17 Box-gum grassy woodlands, Brigalow Belt South and Nandewar	-
Grasslands			
White Box Grassy Woodland (low condition derived native grassland)	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions [NA226, PCT 1383] ' Low condition'	RVC 18 White Box grassy woodland, Brigalow Belt South and Nandewar	Box Gum Woodland (Derived Native Grasslands listed as an EEC (TSC Act)[4].
Intensive agriculture - other	-	RVC 0 Non-native vegetation or non-vegetation	-

(1) Office of Environment and Heritage vegetation types database (Office of Environment and Heritage 2014b) as used in BioMetric 2.0 (Gibbons *et al.* 2008) [NA biometric BioBanking type number, PCT = Plant Community Type Number]

(2) The Vegetation of the Namoi CMA (Eco Logical Australia 2008, 2013)

(3) Commensurate with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC listed udder the EPBC Act and White box yellow box Blakely's red gum woodland listed under the TSC Act.

(4) Commensurate with the White Box Yellow Box Blakely's red gum woodland EEC community listed under the TSC Act.



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Source: ESRI (2015)

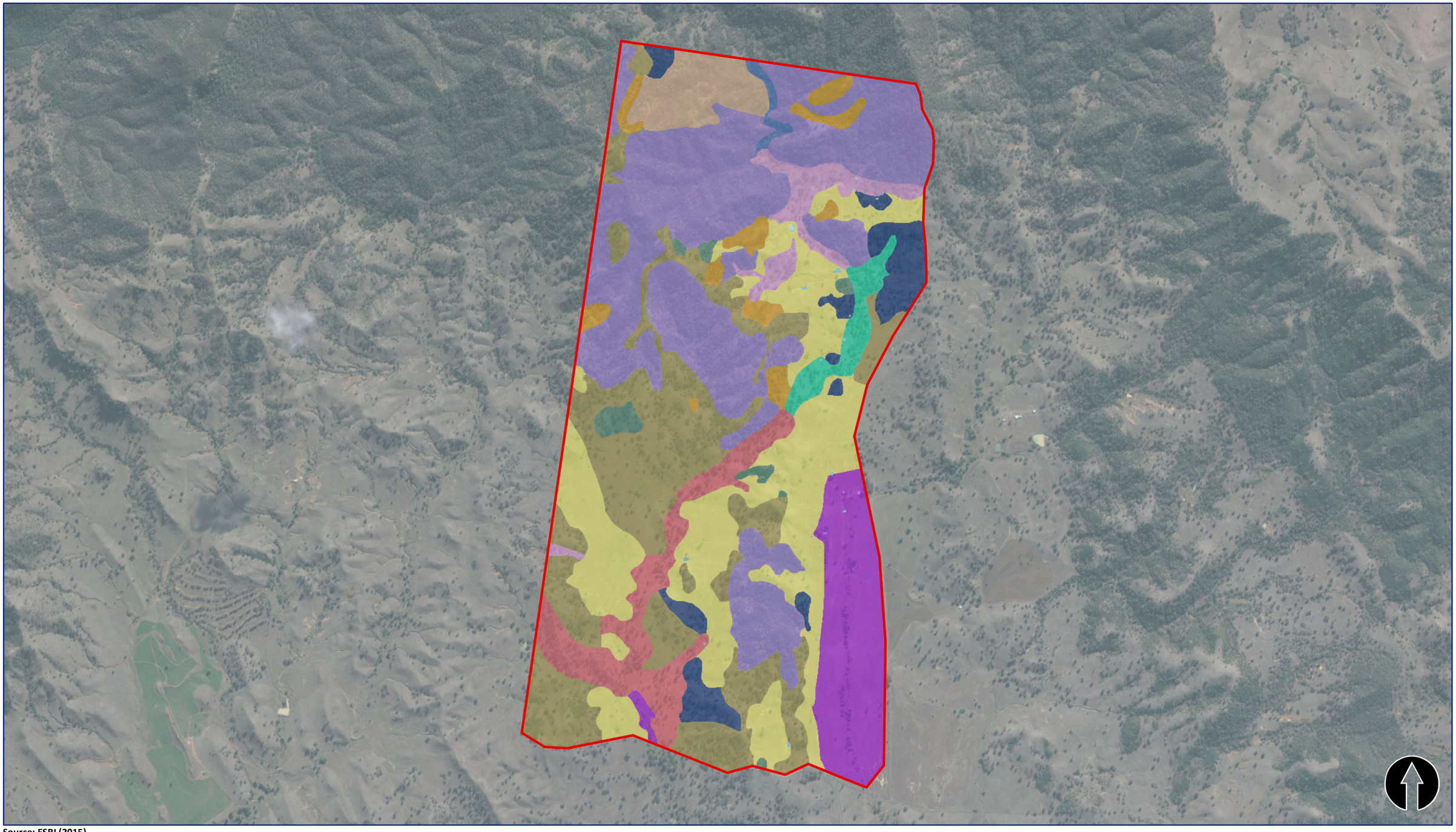
0 0.5 1 1.5 km

Offset property

Vegetation communities

- New England Blackbutt Rough-barked Apple shrubby open forest
- Tumbledown Red Gum grassy woodland
- White Box Blakely's Red Gum Rough-barked Apple riparian woodland (EEC)
- White Box Blakely's Red Gum Rough-barked Apple riparian forest (shrubby variant)
- White Box Dwyers Red Gum Manna Gum shrubby woodland
- White Box Grassy Woodland (moderate condition) (EEC)
- White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Box - White Cypress Pine shrubby open forest
- White Box - White Cypress Pine shrubby open forest (Callitris Regrowth)
- White Box - White Cypress Pine shrubby open forest (Shiny Bush)

Figure 3.1
Vegetation communities
of the Breafield (northern) BOA



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Source: ESRI (2015)

Offset property

Vegetation communities

- Farm dams
- Intensive Agriculture
- Tumbledown Red Gum grassy woodland
- White Box Blakely's Red Gum Rough-barked Apple riparian woodland (EEC)
- White Box Blakely's Red Gum Rough-barked Apple riparian forest (shrubby variant)
- White Box Grassy Woodland (low condition) (EEC)
- White Box Grassy Woodland (moderate condition) (EEC)
- White Box Melaleuca riverine forest
- White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Box - White Cypress Pine shrubby open forest
- White Box - White Cypress Pine shrubby open forest (Callitris Regrowth)
- White Box - White Cypress Pine shrubby open forest (Shiny Bush)
- Yellow Box Blakelys Red Gum grassy woodland (EEC)

0 0.5 1 1.5 km

Figure 3.2
Vegetation communities
of the Breafield (southern) BOA

3.1.1 White Box Grassy Woodland (moderate condition)

White Box Grassy Woodland has been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the both of the northern and southern areas of Braefield and consisted of *Eucalyptus albens, Brachychiton populneus* with occasional occurrences of *Angophora floribunda.* The shrub layer was sparse with a native ground cover. The characteristics of this community are summarised in Table 3.3 and is illustrated in Photo 3.1.

Parts of this community are commensurate with the critically endangered White box - Yellow Box - Blakely's Red Gum Woodland and derived native grassland community as listed on the EPBC Act. Further details and condition assessment for this is provided in Section 4.1. A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.4 and is used in the condition assessment of this community. This table shows that the majority of plots met all the BioBanking benchmarks therefore met good – moderate condition.

Table 3.3 White Box Grassy Woodland

White Box-Grassy Woodland	
Conservation status	**High:** Remnant Box Gum Woodland that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) and Critically Endangered on EPBC Act. Parts of this community met one or both of these TECs, further assessment is provided in section 4.1.
Condition	**Good – Moderate:** Although there was evidence of cattle grazing and historical logging, diversity of species present and the community was structurally intact. Portions of the understorey was in moderate to low condition due to cattle grazing and difficulty in identifying native species due to drought conditions at the time of the field surveys.
Location	**Northern section**: Occurred predominantly on the slopes of the hills scattered throughout as isolated patches. This community encompassed 48.67 ha. **Southern section**: Occurred on the lower slopes throughout the property and encompassed 185.12 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus albens* (dominant), *Brachychiton populneus* and occasionally *Angophora floribunda*
Shrub stratum	*Acacia decora, Pimelea neo-anglica, Geijera parviflora, Olearia elliptica* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Aristida calycina, Austrostipa verticillata, Dichondra sp. A, Bothriochloa decipiens, Austrostipa scabra, Panicum effusum, Chamaesyce drummondii, Sida cunninghamii, Glossocardia bidens, Chloris ventricosa, Sporobolus creber, Themeda triandra, Cyperus gracilis, Carthamus lanatus*, Opuntia stricta** and *Gomphocarpus fruticosus**

Photo 3.1 White Box Grassy Woodland

Table 3.4 Comparison White Box Grassy Woodland quadrat data against vegetation benchmark data (NA226)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grasses	shrubs	other				
Benchmark[1]	**23**	**6-25**	**0-5**	**30-40**	**0**	**3-5**	**1**		**30**	
White Box Grassy Woodland (moderate condition)										
Q03	42	20	0	50	0	42	2	0	87.8	Good-Moderate
Q04	27	14.5	0	50	0	26	0	0	42	Good-Moderate
Q15	26	10.5	0	50	0	30	2	2	33.2	Good-Moderate
Q19	27	4.5	2.5	48	6	50	1	0	22.3	Good-Moderate
Q21	34	11.5	3.5	56	2	40	2	0	109.2	Good-Moderate
Q23	33	19	0.1	58	0	14	3	0	24.1	Good-Moderate
Q24	22	0*	0	78	0	14	0*	8	0*	Low
Q32	44	1.5	5	36	2	38	1	0	58	Good-Moderate
Q34	35	14.5	5	64	0	12	1	0	37.4	Good-Moderate
Q36	36	9	6.5	60	0	18	0*	0	14.6	Good-Moderate
Q40	21	0*	0	64	0	8	0*	26	16.7	Low
Q51	30	8	0.5	72	0	28	1	0	54.2	Good-Moderate

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grasses	shrubs	other				
Benchmark[1]	**23**	**6-25**	**0-5**	**30-40**	**0**	**3-5**	**1**		**30**	
Q54	26	29	24.5	26	42	32	0*	0	83	Good - Moderate
White Box Grassy Woodland (low condition – derived grassland)										
Q05	14	0*	0	48	0	38	0*	8	0*	Low
Q07	10	0*	0	80	0	6	0*	14	0*	Low
Q12	14	0*	0	86	0	6	0*	4	0*	Low
Q13	11	0*	0	56	0	2	0*	42	0*	Low
Q16	15	0*	0	56	0	18	0*	26	0*	Low
Q25	7	0*	0	58	0	14	0*	28	0*	Low

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA226 White Box Grassy Woodland of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

3.1.2 White Box Grassy Woodland (low condition – derived grassland)

White Box Grassy Woodland has been mapped as derived native grasslands by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in both the northern and southern sections of the Braefield property. The community occurred as grasslands with scattered trees with sparse to no shrub layer. The groundlayer contained a number of native grasses and herbs. The characteristics of this community are summarised in Table 3.5 and illustrated in Photo 3.2. This community met the criteria for listing under the TSC Act definition for White Box Yellow Box Blakely's Red Gum Woodland. This community is not however commensurate with the critically endangered White box - Yellow Box - Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act. Further details and condition assessment for this is provided in Section 4.1.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.4 shows that the majority of the plots did not meet the BioBanking benchmarks for Box-gum woodlands and therefore met low condition.

Table 3.5 Summary of characteristics White Box Grassy Woodland (Derived Grassland)

White Box-Grassy Woodland (low condition – derived grassland)	
Conservation status	**High:** Box Gum Woodland (Derived Native Grassland) that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) This community did not meet the criteria for the federal listing of Box-gum woodland. Further assessment is provided in section 4.1 below.
Condition	**Low:** The condition of this community occurred as grassland and met low condition as set out by the BioBanking methodology.
Location	**Southern section**: Occurred on the hills and lower slopes throughout the property and encompassed 173.00 ha.
Strata	**Dominant species**
Canopy	Scattered occurrences of *Eucalyptus albens* and *Eucalyptus blakelyi*
Shrub stratum	Scattered shrubs of *Acacia decora, Pimelea neo-anglica, Swainsona galegifolia* and juvenile *Callitris spp.*
Ground cover	*Aristida ramosa, Aristida calycina, Austrostipa verticillata, Dichondra sp. A, Bothriochloa decipiens, Austrostipa scabra, Panicum effusum, Chamaesyce drummondii, Sida cunninghamii, Glossocardia bidens, Sporobolus creber, Cyperus gracilis, Carthamus lanatus** and *Gomphocarpus fruticosus**

Photo 3.2 **White Box Grassy Woodland – derived native grassland**

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

This community has been mapped by the broad scale vegetation mapping project for the Namoi CMA as Narrow-leaved Ironbark – pine – box woodlands and open forests (Eco Logical Australia 2008, 2013). This community occurred in both the northern and southern sections of the property on the ridgetops and west facing slopes within the study area. This community consisted of a woodland or open forest canopy with a dense shrub layer of native species and a sparse groundlayer of grasses and herbs. The characteristics of this community are summarised in Table 3.6 and illustrated in Photo 3.3.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.7. The plot data shows that the plots meet the majority of the BioBanking benchmarks and therefore meets good - moderate condition.

Table 3.6 **Summary of characteristics White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest**

White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	
Conservation status	**Moderate:** Is not listed as a threatened community; however this community contains habitat for numerous threatened woodland birds and mammals.
Condition	**Good - Moderate**: This condition class of this community met all of BioBanking benchmarks and is considered to be in moderate condition.
Location	**Northern section**: This community occurred as two isolated patches in the west and east of the property and encompassed 7.89 ha. **Southern section**: This community occurred in one patch in the north of this section and encompassed 29.19 ha.

White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	
Strata	**Dominant species**
Canopy	*Eucalyptus albens, Eucalyptus crebra* and *Callitris endlicheri*
Shrub stratum	*Dodonaea viscosa, Olearia elliptica, Pimelea neo-anglica* and *Swainsonia galegifolia*
Ground cover	*Aristida ramosa, Sigesbeckia australiensis, Dichondra sp. A, Vittadinia cuneata, Panicum effusum, Desmodium brachypodium, Poa sp.* and *Cyperus gracilis.*

Table 3.7 Comparison White Box Narrow-leaved Ironbark White Cypress Pine Shrubby open forest quadrat data against vegetation benchmark data (NA225)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**26**	**6-25**	**6-25**	**20-30**	**3-10**	**3-5**	**1**		**15**	
Q43	23	28	46	28	4	22	1	0	59.2	Good-Moderate
Q47	30	18	16	18	1	30	0*	1	39.5	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA225 White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.3 **White Box – Narrow-leaved Ironbark – White Cypress Pine Shrubby open forest moderate condition**

3.1.4 White Box – White Cypress Pine shrubby open forest

This community has been mapped by the broad scale vegetation mapping project for the Namoi CMA as Narrow-leaved Ironbark – pine – box woodlands and open forests (Eco Logical Australia 2008, 2013). This community occurred in the both the northern and southern sections of the property on the ridgetops and slopes within the study area. This community consisted of a woodland or open forest canopy with a dense shrub layer of native species and a sparse groundlayer of grasses and herbs. The characteristics of this community are summarised in Table 3.8 and illustrated in Photo 3.4. Two additional variants of this community have been mapped in Figure 3.1 with Callitris regrowth (refer Photo 3.5) and Shiny Bush.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.9. The plot data shows that the majority of the plots meet the BioBanking benchmarks and therefore meets good – moderate condition.

Table 3.8 **Summary of characteristics White Box – White Cypress Pine shrubby open forest**

White Box – White Cypress Pine shrubby open forest	
Conservation status	**Moderate:** Is not listed as a threatened community; however this community contains habitat for numerous threatened woodland birds and mammals.
Condition	Two condition classes: **Moderate**: This condition class of this community met all of BioBanking benchmarks and is considered to be in moderate condition.

White Box – White Cypress Pine shrubby open forest	
	Low: This condition class occurred as two variants across the property as follows: **Callitris Regrowth**: this variant occurred predominantly within the southern section of the property and has previously been cleared and contains significant Callitris regrowth **Shiny Bush**: This condition class occurred predominantly within the northern section as an invasion of two native shrub species, *Dodonaea viscosa* and *Olearia elliptica,* these areas will need specific management to restore to the moderate condition of this community.
Location	**Northern section**: The moderate condition of this community occurred in as the dominant community across the entire northern section. This condition encompassed 603.25 ha. Shiny Bush occurs in two locations in the east and west of the property and encompassed 3.45 ha. The Callitris regrowth condition class occurred as scattered patches across the property and encompassed 26.27 ha. **Southern section**: The moderate condition of this community occurred predominantly in the north and centre of the property and encompassed 243.70 ha. The low condition Shiny Bush and Callitris regrowth occurred within the hills and lower slopes predominantly within the northern portion of the property. The Shiny Bush low condition class encompassed 24.51 ha. The Callitris regrowth low condition class encompassed 9.57ha.
Strata	**Dominant species**
Canopy	*Eucalyptus albens* and *Callitris endlicheri*
Shrub stratum	*Dodonaea viscosa, Olearia elliptica, Pimelea neo-anglica, Psydrax odorata* and *Swainsonia galegifolia*
Ground cover	*Aristida ramosa, Sigesbeckia australiensis, Dichondra sp. A, Vittadinia cuneata, Panicum effusum, Desmodium brachypodium, Rytidosperma racemosum, Bothriochloa decipiens, Digitaria spp., Austrostipa scabra, Poa sieberiana, Cheilanthes distans* and *Cyperus gracilis.*

Table 3.9 Comparison White Box – White Cypress Pine shrubby open forest quadrat data against vegetation benchmark data (NA225)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Benchmark[1]	**26**	**6-25**	**6-25**	**20-30**	**3-10**	**3-5**	**1**		**15**	
Q09	28	21	62.5	28	16	36	1	0	18.4	Good-Moderate
Q17	35	8	77	36	4	42	1	0	46.6	Good-Moderate
Q18	38	14.5	28	28	4	28	2	0	11.3	Good-Moderate
Q20	23	16	21.5	26	22	26	3	0	12.8	Good-Moderate
Q22	35	12	21	40	22	20	2	0	12	Good-Moderate

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Benchmark[1]	**26**	**6-25**	**6-25**	**20-30**	**3-10**	**3-5**	**1**		**15**	
Q28	34	9.5	49	50	16	24	2	0	41.6	Good-Moderate
Q30	34	6.5	29	46	20	18	3	0	19.9	Good-Moderate
Q49	30	19	53	48	14	38	3	0	40	Good-Moderate
Q52	24	18.5	26	40	4	28	0*	0	0*	Good-Moderate
Q53	21	18	35	26	58	6	7	0	97	Good-Moderate
Q14	26	13.5	1*	12	0*	22	1	0	7.8	Good-Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA225 White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.4 White Box – White Cypress Pine shrubby open forest moderate condition

Photo 3.5 White Box – White Cypress Pine shrubby open forest low condition (Callitris regrowth)

3.1.5 Tumbledown Red Gum Grassy Woodland

This community has been mapped by the broad scale vegetation mapping project for the Namoi CMA as White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions (Eco Logical Australia 2008, 2013). This community occurred predominantly within the southern section of the property within shale soils on the upper slopes. The canopy consisted of a woodland structure with a sparse to moderate shrub layer. The groundlayer contained a number of native grasses and herbs. The characteristics of this community are summarised in Table 3.10 and is illustrated in Photo 3.6.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.11. The plot data shows that the majority of the plots meet the BioBanking benchmarks and are in good – moderate condition.

Table 3.10 Tumbledown Red Gum Grassy Woodland

Tumbledown Red Gum Grassy Woodland	
Conservation status	**Moderate:** Is not listed as a threatened community; however this community contains habitat for numerous threatened woodland birds and mammals.
Condition	**Good - Moderate**: The condition of this community met the good - moderate condition as set out by the BioBanking methodology within the property.
Location	**Northern section**: This community occurred as a single patch that adjoined larger remnants to the south of the property and encompassed 3.77 ha. **Southern**: This community occurred on the top of slopes and on slate based soils within the southern and north east portions of the property. This condition encompassed 37.37 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus dealbata, Eucalyptus albens* and juvenile *Callitris glaucophylla*
Shrub stratum	*Geijera parviflora, Olearia elliptica, Pimelea neo-anglica, Acacia decora, Dodonaea viscosa, Cryptandra amara, Cassinia spp.* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Bothriochloa decipiens, Desmodium brachypodium, Austrostipa scabra, Dichondra sp. A, Sigesbeckia australiensis, Glossocardia bidens, Vittadinia cuneata, Cymbopogon refractus* and *Cyperus gracilis.*

Table 3.11 Comparison of Tumbledown Red Gum Grassy Woodland quadrat data against vegetation benchmark data (NA225)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**26**	**6-25**	**6-25**	**20-30**	**3-10**	**3-5**	**1**		**15**	
Q01	39	10.5	0.5*	44	0*	50	0*	0	45.1	Good – Moderate
Q10	32	13	0.5*	62	0*	10	0*	0	12	Good – Moderate
Q33	37	11.5	61	50	2	34	0*	0	23	Good – Moderate
Q42	29	14.5	7.5	42	0*	24	0*	0	11.2	Good – Moderate

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**26**	**6-25**	**6-25**	**20-30**	**3-10**	**3-5**	**1**		**15**	
Q50	33	23.5	16	46	22	22	0*	0	26.6	Good - Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA225 White Box – White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions : Keith Formation: Grassy Woodlands: Keith Class: Western slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.6 Tumbledown Red Gum Grassy Woodland

3.1.6 White Box - Dwyer's Red Gum – Mana Gum shrubby woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred only within the northern section of the property in small patches on the top of hills and ridgetops. The canopy was that of shrubby woodland with a moderate to dense shrub layer. There were some small areas which a sparse shrub layer as a result of grazing by goats and weed invasion. The groundlayer contained moderate numbers of exotic species in some areas however was dominated by native grasses and herbs. The characteristics of this community are summarised in Table 3.12 and is illustrated in Photo 3.7 to Photo 3.9.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.13. The plot data shows that plot 45 which had been grazed contained a high exotic groundcover, whereas plot 44 contained none. The condition of this community was good to moderate in comparison to the benchmarks.

Table 3.12 Summary of characteristics White Box - Dwyer's Red Gum – Manna Gum shrubby woodland

White Box - Dwyer's Red Gum – Manna Gum shrubby woodland	
Conservation status	**Moderate:** This community contains habitat for a number of threatened flora and fauna species.
Condition	**Good-moderate:** The condition of this community met the good-moderate condition as set out by the BioBanking methodology. However the shrublayer was absent in some patches due to grazing from goats.
Location	**Northern section**: Occurs along the ridgetop located in the western section of the property on top of the bluff and encompasses 37.97 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus dwyeri, Eucalyptus viminalis, Eucalyptus nortonii* and *Eucalyptus albens*
Shrub stratum	*Olearia elliptica, Phyllanthus subcrenulatus* and *Acacia cheelii*
Ground cover	*Austrostipa scabra, Aristida ramosa, Austrostipa verticillata, Rytidosperma spp., Dichondra sp. A, Poa spp.* and *Vittadinia cuneata* and *Marrubium vulgare*.*

Table 3.13 Comparison of White Box - Dwyer's Red Gum – Manna Gum shrubby woodland quadrat data against vegetation benchmark data (NA245)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**30**	**25-40**	**6-25**	**20-30**	**3-10**	**3-5**	**2**		**20**	
Q44	26	7.5	21.5	58	30	12	0*	0	7.7	Good - Moderate
Q45	30	15.5	0*	4	4	38	0*	48	83.8	Good - Moderate
Q46	22	21	35.5	36	28	12	1	24	43.5	Good - Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA245 Black Cypress Pine - Dwyers Gum low woodland / open forest on rocky ridges mainly of the Nandewar Range: Keith Formation: Dry Sclerophyll Forests (Shrubby sub-formation): Keith Class: Western Slopes Dry Sclerophyll Forests: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.7 White Box - Dwyer's Red Gum – Manna Gum shrubby woodland

Photo 3.8 White Box - Dwyer's Red Gum – Manna Gum shrubby woodland grassy variation

Photo 3.9 **White Box - Dwyer's Red Gum – Manna Gum shrubby woodland, showing effects of grazing by goats and weed invasion**

3.1.7 New England Blackbutt Rough-barked Apple shrubby open forest

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred only within the northern section of the property in isolated patches on mid to upper slopes. The canopy was that of shrubby woodland with a dense shrub layer. There were some small areas which a sparse shrub. The groundlayer was dominated by native grasses and herbs. The characteristics of this community are summarised in Table 3.14 and is illustrated in Photo 3.10.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.15 and is used in the condition assessment of this community. This table shows that the majority of the plot meets the BioBanking benchmarks.

Table 3.14 **Summary of characteristics New England Blackbutt Rough-barked Apple Shrubby Open Forest**

New England Blackbutt Rough-barked Apple Shrubby Open Forest	
Conservation status	**Moderate**: Not a listed community, however provides habitat for numerous threatened flora and fauna species
Condition	**Good – Moderate:** The condition of this community met the good-moderate condition as set out by the BioBanking methodology.
Location	**Northern section**: occurred as an isolated patch within the centre of the property and encompassed 1.31 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus andrewsonii, Eucalyptus albens* and *Angophora floribunda*

New England Blackbutt Rough-barked Apple Shrubby Open Forest	
Shrub stratum	*Olearia elliptica* and *Notelaea microcarpa*
Ground cover	*Poa sieberiana, Aristida ramosa, Sigesbeckia australiensis, Desmodium brachypodium, Lomandra multiflora subsp. multiflora, Dichondra sp. A, Glycine clandestina, and Digitaria sp.*

Table 3.15 Comparison of New England Blackbutt Rough-barked Apple Shrubby Open Forest quadrat data against vegetation benchmark data (NA162)

Plot	Plant species richness	Native overstorey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Benchmark[1]	**33**	**25-40**	**6-25**	**18-20**	**3-10**	**3-5**	**2**		**20**	
Q29	29	19	79	18	20	26	0*	0	24.9	

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA162 Nandewar Box - New England Blackbutt - Red Stringybark shrub/grass open forest in the Kaputar area of the Nandewar Bioregion: Keith Formation: Dry Sclerophyll Forests (Shrubby subformation): Keith Class: Northern Tableland Dry Sclerophyll Forests: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.10 New England Blackbutt Rough-barked Apple Shrubby Open Forest

3.1.8 White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred throughout the properties within the ephemeral drainage lines. The canopy was that of a woodland structure, with the understorey varying from moderate to sparse in density. The groundlayer contained a number of native grasses and herbs, with pasture weed invasion occurring in some areas. The characteristics of this community are summarised in Table 3.16 and illustrated in Photo 3.11. Parts of this community was commensurate with the critically endangered White box - Yellow Box - Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act and endangered community under the TSC Act. Further details and condition assessment for this is provided in Section 4.1.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.17 and shows that the majority of the plots meet the BioBanking benchmarks for good - moderate condition.

Table 3.16 Summary of characteristics White Box Blakely's Red Gum – Rough-barked Apple riparian woodland

White Box Blakely's Red Gum – Rough-barked Apple riparian woodland	
Conservation status	**High:** Remnant Box Gum Woodland that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) and Critically Endangered on EPBC Act and Endangered under the TSC Act, further assessment is provided in section 4.1 below.
Condition	**Good-moderate**: All of the mapped patches of this community met the BioBanking benchmarks for good - moderate condition.
Location	**Northern**: This community occurred in some of the riparian areas of the property and encompassed 5.82 ha. **Southern:** This community occurred in most riparian areas of the property and encompassed 24.56 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus albens, Eucalyptus blakelyi, Angophora floribunda, Brachychiton populneus* and *Eucalyptus melliodora*
Shrub stratum	*Psydrax odorata, Acacia decora, Pimelea neo-anglica* and *Notelaea microcarpa*
Ground cover	*Aristida calycina, Austrostipa verticillata, Bothriochloa decipiens, Dichondra sp. A, Lomandra filiformis, Desmodium brachypodium, Austrostipa scabra* and *Cyperus gracilis.*

Table 3.17 Comparison of White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland quadrat data against vegetation benchmark data (NA197)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**25**	**6-25**	**0-5**	**30-40**	**3-10**	**3-5**	**1**		**15**	
Q08	33	18	6.5	38	0	56	2	4	11.7	Good - Moderate
Q26	24	0*	0	60	0	18	0*	10	1.9*	Low
Q27	33	8	2.5	46	0	34	2	20	40.6	Good –

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**25**	**6-25**	**0-5**	**30-40**	**3-10**	**3-5**	**1**		**15**	
										Moderate
Q31	38	9.5	11	54	6	38	3	2	35.5	Good - Moderate
Q41	33	15.5	7	52	0*	32	1	16	77	Good – Moderate
Q48	35	16.5	15	44	4	34	2	8	13	Good – Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA197 Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: New England Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.11 White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland

3.1.9 White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred predominantly throughout the northern section and the northern section of the southern portion of the property within the ephemeral drainage lines. The canopy was that of a woodland structure, with the understorey varying from dense to moderate in density. The groundlayer contained a number of native grasses and herbs, with pasture weed invasion occurring in some areas. The characteristics of this community are summarised in Table 3.18 and illustrated in Photo 3.12.

This shrubby variant is not commensurate with the critically endangered White box - Yellow Box - Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act nor is it commensurate with the endangered community of Box Gum Woodland listed under the TSC Act due to its shrubby understorey. Further details and condition assessment for this is provided in Section 4.1.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.19 and shows that the majority of the plots meet the BioBanking benchmarks for good - moderate condition.

Table 3.18 Summary of characteristics White Box Blakely's Red Gum – Rough-barked Apple riparian woodland (shrubby variant)

White Box Blakely's Red Gum – Rough-barked Apple riparian woodland (shrubby variant)	
Conservation status	**Moderate:** Not a listed community, however provides habitat for numerous threatened flora and fauna species.
Condition	**Good-moderate**: All of the mapped patches of this community met the BioBanking benchmarks for good - moderate condition.
Location	**Northern**: This community occurred along most riparian areas of the property and encompassed 146.86 ha. **Southern:** This community occurred along the riparian area at the north of this section of the property and encompassed 4.02 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus albens, Eucalyptus blakelyi, Angophora floribunda* and *Brachychiton populneus.*
Shrub stratum	*Olearia elliptica, Dodonaea viscosa, Acacia decora, Pimelea neo-anglica* and *Notelaea microcarpa*
Ground cover	*Austrostipa scabra, Poa sieberiana, Sigesbeckia australia, Lomandra longifolia, Ajuga australis, Aristida ramosa, Austrostipa verticillata, Dichondra sp. A, Desmodium brachypodium,* and *Cyperus gracilis.*

Table 3.19 Comparison of White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant) quadrat data against vegetation benchmark data (NA197)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**25**	**6-25**	**0-5**	**30-40**	**3-10**	**3-5**	**1**		**15**	
Q35	39	17.5	26	40	10	40	2	0	66.7	Good – Moderate

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**25**	**6-25**	**0-5**	**30-40**	**3-10**	**3-5**	**1**		**15**	
Q37	37	18.5	40	40	10	60	3	0	55.2	Good – Moderate
Q38	37	26	41	20	38	26	1	6	2.3	Good – Moderate
Q39	30	12.5	8.5	54	2	38	2	6	30.1	Good – Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA197 Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: New England Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.12 **White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)**

3.1.10 Yellow Box – Blakely's Red Gum grassy woodland

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the southern section of the Braefield property. The canopy was that of a woodland structure, with the understorey varying from moderate to sparse in density. The groundlayer contained a number of native grasses and herbs, with pasture weed invasion occurring in some areas. The characteristics of this community are summarised in Table 3.20 and is illustrated in Photo 3.13. This community are commensurate with the critically endangered White box - Yellow Box - Blakely's Red Gum Woodland and derived native grassland as listed on the EPBC Act and endangered under the TSC Act, further details and condition assessment for this is provided in Section 4.1.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.21 and shows that the majority of the plots meet the BioBanking benchmarks for good - moderate condition.

Table 3.20 Summary of characteristics Yellow Box – Blakely's Red Gum grassy woodland

Yellow Box – Blakely's Red Gum grassy woodland	
Conservation status	**High:** Remnant Box Gum Woodland that is consistent with the White box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (TSC Act) and Critically Endangered on EPBC Act and Endangered under the TSC Act, further assessment is provided in section 4.1 below.
Condition	**Good-moderate**: The condition of this community is high as it had a high number of native species diversity and contained a complex floristic structure. The majority of the BioBanking benchmarks have been exceeded for this community
Location	**Southern section**: This community occurred only within the southern portion of the property and encompassed 55.73 ha.
Strata	**Dominant species**
Canopy	*Eucalyptus melliodora, Eucalyptus blakelyi* and scattered occurrences of *Brachychiton populneus*
Shrub stratum	*Melaleuca bracteata, Pimelea neo-anglica, Acacia decora* and *Notelaea microcarpa*
Ground cover	*Aristida ramosa, Austrostipa verticillata, Dichondra sp. A, Austrostipa scabra, Vittadinia cuneata, Calotis lappulacea, Glycine tabacina, Chamaesyce drummondii, Sida cunninghamii,* and *Cyperus gracilis.*

Table 3.21 Comparison of Yellow Box – Blakely's Red Gum grassy woodland quadrat data against vegetation benchmark data (NA237)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**23**	**6-25**	**0-5**	**30-40**	**0**	**3-5**	**2**		**20**	
Q02	32	21.5	2	20	0	58	1	0	16	Good - Moderate
Q06	29	21.5	0	44	0	22	3	26	51	Good - Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA237 Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: Western Slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.13 Yellow Box – Blakely's Red Gum grassy woodland

3.1.11 White Box – Melaleuca Riverine Forest

This community has not been mapped by the broad scale vegetation mapping project for the Namoi CMA (Eco Logical Australia 2008, 2013). This community occurred in the southern section of the Braefield property. The canopy was that of a woodland structure, with the understorey varying from sparse to moderate shrub density. The groundlayer contained a number of native grasses and herbs, with pasture weed invasion occurring in some areas. The characteristics of this community are summarised in Table 3.22 and is illustrated in Photo 3.14.

A comparison of the plot data against the BioBanking benchmarks is provided in Table 3.23 and is used in the condition assessment of this community. This table shows that the majority of the plot meets the BioBanking benchmarks.

Table 3.22 Summary of characteristics White Box – Melaleuca Riverine Forest

White Box – Melaleuca Riverine Forest	
Conservation status	**Moderate**: Not a listed community, however provides habitat for numerous threatened flora and fauna species**.**
Condition	**Good-moderate**: The condition of this community is high as it had a high number of native species diversity and contained a complex floristic structure. The majority of the BioBanking benchmarks have been exceeded for this community.
Location	**Southern**: This community occurred only within the southern section of the property along part of the riparian area and encompassed 17.04.

White Box – Melaleuca Riverine Forest	
Strata	**Dominant species**
Canopy	*Eucalyptus albens, Angophora floribunda* and *Melaleuca bracteata*
Shrub stratum	*Acacia decora, Dodonaea viscosa, Pimelea neo-anglica* and *Notelaea microcarpa*
Ground cover	*Austrostipa verticillata, Aristida ramosa, Bothriochloa decipiens, Dichondra sp. A, Vittadinia cuneata, Glycine tabacina, Chamaesyce drummondii, Sida cunninghamii,* and *Cyperus gracilis.*

Table 3.23 Comparison of White Box – Melaleuca Riverine Forest quadrat data against vegetation benchmark data (NA237)

Plot	Plant species richness	Native over-storey (% cover)	Native mid-storey cover (% cover)	Native groundcover (% cover)			Number of trees with hollows	Exotic plant cover	Length of fallen timber (m)	Condition
				grass	shrubs	other				
Bench mark[1]	**23**	**6-25**	**0-5**	**30-40**	**0**	**3-5**	**2**		**20**	
Q11	29	6	47	36	0	22	1	28	21.8	Good - Moderate

Notes: 1) benchmark data for equivalent community in Namoi CMA (Vegetation Type: NA237 Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion: Keith Formation: Grassy Woodlands: Keith Class: Western Slopes Grassy Woodlands: source (Keith 2004): Red font indicates results below benchmark value: * indicates, less than 25% of lower benchmark value.

Photo 3.14 White Box – Melaleuca Riverine Forest

3.1.12 Intensive Agriculture

This community occurred only within the southern section of the property that predominantly includes a creek line that contains exotic species and vegetation surrounding the existing house. These areas are in poor condition with a high density of exotic species. The characteristics of this community are summarised in Table 3.24 and is illustrated in Photo 3.15.

Table 3.24 Summary of characteristics of intensive agriculture

Intensive agriculture	
Conservation status	**Not listed**
Condition	**Poor** condition. The vegetation was substantially modified from the pre-1750 woodland or forest community that is likely to have been present in this area. Although some native species were present and in equal proportions to exotic species in small patches this community was dominated by exotic species. Scattered remnant trees did occur.
Location	**Southern:** This community occurred only within the southern east and south west portion of the property and encompassed 73.73 ha.
Strata	**Dominant species**
Canopy	Scattered **Schinus areira, Jacaranda mimosifolia* and *Eucalyptus albens* trees.
Shrub stratum	Absent
Ground cover	Exotic species included **Carthamus lanatus, *Gomphocarpus fruticosus *, Cirsium vulgare*, Marrubium vulgare*, Sida spinosa*, Richardia* sp. and **Conyza sp..* Native species include *Aristida ramosa, Bothriochloa decepiens, Maireana microphylla*, *Austrostipa verticillata,* and *Dichanthium sericeum.*

Photo 3.15 Intensive Agriculture

3.2 Fauna habitat

The southern section of the study area contained areas that have been long dedicated to grazing of cattle. Such areas were often devoid of native understorey cover and plant diversity, which might otherwise support the occurrence of small woodland fauna. However, some open areas maintained a moderate occurrence of canopy trees, with drainage lines largely retaining canopy cover, which together provide narrow links or stepping-stones between larger patches of woodland habitat. Grassy and shrubby woodland elements and associated ecotonal edges of the southern section, provided habitat for a diversity of threatened woodland birds, including Hooded Robin, Turquoise Parrot and Brown Treecreeper.

More significant and high quality woodland habitat was associated with the large remnant patch of low to moderately disturbed woodland in the north-east of the southern section and the entirety of the northern section of the study area. This large remnant patch included vegetated lowland areas, gullies and higher footslopes culminating at their highest point along the western ridgeline of the northern section at some 920 m above sea level. This patch contained more remote areas that have effectively remained undisturbed and was contiguous with large areas of remnant habitat off site. The quality, extent and structure of this shrubby woodland habitat is likely to support a suite threatened woodland fauna, including woodland birds (Varied Sittella and Speckled warbler), arboreal mammals, microchiropteran bats and forest owls, but limiting others due to the density of understorey shrubs. This large patch primarily consisted of *E. albens* (White Box) in the canopy, and was considered to be of high quality for nectivorous fauna. It is possible that the endangered Swift Parrot and Regent Honeyeater may use such high value areas of woodland habitat intermittently for foraging purposes during some profuse winter-flowering seasons.

Although no caves were observed in the study area, large rocky outcropping associated with the western escarpment in the northern section, particularly including 'the bluff', has the potential to provide roosting and breeding structures for threatened cave-dwelling microchiropteran bats.

3.3 Flora species recorded

A total of 177 plant species were recorded in the ecology survey area during field surveys of which 150 species (85%) were native and 26 species (15%) were exotic (refer Appendix A). The most diverse family recorded was Poaceae (grasses) with 33 species, followed by and Asteraceae with 28 species and Fabaceae with 12 species (refer Appendix A).

3.3.1 Noxious weeds

Of the 26 exotic species that were recorded in the property, three species of plant are listed under the *Noxious Weeds Act 1993* for the Narrabri Shire Council weed control area (refer Table 3.25). None of these species are listed as a Weeds of National Significance (Australian Weeds Committee 2012). Other highly invasive species occurred abundantly, within the intensive agriculture lands within the property included: *Carthamus lanatus*, Sida spinosa** and *Cirsium vulgare*.*

Table 3.25 Noxious weeds recorded within the Braefield property

Name	Noxious Weeds Act 1993 control category[1]
*Xanthium spinosum** (Bathurst Burr)	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.
*Opuntia stricta** (Prickly Pear)	
*Argemone mexicana** (Mexican Poppy)	Class 5 - The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with

(1) Classes of noxious weed and control requirements under the *Noxious Weed Act 1993*; * - denotes an introduced species.

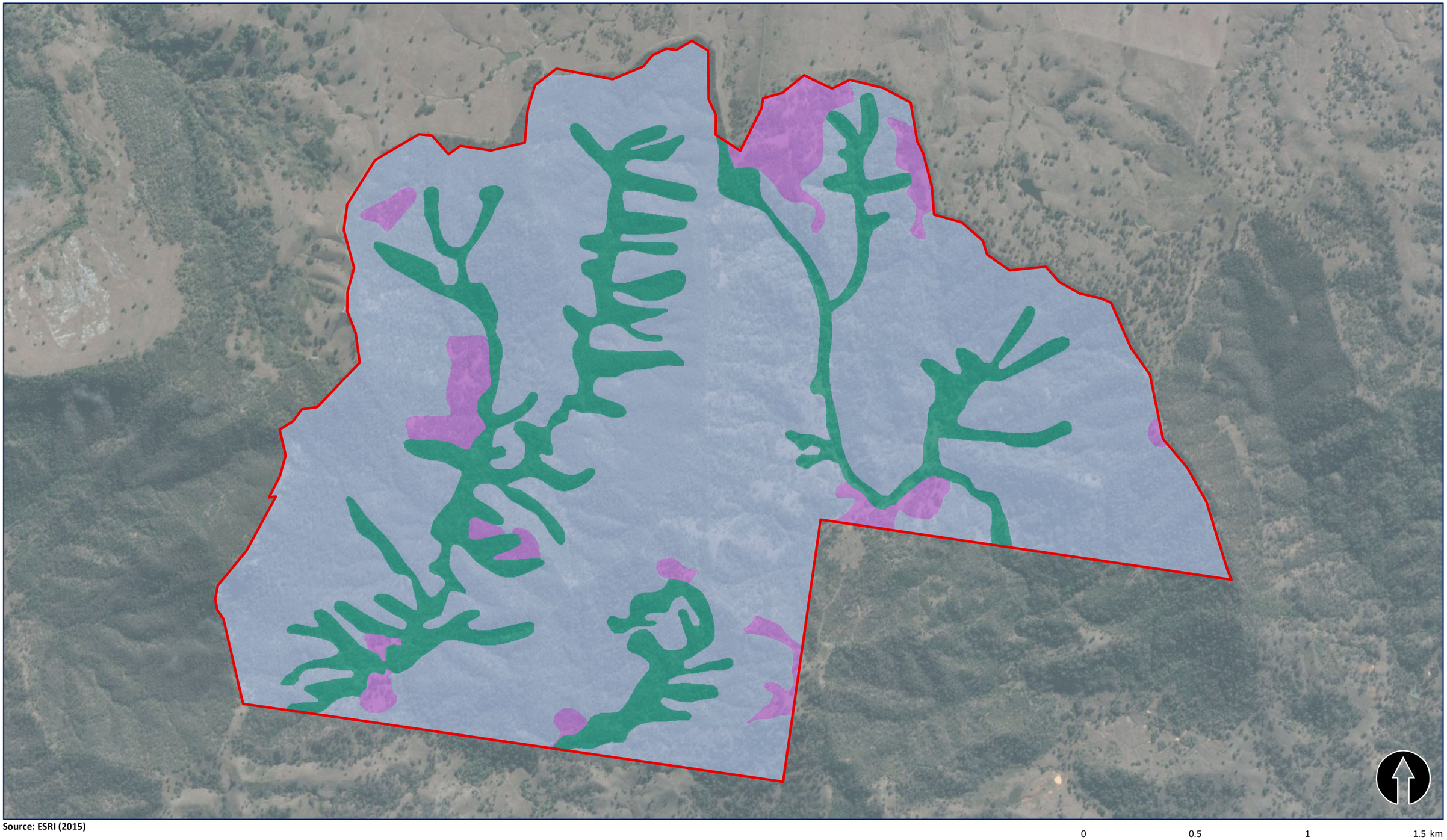
3.4 Fauna Species recorded

A total of 99 fauna species were recorded across the Braefield properties during surveys completed in late April 2015, including 84 species of bird, 11 mammals, two reptiles and two frogs. Of the 98 species observed, six were listed as threatened under the TSC Act and included Brown Treecreeper, Speckled Warbler, Hooded Robin, Varied Sittella, Turquoise Parrot and Little Lorikeet. No species listed as threatened under the EPBC Act were recorded during field surveys.

During the current seasonal conditions the most obvious fauna group were species of woodland bird. The most widespread being Speckled Warbler, due to the widespread occurrence of shrubby understorey habitats that are favoured by this species. Little Lorikeets were also recorded relatively frequently, due to the occurrence of White Box blossom in some woodland patches. All other threatened bird species were relatively sparse in their occurrence, due to reduced areas of suitable habitat within the combined Braefield properties. However, their presence, particularly the Hooded Robin, was an indicator that some areas of habitat within the properties are of high value (refer Figure 3.3 and Figure 3.4).

The occurrence of the large remnant patch of shrubby woodland, primarily consisting of *E. albens* (White Box) in the canopy was considered to be of high quality for nectivorous fauna and may be used intermittently by threatened fauna, including endangered bird species, such as the Swift Parrot and Regent Honeyeater.

A low number of herpetofauna species were recorded, but cool climatic conditions during the survey period appeared to reduce the activity of such species.



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Source: ESRI (2015)

0 0.5 1 1.5 km

Offset property

Fauna habitat

- Grassy Woodland on Fertile Soils
- Riverine Woodland
- Shrubby Woodlands/Open Forest on Skeletal Soils

Figure 3.3
Fauna habitat of the Breafield (northern) BOA

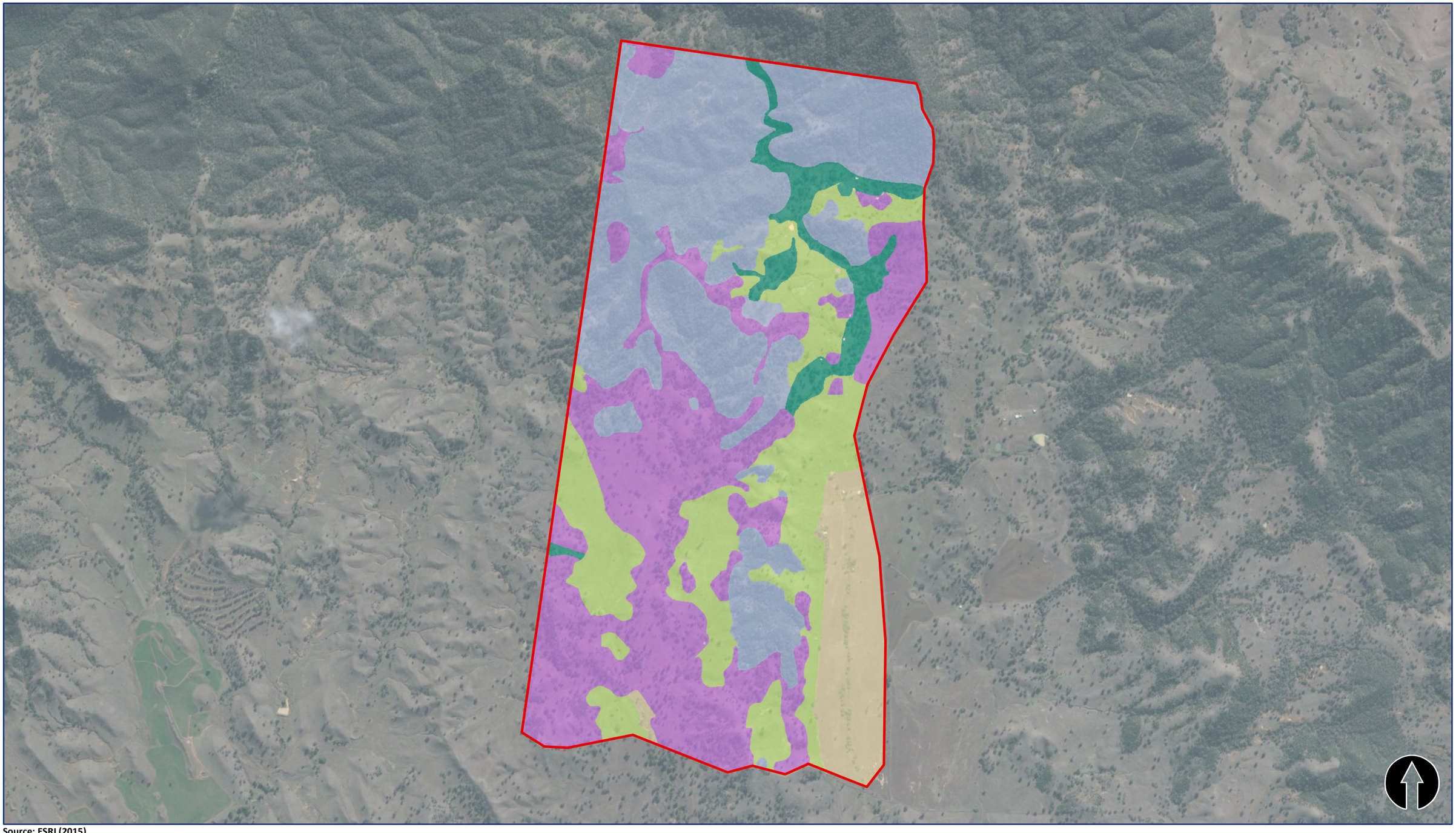


Figure 3.4
Fauna habitat of the
Breafield (southern) BOA

4. Threatened biodiversity

4.1 Threatened ecological communities

Threatened ecological communities (critically endangered, endangered and vulnerable) are listed under the TSC Act, EPBC Act and the *Fisheries Management Act 1994* (FM Act).

Results from the database searches indicated that 12 threatened communities (refer Table 4.1) were predicted to occur within the vicinity of the BOAs. One threatened ecological community was recorded within the Braefield property. This threatened ecological community was commensurate with four vegetation communities recorded within the property. Further discussion on this community is provided Section 4.1.1 and the locations of the Box-gum woodlands are shown in Figure 4.1.

Table 4.1 Threatened ecological communities predicted to occur in the vicinity of the BOAs

Threatened ecological community	TSC Act[1]	EPBC Act[2]	FM Act[3]	Recorded at Braefield
Aquatic Ecological community in the natural drainage system of the lowland catchment of the Darling river	-	-	E	No
Cadellia pentastylis (ooline) community in the Brigalow Belt South Bioregions	E	-	-	No
Coolibah – Black Box Woodlands of the Darling Riverine Plains and Brigalow Belt South Bioregions	E	E	-	No
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and North Coast Bioregions	E	-	-	No
Howell Shrublands in the New England Tableland and Nandewar bioregions	E	-	-	No
Inland Grey Box Grassy Woodlands and derived native grasslands of south-eastern Australia	E	E	-	No
Mt Kaputar high elevation and dry rainforest land snail and slug community in the Nandewar and Brigalow Belt south Bioregions	E	-	-	No
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	E	CE	-	No
New England Peppermint Grassy Woodland	CE	CE	-	No
Semi-evergreen Vine Thicket in the Brigalow Belt south and Nandewar biodregions	E	E	-	No
Weeping Myall Woodlands	E	E	-	No
White Box Yellow Box Blakely's Red Gum Grassy Woodland and derived native grassland	**E**	**CE**	**-**	**Yes**

(1) CE = listed as critically endangered community, E = Listed as endangered ecological community on the TSC Act.

(2) CE = listed as Critically Endangered community, E = listed as endangered ecological community on the EPBC Act.

(3) E = listed as Endangered Ecological community on the FM Act.

4.1.1 White Box Yellow Box, Blakely's Red Gum woodland

Conditions for the detection of native flora species to assist in identification were harsh due to drought conditions for the last 3 years and a grasshopper plague which was occurring at the time of the survey. It is highly likely that an additional survey after significant rain during spring will result in in higher species richness.

4.1.1.1 Commonwealth listed White Box, Yellow Box, Blakely's Red Gum woodland and derived native grassland

Four communities, including derived grasslands, within the Braefield property have some of the characteristics of the federally listed White Box Yellow Box Blakely's Red Gum grassy woodland and Derived Native Grassland (hereafter referred to as Remnant Box Gum Woodland):

- **White Box Grassy Woodland (moderate condition)** – This community has White Box as a dominant species within the canopy layer and contained a sparse shrub layer and grassy ground layer and therefore this community has been considered in Table 4.2 to determine if it meets the criteria for EPBC Act Remnant Box Gum Woodland.
- **White Box grassy woodland (low condition derived grassland)** – This community had scattered white box species present and generally occurred as grassland between areas of grassy woodland. Therefore this grassland community has been considered further in an assessment to determine if some of the patches meet the derived grassland criteria for the EPBC Act listed community in Table 4.2 (henceforth referred to as Box Gum Woodland (Derived Native Grassland).
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland** – this community occurred in the riparian area of both the northern and southern sections of the property. The dominant canopy species were White Box, Blakely's Red Gum and Rough-barked Apple. Therefore this community has been considered in Table 4.2 to determine if it meets the criteria for EPBC Act Remnant Box Gum Woodland. The shrubby variant of this community is not consistent with the determination for EPBC Act Box-gum woodland due to a shrub layer greater than 30%.
- **Yellow Box Blakely's Red Gum grassy Woodland this community** – occurred in the riparian areas in the southern section of the property. The dominant canopy species were Blakely's Red Gum and Yellow Box. Therefore this community has been considered in Table 4.2 to determine if it meets the criteria for EPBC Act Remnant Box Gum Woodland.

The process for determining if the above four communities meet the detailed Box Gum Woodland identification guidelines is provided in Figure 4.1 and is described in more detail in Table 4.2.

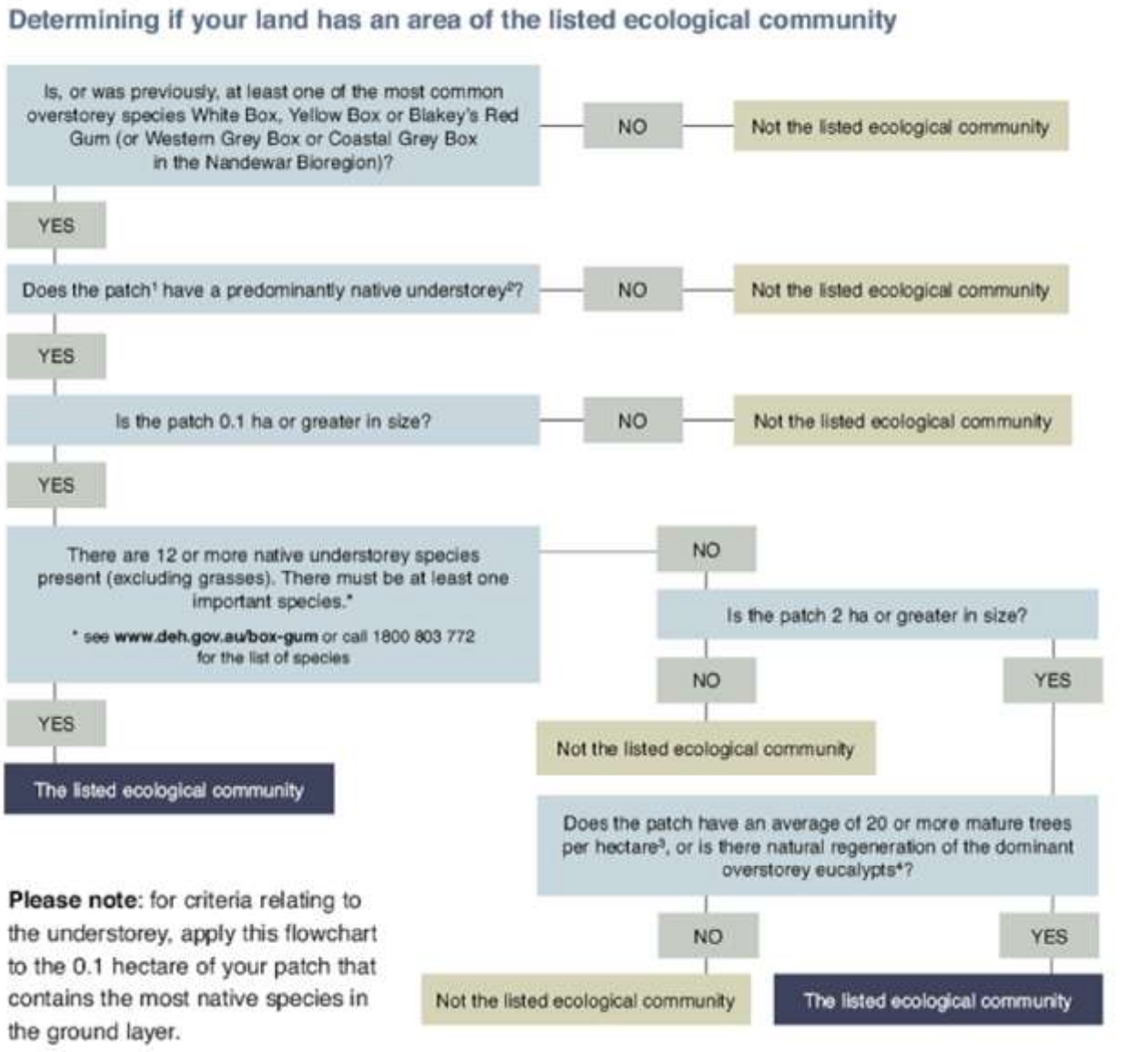
In addition to the identification guidelines presented below, the advice of the Threatened Species Scientific Committee (Environment Australia 2000) and final determination (Department of Environment and Heritage 2004) for this community were considered in determining the presence of Box-Gum Woodlands.

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).

The four communities above all had a shrub layer density that was low (generally less than 10%) and as such is consistent with the sparse open shrub layer of the EPBC Act community.

Six additional communities, White Box – White Cypress Pine shrubby open forest, White box – Melaleuca riverine forest, White Box Blakely's Red gum Rough-barked Apple riparian woodland (shrubby variant), White Box - Dwyer's Red Gum – Mana Gum shrubby woodland, New England Blackbutt Rough-barked Apple shrubby open forest, White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest and Tumbledown Red Gum Grassy Woodland which all have White Box present in the canopy layer however both of these communities have a shrub layer greater than 30% and therefore do not meet the criteria for the federal listed of Box Gum Woodlands.



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 4.1 Identification of Box Gum Woodland

Table 4.2 Summary table of EPBC determination of Box Gum Woodlands for each patch

Step	EPBC Criteria for determining Box-Gum Woodlands	White Box Grassy Woodland		White Box Blakely's Red gum Rough-barked Apple riparian woodland	Yellow Box Blakely's Red Gum grassy woodland
		Woodland variant (moderate condition)	Derived grassland variant (low condition)		
1	Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?	**Yes**. White Box was present in all patches. This included **plots 3, 4, 15, 19, 21, 23, 26, 32, 34, 36, 40, 51 and 54.**	There was evidence of regeneration of eucalypts in parts of the areas mapped as derived grassland. Therefore the, low condition white box grassy woodland may have previously contained White box species. This included **plots 5, 7, 12, 13, 16** and **25.**	**Yes**. White Box and Blakely's Red Gum were common in the overstorey. This included **plots 8, 24, 27, 31, 35, 37, 38, 39, 41 and 48.**	**Yes**. Blakely's Red Gum and Yellow Box were common species in the overstorey. This included **plots 2 and 6.**
2	Does the patch have a predominantly native understorey?	**Yes.** All areas mapped as moderate- good condition and dominated by native understorey of native grasses.	**Yes in part**. The majority of the areas of grassland were dominated by native understorey species.	**Yes.** The patch mapped was dominated by native understorey of native grasses and herbs.	**Yes.** All areas mapped as moderate- good condition were dominated by native understorey of native grasses and herbs.
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 derived grassland are greater than 0.1 ha	**Yes.** All areas of this community are greater than 0.1 ha.	**Yes.** The patch of this community is greater than 0.1 ha.
4	Are there 12 or more native understorey species present (excluding grasses), with at least one important species?	**Yes**. Quadrat data showed that all remnant patches included 12 or more native understorey species with at least one important species.	**No.** All plots did not have more than 12 native species (excluding grasses) or contain at least one important species.	**Yes**. Quadrat data showed that all patches included 12 or more native understorey species with at least three important species.	**Yes**. Quadrat data showed that all remnant patches included 12 or more native understorey species with at least two important species.
5	Is the patch 2 ha or greater in size?	**Yes**. The majority of patches are greater than 2 ha.	**Yes**. The majority of patches are greater than 2 ha.	**Yes**. The majority of patches are greater than 2 ha.	**Yes**. The majority of patches are greater than 2 ha.

Step	EPBC Criteria for determining Box-Gum Woodlands	White Box Grassy Woodland		White Box Blakely's Red gum Rough-barked Apple riparian woodland	Yellow Box Blakely's Red Gum grassy woodland
		Woodland variant (moderate condition)	Derived grassland variant (low condition)		
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**. None of the patches had an average of 20 mature trees per hectare. Some of the plots had regeneration of Eucalypts, however plot 40 did not contain regeneration of 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.	**Yes**. The majority of patches greater than 2 ha have more than 20 mature trees per hectare and/or have natural regeneration of eucalypts.
END	Does patch meet final determination of the listed community (Department of the Environment and Heritage 2006)?	**Yes**. All patches that occurred within both the northern and southern sections of the property meet the criteria for the federal listing of Box-gum Woodland.	**No.** The derived grassland patches in both the northern and southern areas of Braefield did not have 12 or more native species (excluding grasses), and patches generally lacked regeneration of dominant eucalypt overstorey.	**Yes**. All patches that occurred within both the northern and southern sections of the property meet the criteria for the federal listing of Box-gum Woodland.	**Yes**. All patches that occur within southern section of the property meet the criteria for EPBC Box Gum Woodland.

Notes: 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 ha 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.

4.1.1.2 TSC Act listed 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 (NSW Scientific Committee 2002).

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:

1. whether the site is within the area defined in the determination
2. whether the characteristic trees of the site are (or are likely to have been) White Box, Yellow Box or Blakely's Red Gum
3. whether the site is mainly grassy
4. whether any of the listed characteristic species occur (including as part of the seedbank in the soil)
5. 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).

Eight vegetation communities that occur within the Braefield property has the potential to be commensurate with the TSC Act listed Box-Gum Woodland with four meeting the criteria above. The reasons for this are outlined below:

- **White Box Grassy Woodland (moderate condition)** – this community meets the first four criteria above therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Remnant Box Gum Woodland.
- **White Box grassy woodland (low condition derived grassland)** – this community had scattered white box species present and generally occurred as grassland between areas of grassy woodland. This community meets 1, 2, 3 & 5 of the above criteria and therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Box Gum Woodland (Derived Native Grassland).
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland** – this community occurred in the riparian areas throughout the property. The dominant canopy species were White Box, Blakely's Red Gum and Rough-barked Apple. Therefore this community meets the first four criteria above therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Remnant Box Gum Woodland.
- **Yellow Box Blakely's Red Gum grassy Woodland this community** – occurred in the riparian areas within the southern section of the property. The dominant canopy species were Blakely's Red Gum and Yellow Box. Therefore This community meets the first four criteria above therefore this community has been considered in Table 4.3 to determine the condition class of the TSC Act listed Remnant Box Gum Woodland.
- **White Box Blakely's Red gum Rough-barked Apple riparian woodland (shrubby variant)** – this community occurred in the riparian areas in both the northern and southern sections of the property. The dominant canopy species were White Box, Blakely's Red Gum and Rough-barked Apple. Therefore this community meets the criteria 1 and 2 however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland.
- **White Box – White Cypress Pine shrubby open forest** – this community meets criteria 1 and 2, however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland.
- **White Box Narrow-leaved Ironbark White Cypress Pine shrubby open forest** – this community meets criteria 1 and 2, however it is a shrubby woodland and does not meet condition 3 and therefore it

is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland.

- **White Box - Dwyer's Red Gum – Manna Gum shrubby woodland** – this community meets criteria 1 and 2, however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community of Remnant Box Gum Woodland.
- **White Box – Melaleuca Riverine Forest** – this community meets criteria 1 and 2, however it is a shrubby woodland and does not meet condition 3 and therefore it is not considered to be commensurate with the TSC Act listed endangered ecological community Remnant Box Gum Woodland.

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 2002b).

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 (refer Table 4.3). This assessment was based on the results of the sampled plot with the greatest native diversity and cover for each patch.

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

TSC Act condition criteria for determining White Box, Yellow Box, Blakely's Red Gum Woodland	General comment	White Box Grassy Woodland		White Box Blakely's Red gum Rough-barked Apple riparian woodland (grassy variant)	Yellow Box Blakely's Red Gum grassy woodland
		Woodland (moderate condition)	Derived grassland (low condition)		
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.	Yes - the community had a high diversity of natives (50+) and a multi aged overstorey.	No	Yes – the community had a high diversity of natives (50+) and a multi aged overstorey.	Yes – the community had a high diversity of natives (40+) and a multi aged overstorey.
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. Some of the patches of this community meet this condition class.	No	Yes. Some of the patches of this community meet this condition class.	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.	Yes. Some of the patches of this community meet this condition class.	No	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 Grassy Woodland (low condition) community mapped within both the northern and southern sections of the property.	No	No
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	No	No
Does patch meet one of the five condition criteria for classification of the vegetation as the listed community? (condition class)		Yes all patches (Class two, three and class five). This community was in very good condition.	Yes all derived grassland (Class four). This community was in very good condition.	Yes all patches (Class five and class four). This community was in very good condition.	Yes all patches (Class five). This community was in very good condition.

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Source: ESRI (2015)

Offset property

Threat-listed fauna

- Brown Treecreeper
- Little Lorikeet
- Speckled Warbler
- Varied Sittella

Threatened ecological communities

- Box Gum Woodland (EPBC Act)

0 0.5 1 1.5 km

Figure 4.2
Threat-listed species and threatened ecological communities within the Breafield (northern) BOA

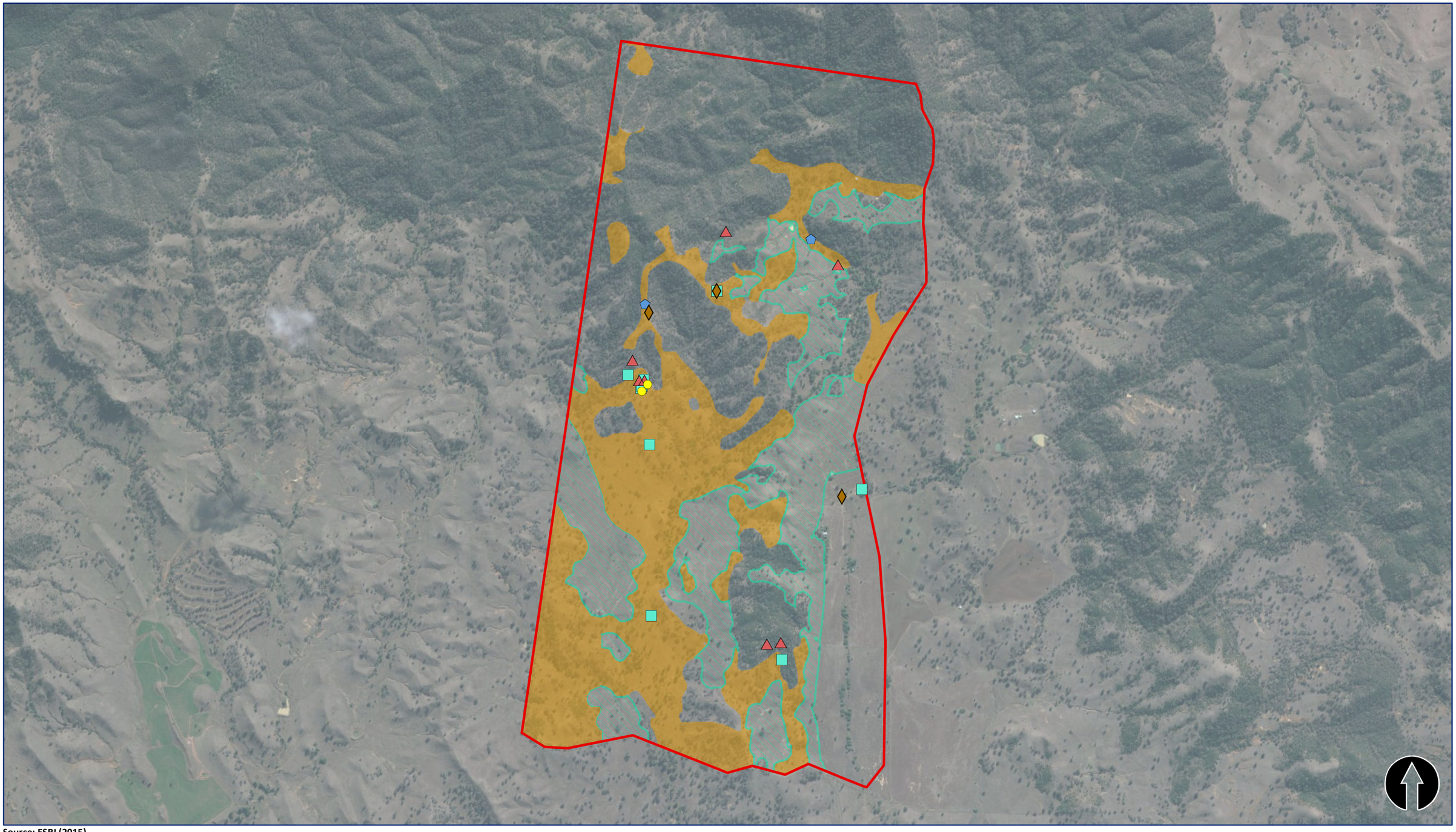

Figure 4.3
Threatened fauna species and threatened ecological communities within the Breafield (southern) BOA

4.2 Threatened flora

Based on the database searches (refer Table 2.2), a total of 26 threatened flora species listed under the TSC Act and/or the EPBC Act have been recorded previously or are predicted to occur within the locality of the Braefield property. Details of these species and their habitat requirements are provided in Appendix C.

No threatened flora species of plant were recorded during the field survey. Based on the presence of suitable habitat, eight species are considered to have a moderate likelihood of occurrence (refer Table 4.4).

Table 4.4 Threatened flora species recorded or with potential habitat within the Braefield property

Common name	Scientific name	EPBC Act[1]	TSC Act[2]	Recorded?
Donkey Orchid	*Diuris tricolor*	-	V	No
Bluegrass	*Dichanthium setosum*	V	V	No
Finger Panic Grass	*Digitaria porrecta*	E	E	No
Scant Pomaderris	*Pomaderris queenslandica*	-	E	No
A Leek Orchid	*Prasophyllum sp. Wybong (C. Phelps ORG 5269)*	E	-	No
-	*Tylophora linearis*	E	E	No
Hawkweed	*Picris evae*	V	V	No
Austral Toadflax	*Thesium australe*	-	V	No

(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 (E) or critically endangered (CE) under the TSC Act.

The remaining threatened species of plant are considered to have a low likelihood of occurrence based on the availability of habitat. Full details of species requirements and reasons for not considering further are provided in Appendix C.

4.3 Threatened fauna

Based on database searches (refer Table 2.2), a total of 62 threatened fauna species listed under the TSC Act and/ or the EPBC Act have been recorded previously or are predicted to occur within the locality of the BOA. Based on likelihood of occurrence assessments, 24 threatened species of fauna were considered likely to occur in the study area with a moderate or greater likelihood. Details of these species and their habitat requirements are provided in Appendix D. A further six species of fauna listed as threatened under the TSC Act were recorded across the northern and southern sections of the study area and included Brown Treecreeper, Speckled Warbler, Varied Sittella, Hooded Robin, Turquoise Parrot and Little Lorikeet (refer Figure 4.2 and Figure 4.3).

Speckled Warbler was the most widespread and numerously recorded threatened bird, which coincided with most remnant woodland patches containing shrubby understoreys that this species prefers for both cover and breeding purposes.

The Little Lorikeet was recorded relatively commonly due to the occurrence of White Box blossom in some woodland patches during the survey period. The occurrence of the large remnant patch of woodland on the Braefield property, primarily consisting of *E. albens* (White Box) in the canopy, was considered to be of high quality for nectivorous fauna. It is possible that the endangered Swift Parrot and Regent Honeyeater may use such high value areas of woodland habitat intermittently for foraging purposes during some winter-flowering seasons.

All other woodland birds species were largely limited to a small number of observations (if not single observations), however the recording of multiple individuals of Turquoise Parrot and Brown Treecreeper, suggest that these species are relatively well established in the locations where they were observed.

A pair of Hooded Robins was observed at one location (refer Figure 4.2 and Figure 4.3) in the study area, and although not observed, there is sufficient mistletoe throughout the property to attract Painted Honeyeaters during peak fruiting seasons.

No large forest owls were observed during the survey period, however the quality and extent of fauna habitats within the property are likely to represent at least a part of a home range of the Barking and Masked Owls.

No threatened birds of prey were observed within the property, however such species range over large areas and suitable habitats onsite were not large enough to support such species in isolation. Nevertheless it is considered likely that the properties may represent part of the home or seasonal range of a number of local threatened raptor species, including Spotted Harrier, Little Eagle, Square-tailed Kite and Black Falcon.

Climatic variables (cool overnight temperatures and moderate rainfall) together with property remoteness and limited access, reduced the efficacy of completing targeted microchiropteran bat surveys on an animal welfare basis. Due to the quality and extent of habitat within the property, it is considered very likely that the majority of threatened microchiropteran bats recorded in the locality would utilise such habitats for important foraging, roosting, and potentially breeding purposes. Although no caves were observed on the property during surveys, large exposed rock outcrops along the western ridgeline of the northern section of the property (i.e. the bluff) suggest that such structures may be available. It is considered highly likely that hollow-dependent threatened microchiropteran bats would roost and potentially breed regularly where trees contain suitable habitat, including isolated trees within pasture lands.

Due to the quality and extent of fauna habitat available in the study area and its contiguous nature with offsite habitat, it is considered likely that a number of locally occurring threatened fauna species, such as Koala and Spotted-tailed Quoll, would use such habitat at least on an intermittent basis.

Although no fauna species listed as threatened under the EPBC Act were observed during the surveys, there is suitable habitat onsite to attract a number of locally occurring EPBC Act listed animals on a seasonal or intermittent basis; including, Swift Parrot, Regent Honeyeater, Large-eared Pied Bat, Koala and Spotted-tailed Quoll.

4.4 Migratory species

Twelve species listed as migratory on the EPBC Act have been recorded as having potential habitat within the locality of the BOAs based on the EPBC Act protected matters database search (refer Table 2.2).

There is limited potential for EPBC Act Migratory species to occur within the properties, since many such species are coastal in their movements and layover sites or are attracted to significant inland water bodies as stopover sites, and these do not occur onsite. No terrestrial migratory species was observed in the study area during surveys. Notwithstanding this, six migratory species are considered likely to occur with a moderate or greater likelihood, at least on an infrequent basis including, Fork-tailed Swift, White-throated Needletail, Cattle Egret, Eastern Great Egret, Rainbow Bee-eater and Regent Honeyeater.

Two species, Fork-tailed Swift and White-throated Needletail, are two far dispersing species during warmer months, which may forage in aerial space above the study area. However no suitable terrestrial habitats are available for these species in the study area.

The occurrence of a large remnant patch of woodland in the study area (particularly the northern section), which primarily consisted of *E. albens* (White Box) in the canopy, was considered to be of high quality for nectivorous fauna. It is possible that the endangered and migratory Regent Honeyeater may use such high value areas of woodland habitat intermittently for foraging purposes during some winter-flowering seasons.

The remaining three species, Eastern Great Egret, Cattle Egret and Rainbow Bee-eater, are considered to have potential habitat within the study area (refer Appendix D).

5. Conclusions

5.1 Vegetation extent

Both the southern and northern sections of the Braefield property contain significant areas of native vegetation that contain threatened ecological communities and habitat for threatened biodiversity (refer Table 5.1). Collectively the Braefield property contained **319.9 ha of remnant Box Gum Woodland** and **173.00 ha of Box Gum Woodland (Derived Native Grassland).**

- **Southern section –** contained 265.41 ha of Remnant Box Gum Woodland and 173.00 ha of Box Gum Woodland.
- **Northern section –** contained 54.49 ha of Remnant Box Gum Woodland.

The large areas of Box Gum Woodland (Derived Native Grasslands) within the southern section of the property that meets the endangered ecological community as listed on the TSC Act has high potential to be rehabilitated to a higher quality remnant Box Gum Woodland.

Table 5.1 Extent of Vegetation within the Biodiversity Offset Areas

Vegetation community	Vegetation extent within Northern section (ha)	Vegetation extent within Southern section (ha)	Combined extent (ha)
White Box Grassy Woodland (moderate condition)[1]	48.67	185.12	233.79
White Box Grassy Woodland (low condition derived native grassland)[2]	0	173.00	173.00
White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest	7.89	29.19	37.08
White Box – White Cypress Pine shrubby open forest	603.26	243.70	846.96
White Box – White Cypress Pine shrubby open forest (Callitris Regrowth)	26.27	9.57	35.84
White Box – White Cypress Pine shrubby open forest (Shiny Bush)	3.45	24.51	27.96
Tumbledown Red Gum Grassy Woodland	3.77	37.37	41.14
White Box - Dwyer's Red Gum – Manna Gum shrubby woodland	37.97	0	37.97
New England Blackbutt Rough-barked Apple Shrubby Open Forest	1.31	0	1.31
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland[1]	5.82	24.56	30.38
White Box – Blakely's Red Gum – Rough-barked Apple Riparian woodland (shrubby variant)[3]	146.86	4.02	150.88
Yellow Box – Blakely's Red Gum grassy woodland[1]	0	55.73	55.73

Vegetation community	Vegetation extent within Northern section (ha)	Vegetation extent within Southern section (ha)	Combined extent (ha)
White Box – Melaleuca Riverine Forest	0	17.04	17.04
Intensive Agriculture	0	73.73	73.73
Total area of vegetation	**885.27**	**877.54**	**1762.81**
Total native vegetation	**885.27**	**803.81**	**1689.08**
Total Remnant Box Gum Woodland[1]	**54.49**	**265.41**	**319.9**
Total Box Gum Woodland (Derived Native Grassland)[2]	**0**	**173.00**	**173.00**

(1) Commensurate with Critically Endangered Ecological Community, White Box Yellow Box Blakely's Red Gum Grassy Woodland and derived native grassland as listed under the EPBC Act and is Commensurate with Endangered Ecological Community of White Box Yellow Box Blakely's Red Gum Woodland as listed on the TSC Act.

(2) Commensurate with Endangered Ecological Community of White Box Yellow Box Blakely's Red Gum Woodland as listed on the TSC Act, derived native grassland variant.

(3) This community is not commensurate with Box Gum Woodland communities listed on the TSC Act or the EPBC Act, as the understorey is too shrubby to meet listing criteria for TSC Act and EPBC Act.

5.2 Threatened flora and fauna

Although no threated flora species were recorded during the field survey the property is considered to have high quality habitat for eight threatened flora species, being *Diuris tricolor, Dichanthium setosum, Digitaria porrecta, Picris evae, Pomaderris queenslandica, Prasophyllum sp. Wybong (C. Phelps ORG 5269), Tylophora linearis* and *Thesium australe.*

Six species of fauna listed as threatened under the TSC Act were **recorded** in the study area. These include:

- Brown Treecreeper
- Speckled Warbler
- Varied Sittella
- Hooded Robin
- Turquoise Parrot and
- Little Lorikeet.

Due to the quality, extent and contiguous nature of habitats in the study area with offsite habitats, a further 24 threatened species listed on the TSC Act and or the EPBC Act have the potential to occur within the study area. These include the following, Pale-headed Snake, Border Thick-tailed Gecko, Regent Honeyeater, Spotted Harrier, Black Falcon, Painted Honeyeater, Little Eagle, Swift Parrot, Square-tailed Kite, Black-chinned Honeyeater, Barking Owl, Grey-crowned Babbler, Diamond Firetail, Masked Owl, Large-eared Pied Bat, Spotted-tailed Quoll, Eastern false Pipistrelle, Eastern Bent-wing Bat, South-eastern Long-eared Bat, Squirrel Glider, Koala, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat and Eastern Cave Bat.

6. References

Australian Weeds Committee 2012, *Weeds of National Significance*, viewed 8 June 2012 2012, <http://www.weeds.org.au/WoNS/>.

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

Department of Environment 2015, *Protected Matters Search Tool*, <http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/protected>.

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 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 Water Heritage and the Arts 2010, *Survey guidelines for Australia's threatened birds - Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*.

Department of Primary Industries 2015a, *Noxious Weed Declarations Web Site*, <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed>.

Department of Primary industries 2015b, *Threatened Aquatic Fauna Database Search*, Department of Fishing and Aquaculture.

Department of the Environment 2015, *Australian Faunal Directory*, viewed 8 January 2015, <http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/home>.

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.

Eco Logical Australia 2008, *A Vegetation Map for the Namoi Catchment Management Authority*, An unpublished report prepared for Namoi Catchment Management Authority, December 2008.

Eco Logical Australia 2013, *Refinement of vegetation mapping in the Namoi Catchment: Extant and pre-European*, Prepared for the Namoi CMA, May 2013.

Environment Australia 2000, *Grassy white box woodlands listing advice*, Environment Australia, Canberra.

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.

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.

Keith, D 2004, *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT* Department of Environment and Conservation, Hurstville.

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, *White Box Yellow Box Blakely's Red Gum (Box-Gum) woodland: fact-sheet for NSW*, 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.

Office of Environment and Heritage 2014a, *BioBanking Assessment Methodology 2014*, Sydney.

Office of Environment and Heritage 2014b, *Plant Community Type Identification Tool*

Office of Environment and Heritage 2014c, *Vegetation Benchmarks Database*, October, 2014, <http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm>.

Office of Environment and Heritage 2015a, *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 2015b, *Threatened species search by CMA region* viewed 28 April 2015, <http://www.environment.nsw.gov.au/threatenedspeciesapp/AreaHabitatSearch.aspx>.

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

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

Royal Botanic Gardens 2015, *Plant Information Network System of The Royal Botanic Gardens and Domain Trust Version 2.0*, viewed 8 January 2015, <http://plantnet.rbgsyd.nsw.gov.au/>.

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

Appendix A

Plant Species Recorded

Table A.1 Species of plant recorded within the study area

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Native
Acanthaceae	*Rostellularia adscendens*				Y
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair			Y
Adiantaceae	*Cheilanthes distans*	Bristly Cloak Fern			Y
Adiantaceae	*Cheilanthes sieberi*	Mulga Fern			Y
Amaranthaceae	*Alternanthera pungens*	Khaki Weed			N
Anacardiaceae	*Schinus areira*	Pepper Tree			N
Anthericaceae	*Arthropodium minus*	Small Vanilla Lily			Y
Anthericaceae	*Caesia parviflora*	Pale Grass-lily			Y
Anthericaceae	*Dichopogon fimbriatus*	Nodding Chocolate Lily			Y
Apiaceae	*Daucus glochidiatus*	Native Carrot			Y
Apiaceae	*Cyclospermum leptophyllum*	Slender Celery			N
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort			Y
Asclepiadaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush			N
Asteraceae	*Bidens pilosa*	Cobblers Pegs			N
Asteraceae	*Bidens subalternans*	Greater Beggars Ticks			N
Asteraceae	*Brachyscome sp.*				Y
Asteraceae	*Calotis cuneifolia*	Purple Burr-Daisy			Y
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy			Y
Asteraceae	*Carthamus lanatus*	Saffron Thistle			N
Asteraceae	*Cassinia laevis*	Cough Bush			Y
Asteraceae	*Cassinia quinquefaria*				Y
Asteraceae	*Chondrilla juncea*	Skeleton Weed			N
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting			Y
Asteraceae	*Cirsium vulgare*	Spear Thistle			N
Asteraceae	*Conyza albida*	Tall Fleabane			N
Asteraceae	*Euchiton sphaericus*	Annual Cudweed			Y
Asteraceae	*Glossocardia bidens*				Y
Asteraceae	*Hypochaeris glabra*	Smooth Catsear			N
Asteraceae	*Hypochaeris radicata*	Catsear			N

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Native
Asteraceae	*Olearia elliptica*	Sticky Daisy Bush			Y
Asteraceae	*Senecio linearifolius*	Fireweed Groundsel			Y
Asteraceae	*Senecio quadridentatus*	Cotton Fireweed			Y
Asteraceae	*Sigesbeckia australiensis*	Cobber Weed			Y
Asteraceae	*Silybum marianum*	Variegated Thistle			N
Asteraceae	*Solenogyne bellioides*				Y
Asteraceae	*Taraxacum officinale*	Dandelion			N
Asteraceae	*Vernonia cinerea*				Y
Asteraceae	*Vittadinia cuneata*	Fuzzweed			Y
Asteraceae	*Vittadinia muelleri*	Narrow-leaf New Holland Daisy			Y
Asteraceae	*Vittadinia pustulata*				Y
Asteraceae	*Vittadinia sp.*				Y
Asteraceae	*Xanthium spinosum*	Bathurst Burr			N
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine			Y
Brassicaceae	*Lepidium sp.*				Y
Cactaceae	*Opuntia stricta*	Prickly Pear			N
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell			Y
Campanulaceae	*Wahlenbergia gracilis*	Sprawling or Australian Bluebell			Y
Campanulaceae	*Wahlenbergia stricta*	Tall Bluebell			Y
Chenopodiaceae	*Einadia hastata*	Berry Saltbush			Y
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush			Y
Chenopodiaceae	*Einadia polygonoides*				Y
Chenopodiaceae	*Einadia trigonos*	Fishweed			Y
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush			Y
Chenopodiaceae	*Sclerolaena birchii*	Galvanized Burr			Y
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort			Y
Commelinaceae	*Commelina cyanea*	Native Wandering Jew			Y
Convolvulaceae	*Convolvulus erubescens*				Y
Convolvulaceae	*Dichondra sp. A*				Y
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine			Y
Cyperaceae	*Carex appressa*	Tussock Sedge			Y

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Native
Cyperaceae	*Carex inversa*	Knob Sedge			Y
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge			N
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge			Y
Cyperaceae	*Cyperus sp.*				Y
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge			Y
Dilleniaceae	*Hibbertia obtusifolia*	Grey Guinea-flower			Y
Epacridaceae	*Melichrus urceolatus*	Urn Heath			Y
Euphorbiaceae	*Beyeria viscosa*	Pinkwood			Y
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed			Y
Euphorbiaceae	*Phyllanthus sp.*				Y
Euphorbiaceae	*Phyllanthus subcrenulatus*				Y
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil			Y
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil			Y
Fabaceae (Faboideae)	*Glycine clandestina*	Twining Glycine			Y
Fabaceae (Faboideae)	*Glycine tabacina*				Y
Fabaceae (Faboideae)	*Hovea lanceolata*				Y
Fabaceae (Faboideae)	*Swainsona galegifolia*	Smooth Darling Pea			Y
Fabaceae (Faboideae)	*Trifolium subterraneum*	Subterraneum Clover			N
Fabaceae (Faboideae)	*Zornia dyctiocarpa*				Y
Fabaceae (Mimosoideae)	*Acacia cheelii*	Motherumbah			Y
Fabaceae (Mimosoideae)	*Acacia decora*	Western Golden Wattle			Y
Fabaceae (Mimosoideae)	*Acacia salicina*	Cooba			Y
Fabaceae (Mimosoideae)	*Acacia gladiiformis*	Sword Wattle			Y
Geraniaceae	*Geranium homeanum*	Rainforest Cranes-bill			Y
Geraniaceae	*Geranium molle subsp. molle*	Cranesbill Geranium			N
Juncaceae	*Juncus cognatus*				N
Lamiaceae	*Ajuga australis*	Austral Bugle			Y
Lamiaceae	*Marrubium vulgare*	Horehound			N
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush			Y
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			Y

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Native
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush			Y
Loranthaceae	*Amyema miquelii*	Box Mistletoe			Y
Loranthaceae	*Lysiana subfalcata*	Mistletoe			Y
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry			Y
Malvaceae	*Sida corrugata*	Corrugated Sida, Variable Sida			Y
Malvaceae	*Sida cunninghamii*				Y
Malvaceae	*Sida spinosa*				N
Myoporaceae	*Eremophila debilis*	Amulla			Y
Myrtaceae	*Angophora floribunda*	Rough-barked Apple			Y
Myrtaceae	*Eucalyptus albens*	White Box			Y
Myrtaceae	*Eucalyptus andrewsii*	New England Blackbutt			Y
Myrtaceae	*Eucalyptus blakelyi*	Blakely's Red Gum			Y
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark			Y
Myrtaceae	*Eucalyptus dealbata*	Tumbledown Red Gum			Y
Myrtaceae	*Eucalyptus dwyeri*	Dwyer's Red Gum			Y
Myrtaceae	*Eucalyptus melliodora*	Yellow Box			Y
Myrtaceae	*Eucalyptus viminalis*	Ribbon Gum			Y
Myrtaceae	*Melaleuca bracteata*				Y
Nyctaginaceae	*Boerhavia dominii*	Tarvine			Y
Oleaceae	*Jasminum lineare*	Desert Jasmine			Y
Oleaceae	*Notelaea linearis*				Y
Oleaceae	*Notelaea microcarpa*	Native Olive			Y
Orchidaceae	*Cymbidium canaliculatum*	Tiger Orchid			Y
Orchidaceae	*Pterostylis sp.*				Y
Oxalidaceae	*Oxalis perennans*	Grassland Wood-sorrel			Y
Papaveraceae	*Argemone mexicana*	Mexican Poppy			N
Phormiaceae	*Dianella revoluta var. revoluta*				Y
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn			Y
Plantaginaceae	*Plantago debilis*	Shade Plantain			Y
Plantaginaceae	*Plantago gaudichaudii*	Narrow Plantain			Y

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Native
Poaceae	*Aristida calycina var. calycina*	Dark Wire-grass			Y
Poaceae	*Aristida ramosa*	Cane Wire-grass			Y
Poaceae	*Austrostipa scabra*	Speargrass			Y
Poaceae	*Austrostipa verticillata*				Y
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass			N
Poaceae	*Bothriochloa decipiens*	Red Grass			Y
Poaceae	*Chloris truncata*	Windmill Grass			Y
Poaceae	*Chloris ventricosa*	Tall Chloris			Y
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass			Y
Poaceae	*Dichanthium sericeum*	Queensland Bluegrass			Y
Poaceae	*Dichelachne sp.*				Y
Poaceae	*Digitaria breviglumis*				Y
Poaceae	*Digitaria brownii*	Cotton Panic Grass			Y
Poaceae	*Digitaria sp.*				Y
Poaceae	*Eleusine tristachya*	Goose Grass			N
Poaceae	*Elymus scaber*				Y
Poaceae	*Enneapogon gracilis*	Slender Nineawn			Y
Poaceae	*Enteropogon acicularis*	Spider Grass			Y
Poaceae	*Eragrostis brownii*	Browns Lovegrass			Y
Poaceae	*Eragrostis cilianensis*	Stinkgrass			N
Poaceae	*Eragrostis elongata*	Clustered Lovegrass			Y
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass			Y
Poaceae	*Eragrostis sp.*				Y
Poaceae	*Microlaena stipoides*				Y
Poaceae	*Panicum effusum*	Poison or Hairy Panic			Y
Poaceae	*Paspalidium sp.*				Y
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass			N
Poaceae	*Poa sieberiana*	Grey Tussock-grass			Y
Poaceae	*Rytidosperma racemosum*				Y
Poaceae	*Rytidosperma sp.*				Y
Poaceae	*Sporobolus creber*	Slender Rats Tail Grass			Y

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Native
Poaceae	*Themeda triandra*	Kangaroo Grass			Y
Poaceae	*Tragus australianus*	Small Burrgrass			Y
Polygonaceae	*Rumex brownii*	Swamp Dock			Y
Portulacaceae	*Portulaca oleracea*	Pigweed			Y
Ranunculaceae	*Clematis aristata*	Mountain Clematis			Y
Rhamnaceae	*Cryptandra amara*				Y
Rosaceae	*Acaena ovina*	Australian Sheeps Burr			Y
Rosaceae	*Rosa rubiginosa*	Sweet Briar			N
Rubiaceae	*Asperula conferta*	Common Woodruff			Y
Rubiaceae	*Psydrax odoratum*	Shiny-leaved Canthium			Y
Rubiaceae	*Galium binifolium*	Reflexed Bedstraw			Y
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw			Y
Rubiaceae	*Opercularia diphylla*				Y
Rutaceae	*Geijera parviflora*	Wilga			Y
Sapindaceae	*Alectryon subdentatus*				Y
Sapindaceae	*Dodonaea pinnata*				Y
Sapindaceae	*Dodonaea viscosa*	Sticky Hop-bush			Y
Sapindaceae	*Dodonaea viscosa subsp. cuneata*	Wedge-leaf Hop-bush			Y
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell			Y
Solanaceae	*Solanum cinereum*	Narrawa Burr			Y
Solanaceae	*Solanum nigrum*	Black-berry Nightshade			N
Solanaceae	*Solanum sp.*				Y
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia			Y
Sterculiaceae	*Brachychiton populneus*	Kurrajong			Y
Thymelaeaceae	*Pimelea neo-anglica*	Poison Pimelea			Y
Urticaceae	*Urtica incisa*	Stinging Nettle			Y
Verbenaceae	*Oncinocalyx betchei*				Y
Viscaceae	*Notothixos cornifolius*	Kurrajong Mistletoe			Y
Xanthorrhoeaceae	*Xanthorrhoea glauca subsp. angustifolia*				Y
Zamiaceae	*Macrozamia heteromera*				Y
Zygophyllaceae	*Tribulus micrococcus*	Yellow Vine, Spineless Caltrop			Y

Notes:

1:*Environmental Protection and Biodiversity Conservation Act 1999*

2:*Threatened Species Conservation Act 1995:* E = Endangered

Appendix B

Animal species recorded

Table B.1 Species of animal recorded within the study area

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Observation Type[3]
Amphibians					
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet			O
Myobatrachidae	*Pseudophryne bibronii*	Brown Toadlet			T
Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk			O
Accipitridae	*Aquila audax*	Wedge-tailed Eagle			O
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar			O
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra			O
Anatidae	*Chenonetta jubata*	Australian Wood Duck			O
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow			O
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird			O
Artamidae	*Cracticus torquatus*	Grey Butcherbird			O
Artamidae	*Gymnorhina tibicen*	Australian Magpie			O
Artamidae	*Strepera graculina*	Pied Currawong			O
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo			O
Cacatuidae	*Cacatua roseicapilla*	Galah			O
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			O
Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike			W
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel			O
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)		V	O
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper			O
Columbidae	*Ocyphaps lophotes*	Crested Pigeon			O
Columbidae	*Phaps chalcoptera*	Common Bronzewing			O
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough			O
Corcoracidae	*Struthidea cinerea*	Apostlebird			O
Corvidae	*Corvus coronoides*	Australian Raven			O
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird			W

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Observation Type[3]
Dicruridae	*Grallina cyanoleuca*	Magpie-lark			O
Dicruridae	*Myiagra inquieta*	Restless Flycatcher			O
Dicruridae	*Rhipidura fuliginosa*	Grey Fantail			O
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail			O
Falconidae	*Falco berigora*	Brown Falcon			O
Falconidae	*Falco cenchroides*	Nankeen Kestrel			O
Falconidae	*Falco longipennis*	Australian Hobby			O
Hirundinidae	*Hirundo neoxena*	Welcome Swallow			O
Maluridae	*Malurus cyaneus*	Superb Fairy-wren			O
Maluridae	*Malurus lamberti*	Variegated Fairy-wren			O
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater			O
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill			O
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird			O
Meliphagidae	*Caligavis chrysops*	Yellow-faced Honeyeater			O
Meliphagidae	*Entomyzon cyanotis*	Blue-faced Honeyeater			O
Meliphagidae	*Lichenostomus fuscus*	Fuscous Honeyeater			O
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater			O
Meliphagidae	*Lichenostomus melanops*	Yellow-tufted Honeyeater			O
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater			O
Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater			O
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater			O
Meliphagidae	*Manorina melanocephala*	Noisy Miner			O
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater			W
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater			O
Meliphagidae	*Philemon citreogularis*	Little Friarbird			O
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird			O

Family Name	Scientific Name	Common Name	EPBC Act Status[1]	TSC Act Status[2]	Observation Type[3]
Meliphagidae	*Plectorhyncha lanceolata*	Striped Honeyeater			W
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella		V	W
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole			O
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush			O
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler			O
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler			O
Pardalotidae	*Acanthiza apicalis*	Inland Thornbill			O
Pardalotidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill			O
Pardalotidae	*Acanthiza lineata*	Striated Thornbill			O
Pardalotidae	*Acanthiza nana*	Yellow Thornbill			O
Pardalotidae	*Acanthiza reguloides*	Buff-rumped Thornbill			O
Pardalotidae	*Aphelocephala leucopsis*	Southern Whiteface			O
Pardalotidae	*Chthonicola sagittata (syn. Pyrrholaemus sagittatus)*	Speckled Warbler		V	O
Pardalotidae	*Gerygone olivacea*	White-throated Gerygone			W
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote			O
Pardalotidae	*Pardalotus striatus*	Striated Pardalote			W
Pardalotidae	*Sericornis frontalis*	White-browed Scrubwren			O
Pardalotidae	*Smicrornis brevirostris*	Weebill			O
Passeridae	*Neochmia temporalis*	Red-browed Finch			O
Passeridae	*Taeniopygia bichenovii*	Double-barred Finch			O
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin			O
Petroicidae	*Melanodryas cucullata cucullata*	Hooded Robin (South-Eastern)		V	O
Petroicidae	*Microeca fascinans*	Jacky Winter			O
Petroicidae	*Petroica goodenovii*	Red-capped Robin			O
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe			O
Psittacidae	*Alisterus scapularis*	Australian King-Parrot			O

Family name	Scientific name	Common name	EPBC Act Status[1]	TSC Act Status[2]	Observation Type[3]
Psittacidae	*Aprosmictus erythropterus*	Red-winged Parrot			O
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet			W
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet		V	O
Psittacidae	*Neophema pulchella*	Turquoise Parrot		V	O
Psittacidae	*Platycercus elegans*	Crimson Rosella			O
Psittacidae	*Platycercus eximius*	Eastern Rosella			O
Psittacidae	*Psephotus haematonotus*	Red-rumped Parrot			O
Sturnidae	*Sturnus vulgaris*	Common Starling		U	O
Zosteropidae	*Zosterops lateralis*	Silvereye			O
Bovidae	*Bos taurus*	Cattle (feral)		U	O
Bovidae	*Capra hircus*	Goat (feral)		U	O
Canidae	*Vulpes vulpes*	Fox		U	O
Leporidae	*Lepus capensis*	Brown Hare		U	O
Leporidae	*Oryctolagus cuniculus*	Rabbit		U	O
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo			O
Macropodidae	*Macropus robustus*	Common Wallaroo/Euro			O
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby			O
Macropodidae	*Wallabia bicolor*	Swamp Wallaby			O
Pteropodidae	*Pteropus scapulatus*	Little Red Flying-fox			T
Suidae	*Sus scrofa*	Pig (feral)		U	O
Agamidae	*Amphibolurus nobbi coggeri*	Nobbi Dragon			T
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake			O

Notes:

1:*Environmental Protection and Biodiversity Conservation Act 1999*;

2:*Threatened Species Conservation Act 1995:* E = Endangered;

3: Observation type = O (observed), T (trapped), W (heard).

Appendix C

Threatened species of plant

Table C.1 Threatened Species of Plant

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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).	■ EPBC Protected Matters Search ■ BioNet NSW Atlas search Namoi CMA - Peel sub-region ■ Plant Net	**Moderate**. Potential habitat in the Box Gum woodlands within the study area.
Asteraceae	*Picris evae*	Hawkweed	V	V	The main habitat is open Eucalypt forest including a canopy of *Eucalyptus melliodora, E. crebra, E. populnea, E. albens, Angophora subvelutina*, *Allocasuarina torulosa*, and/or *Casuarina cunninghamiana* with a *Dichanthium* grassy understory. Known in NSW north from the Inverell area, in the north-western slopes and plains regions. It has been collected near Inverell Oxley Park and also from Dangar Falls in the Oxley Wild Rivers National Park in the northern tablelands of NSW. (Royal Botanic Gardens 2005).	■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	**Moderate**. Potential habitat in the grassy woodlands within the study area.
Brassicaceae	*Stenopetalum velutinum*	Velvet Thread-petal		E4	*Stenopetalum velutinum* is an annual woody herb with basal leaves. It is greyish green in colour and plants are densely hairy. It grows to approximately 7 cm in height and has yellow-green to brown flowers. It is known to grow on sandy soils with Buffel Grass. This species is known to occur in QLD, WA, NT and South Australia, however it is presumed extinct in NSW (Office of Environment and Heritage 2015).	■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Euphorbiaceae	*Monotaxis macrophylla*			E1	*Monotaxis macrophylla* is a fire ephemeral species where germination is stimulated only by fire. This species has a short life span with flowering occurs in August and within 2 to 3 months after germination. Flowers. Plants have a short life span and do not seem to persist longer than six months. Many hundreds of plants have been observed growing with Muehlenbeckia costata on recently burnt rock outcrops. Plants are recorded as common but localised in populations. In the northern NSW sites, *Monotaxis macrophylla* was locally abundant on outcrops especially where burnt. Grows on rocky ridges and hillsides. There is a great diversity in the associated vegetation within NSW, encompassing coastal heath, arid shrubland, forests and montane heath from almost sea level to 1300 m altitude (Royal Botanic Gardens 2008).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
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 Protected Matters Search	Low. No potential habitat within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Haloragaceae	*Haloragis exalata subsp. velutina*		V	V	Damp places near watercourses (Royal Botanic Gardens 2005). This subspecies of Tall Sea-berry occurs on the north coast of NSW and south-eastern Queensland. It is plentiful in inaccessible areas of the upper Macleay River. This subspecies also occurs in woodland on the steep rocky slopes of gorges (Department of Environment and Conservation 2006b).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	Occurs from Niangala to Glenn Innes where it grows in grassy sclerophyll woodland on shallow relatively infertile soils on shales and slates, mainly on granite (Harden, 1991; DLWC, 2001). Endemic on the NSW Northern Tablelands, of limited occurrence, particularly in the area from Walcha to Glen Innes; often on porphyry or granite (Brooker and Kleinig 1999).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Myrtaceae	*Eucalyptus rubida subsp. barbigerorum*	Blackbutt Candlebark		V	Eucalyptus rubida subsp. barbigerorum has a very restricted distribution in the Northern Tablelands of NSW, occurring in scattered populations from west of Glen Innes and Guyra, and in the Moonbi Ranges between Woolbrook and Nundle. It occurs in grassy woodland on deep, fertile clay-loam soils. Associated species include Yellow Box (*Eucalyptus melliodora*), Ribbon Gum (*E. viminalis*), Mountain Gum (*E. dalrympleana* subsp. *heptantha*) and Rough-barked Apple (*Angophora floribunda*). Most populations occur on agriculturally valuable land, and considerable areas of this taxon undoubtedly have already been cleared (Brooker & Kleinig 1999).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Myrtaceae	*Eucalyptus scoparia*		V	E1	Occurs in Queensland and reaches its southern limit in NSW. In NSW it is known from three locations all near Tenterfield in the far northern New England Tableland Bioregion where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland (Royal Botanic Gardens 2004).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Myrtaceae	*Homoranthus prolixus*		V	V	Grows in heath in skeletal soil among crevices in granite outcrops; rare, in the Howell area (near Inverell) and at Bendemeer, in NT and NWS botanical subdivisions (Royal Botanic Gardens 2005).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	V	E1	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden 2002). On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (Department of Environment and Climate Change 2008).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Orchidaceae	*Chiloglottis platyptera*			V	Grows among grass in tall forest; north from Barrington Tops (Royal Botanic Gardens 2005).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Orchidaceae	*Diuris tricolor*	Pine Donkey Orchid		V	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2004), or in grassy Callitris woodland (Bishop 2000). 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 2007). 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).	Local knowledge	**Moderate.** Suitable habitat in the form of shrubby woodlands and forests that were recorded within the study area.
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 Protected Matters Search	**Moderate.** Suitable habitat in the form of Grassy Woodlands and Derived Native Grasslands that were recorded within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 2005).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	**Moderate.** Suitable habitat in the form of grasslands and grassy woodlands that occur on the basalt hills in the north of the study area.
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 2006a).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region	**Moderate.** Suitable habitat in the form of grasslands and grassy woodlands that were recorded within the study area.
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 2006a; Royal Botanic Gardens 2005)	▪ EPBC Protected Matters Search	Low. No suitable habitat was recorded within the study area.
Proteaceae	*Hakea pulvinifera*	Keepit Hakea	E	E1	Known from single population near Namoi River below Keepit Dam where it grows on a hard rocky hillside (Department of Environment and Conservation 2006a).	▪ BioNet NSW Atlas search Namoi CMA - Peel sub-region, Plant Net	Low. No potential habitat within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris		E	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).	Local knowledge	**Moderate** Potential habitat for this species was recorded in the shrubby open forests
Rutaceae	*Asterolasia sp. Dungowan Creek*			E1	Grows in rocky alluvial soil along creekbank, in riparian community with *Casuarina cunninghamiana* the dominant species	■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Rutaceae	*Boronia ruppii*			E1	Confined to soils derived from serpentinite around Woodsreef open cut asbestos mine. Shrub 0.4-2 m high (NSW National Parks and Wildlife Service 2000).	■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Rutaceae	*Philotheca ericifolia*	-	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).	■ EPBC Protected Matters Search	Low. No potential habitat within the study area.

Family name	Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 Protected Matters Search ■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	**Moderate.** Potential habitat within the study area
Scrophulariaceae	*Euphrasia arguta*		CE	V	Rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008, it had not been collected for 100 years. Historically, it was recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. Ecological information from historical records is scarce including, 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', 'in meadows near rivers'. The populations that are currently known are located in the Nundle State Forest and on nearby private land, in eucalypt forest with a mixed grass and shrub understorey (NSW Scientific Committee 2011).	■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
Scrophulariaceae	*Euphrasia ruptura*		X	E4	Presumed extinct; known from a single collection from Tamworth area (NT) made in 1904. Attempts to recollect this species have not been successful (Royal Botanic Gardens 2005)	■ BioNet NSW Atlas search Namoi CMA - Peel sub-region	Low. No potential habitat within the study area.
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 2005).	■ EPBC Protected Matters Search, Plant Net	Low. No potential habitat within the study area.

(1) Listed as vulnerable (V), endangered (E), critically endangered (CE), extinct (X) under the EPBC Act.

(2) Listed as an endangered population (E2), vulnerable (V), endangered (E1), critically endangered (CE), presumed extinct (E4) under the TSC Act.

(3) EPBC Search = EPBC Act Protected Matters Search Tool Report
PlantNet = Royal Botanical Gardens, Sydney – 10 km buffer of study area
Bionet = Office of Environment and Heritage Bionet Atlas – 10 km buffer of study area
(4) Refer to Section 4 of the main report

Appendix C References

Brooker, MIH & Kleinig, DA 1999, *Field guide to Eucalypts, Volume 1: South-eastern Australia*, Blooming Books, Hawthorn, Australia.

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 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, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Sustainability Environment Water Population and Communities 2011, *Prasophyllum sp. Wybong (C.Phelps ORG 5269) in Species Profile and Threats Database*, Department of sustainability Environment Water Population and Communities, <http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81964>.

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

NSW National Parks and Wildlife Service 2000, *Boronia ruppii endangered species listing*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2011, *Euphrasia arguta R. Br. - critically endangered species listing*, NSW Scientific Committee, Hurstville.

Office of Environment and Heritage 2015, *Threatened Species, populations and communities profiles database*, <http://www.environment.nsw.gov.au/threatenedspecies/>.

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 2008, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <http://plantnet.rbgsyd.nsw.gov.au/>.

Appendix D

Threatened species of animal

Table D.1 Threatened Species of Animal

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 Protected Matters Search, Namoi CMA - Peel sub-region	Low. No local records.
Reptiles						
Anomalopus mackayi	Five-clawed Worm-skink	V	E1	Close to or on the lower slopes of slight rises, in grassy White Box Woodlands on moist black soils and River Red Gum-Coolabah-Bimble Box woodland on deep cracking loose clay soils. May also occur in grassland areas and open paddocks with scattered trees. Lives in deep tunnel-like burrows and deep soil cracks, coming close to the surface under fallen timber and litter, especially partly buried logs (Swan *et al.* 2004).	▪ EPBC Protected Matters Search	Low. No local records.
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 Protected Matters Search	Low. No local records, although some habitats in the study area likely to be suitable for this species.
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).	▪ Namoi CMA - Peel sub-region	**Moderate.** Preferred habitat recorded.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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).	▪ Atlas of NSW Wildlife, EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Preferred habitat recorded.
Birds						
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 - Peel sub-region	Low. No preferred habitat in study area.
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).	▪ Atlas of NSW Wildlife, EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Suitable foraging habitat for this species is present in the study area.
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 Protected Matters Search	**High.** A far dispersing species in warmer months, which may forage above the sites. No suitable terrestrial habitats available for this species in the study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 Protected Matters Search	**Moderate.** Suitable foraging habitat for this species occurred in the southern section of the study area.
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 Protected Matters Search	**Moderate.** Suitable foraging habitat for this species occurred in the southern section of the study area
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 2006). In coastal areas, structurally similar elements of tidal and estuarine communities (Casuarina woodlands, saltmarsh and mangroves) provide suitable habitat (Price & Whitehead 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 Climate Change 2007).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in the study area.
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 - Peel sub-region	Low. No preferred habitat in study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 Wildlife, Namoi CMA - Peel sub-region	**Recorded.** Occurs throughout shrubby woodland throughout the study area.
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 2010).	▪ Namoi CMA - Peel sub-region	**Moderate.** Suitable habitat for this species occurred in the southern section of the study area.
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).	▪ Namoi CMA - Peel sub-region	**Recorded.** Occurred sparsely in woodland with an open understorey.
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 2010).	▪ Namoi CMA - Peel sub-region	**Recorded.** Recorded n shrubby woodland in the northern section of the study area, but suitable habitat present in good quality woodland habitat in the southern section of the study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 - Peel sub-region	Low. No preferred habitat recorded in the study area. May occur infrequently during sporadic movements west of the Range.
Falco subniger	Black Falcon		V	Widely, but sparsely, distributed in New South Wales, mostly occurring in woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. It is usually associated with streams or wetlands, visiting them in search of prey and often using standing dead trees as lookout posts. Habitat selection is generally influenced more by prey densities than by specific aspects of habitat floristics or condition, although in agricultural landscapes it tends to nest in healthy, riparian woodland remnants with a diverse avifauna (NSW Scientific Committee 2013).	▪ Namoi CMA - Peel sub-region	**Moderate.** Suitable habitat for this species occurred in the study area.
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 Protected Matters Search	Low. No suitable wetland habitats occurred within the study area.
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 Wildlife, Namoi CMA - Peel sub-region	**Recorded.** Occurred widely in the study area where blossom was available.
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).	▪ Namoi CMA - Peel sub-region	**Moderate.** Likely to occur sparsely in good quality woodland when mistletoes are fruiting.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 & Knight 2007).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
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 Protected Matters Search	Low. Species may fly over during dispersive movements, but no suitable habitat was recorded in study area.
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 - Peel sub-region	Low. No preferred habitat in study area.
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).	▪ Namoi CMA - Peel sub-region	**High.** Likely that the study area represents part of a home range of local individuals.
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 Wildlife, EPBC Protected Matters Search	**High.** A far dispersing species in warmer months, which may forage above the study area. No suitable terrestrial habitats available for this species in the study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Irediparra gallinacea	Comb-crested Jacana		V	Occurs in floating vegetation of permanent well-vegetated wetlands and dams. Walks on floating plants. Occasionally feeds along muddy wetland margins on east coast of NSW (Garnett & Crowley 2000).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
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 Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** A highly dispersive species in response to variations in blossom distributions. The study area, particularly the large remnant patch of woodland in the northern section, is likely to contain quality foraging habitat for this species when White Box is flowering profusely.
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).	▪ Namoi CMA - Peel sub-region	**Moderate.** Likely that the study area represents part of a home range of local individuals.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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).	▪ Atlas of NSW Wildlife, Namoi CMA - Peel sub-region	**Recorded.** Observed along ecotone of good quality woodland in the southern section of the study area. Limited habitat available for this species in the northern section of the study area.
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).	▪ Atlas of NSW Wildlife, Namoi CMA - Peel sub-region	**High.** Suitable habitat for this species occurred in the study area.
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 Wildlife, EPBC Protected Matters Search	**High.** Suitable habitat for this species occurred in the study area. Riparian substrates and banks provide potential breeding habitat.
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 Protected Matters Search	Low. An upland species in NSW that is rare west of the Great Dividing Range.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 Wildlife, Namoi CMA - Peel sub-region	**Recorded.** Several individuals were recorded in the southern section of the study area
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 - Peel sub-region	**Moderate.** Suitable habitat present in the study area. The large patch of good quality remnant woodland is likely to represent a substantial part of a larger home range for local individuals.
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 - Peel sub-region	Low. No local records, although woodland habitats in the study area likely to be suitable for this species.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 - Peel sub-region	Low. No preferred habitat in study area.
Pachycephala olivacea	Olive Whistler		V	Distributed from Queensland to South Australia, and occurs across the altitudinal range from coastal to alpine areas. In NSW, found north of the Hunter River, NSW, extending just into the Lamington Plateau in far south-east Queensland. There are isolated populations in the Macpherson Range, New England NP, Mt. Boss and Barrington Tops areas, and possibly in the Gibraltar Range and Walcha-Nundle areas. Occurs in tall wet sclerophyll forest, rainforest, woodland, alpine heaths (Simpson & Day 1996). In NE NSW, occurs in cool temperate rainforest and cool, moist sclerophyll forest at elevations of >=800 metres asl. Also recorded in warm temperate and sub-tropical rainforests. South of Sydney, the species inhabits rainforest, moist eucalypt forest, coastal, moist thickets and mountain scrubs. Microhabitat is areas with a dense, moist understorey (NSW National Parks and Wildlife Service 1999e).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
Pandion cristatus (syn. P. haliaetus)	Eastern Osprey	M	V	Generally a coastal species, occurring in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers to far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish (Pizzey & Knight 2007).	▪ EPBC Protected Matters Search, Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 2010; 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 - Peel sub-region	Low. No local records, although woodland habitats likely to be suitable for this species. May occur during winter dispersive movements to lowland habitats.
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 2010).	▪ Namoi CMA - Peel sub-region	Low. No local records, although woodland habitats likely to be suitable for this species. May occur during winter dispersive movements to lowland habitats.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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).	▪ Namoi CMA - Peel sub-region	**High.** Suitable habitat occurred in the study area; particularly in the southern section.
Rhipidura rufifrons	Rufous Fantail	M		Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range (Pizzey & Knight 2007).	▪ EPBC Protected Matters Search	Low. No preferred habitat in the study area. Likely only as accidental occurrences.
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 Protected Matters Search, Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 Wildlife, Namoi CMA - Peel sub-region	**High.** Suitable habitat occurred in the study area.
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 - Peel sub-region	Low. No preferred habitat in study area.
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).	▪ Namoi CMA - Peel sub-region	**Moderate.** Suitable habitat occurred in open woodland and along woodland ectones in the study area.
Tyto tenebricosa	Sooty Owl		V	Occurs in wet eucalypt forest and rainforest on fertile soils with tall emergent trees. Typically found in old growth forest with a dense understorey but also occurs in younger forests if nesting trees are present nearby. It nests in large hollows within eucalypts and occasionally caves. It hunts in open and closed forest for a range of arboreal and terrestrial mammals including introduced species and sometimes birds (Garnett & Crowley 2000).	▪ Namoi CMA - Peel sub-region	Low. No local records.
Mammals						

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 1999e).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
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 - Peel sub-region	Low. No local records.
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 2011). Breeding habitat (maternity roosts) is located in roof domes in sandstone caves (Office of Environment and Heritage 2011). Thought to forage below the forest canopy for small flying insects (Churchill 1998).	▪ EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Woodland habitats in the study area provide potential foraging habitat for this species. Large rocky outcropping associated with the western escarpment (the bluff) in the northern section of the study area has potential to provide roosting and breeding habitat.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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 1999e). 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 1999c, 1999e).	▪ EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Suitable woodland habitats available for this species in the study area. The large remnant patch of good quality woodland in the northern section of the study area has potential to support an entire home range of an individual female.
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)	▪ Namoi CMA - Peel sub-region	**Moderate.** Woodlands in the study area provide potential foraging and breeding habitat for this species.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat		V	This species is found along the east coast of Australia from Cape York in Queensland to Castlemaine in Victoria. Habitat includes rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands. Roosts in caves, old mines, stormwater channels and sometimes buildings with populations centred on maternity caves that are used annually for the birth and development of young (Churchill 2008).	▪ Atlas of NSW Wildlife, Namoi CMA - Peel sub-region	**Moderate.** Woodlands in the study area provide potential foraging habitat for this species. Large rocky outcropping associated with the western escarpment (the bluff) in the northern section of the study area has potential to provide roosting and breeding habitat.
Mormopterus norfolkensis	Eastern Free-tail bat		V	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures (Churchill 2008).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
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 & Bennett 1995; 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 Wildlife, EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Woodlands in the study area provide foraging and breeding habitat for this species.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Onychogalea fraenata	Bridled Nailtail Wallaby	E	E4	The species is recorded in habitats west of the Great Dividing Range in a mixture of tall shrubland and grassy woodland, and on the fertile soils which support open eucalypt forest and woodland, and Brigalow scrub. The species has a preference for scrub edges and adjacent vegetation, grazing and sheltering in the shrubland and grazing the grassy woodland (Strahan 1995).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
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 1999f, 2003c).	▪ Namoi CMA - Peel sub-region	Low. No preferred habitat.
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 1999d).	▪ Atlas of NSW Wildlife	**High.** Suitable habitat available in the study area
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).	▪ EPBC Protected Matters Search, Namoi CMA - Peel sub-region	Low. No preferred habitat in study area.
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 - Peel sub-region	Low. No preferred habitat in study area.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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.	▪ EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Suitable foraging habitat across woodland habitat in the study area.
Pseudomys australis	Plains Rat	V	E4	The species lives in complex burrow systems dug into hard rock gibber or the softer soil built up around the bases of the stunted bushes on the inland slopes of the Great Dividing Range (Strahan 1995).	▪ Namoi CMA - Peel sub-region	Low. No local records.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lily pillies. It roosts in the branches of large trees in forests or mangroves (Churchill 2008; NSW National Parks and Wildlife Service 2001)	▪ EPBC Protected Matters Search, Namoi CMA - Peel sub-region	**Moderate.** Suitable foraging habitat in woodland and isolated paddock trees in the study area.
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 Wildlife, Namoi CMA - Peel sub-region	**High.** Woodlands in the study area provide foraging and breeding habitat for this species.

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
Scoteanax rueppellii	Greater Broad-nosed Bat		V	The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 2008)	▪ Namoi CMA - Peel sub-region	Low. No local records, although woodland habitats likely to be suitable for this species. Study area occurs adjacent to the western limit of this species.
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 2011).	▪ Namoi CMA - Peel sub-region	**High.** Woodland habitats in the study area provide potential foraging habitat for this species. Large rocky outcropping associated with the western escarpment (the bluff) in the northern section of the study area has potential to provide roosting and breeding habitat.
Fish						

Scientific name	Common name	EPBC Act	TSC Act	Habitat	Data source	Likelihood of occurrence
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).	▪ Fisheries	Low. No preferred habitat in study area.
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 in study area.
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 Protected Matters Search, Fisheries	Low. No preferred habitat in study area.
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 in study area.

(1) Listed as vulnerable (V), endangered (E), critically endangered (CE), extinct (X) under the EPBC Act.

(2) Listed as an endangered population (E2), vulnerable (V), endangered (E1), critically endangered (CE), presumed extinct (E4) under the TSC Act.

(3) EPBC Search = EPBC Act Protected Matters Search Tool Report
PlantNet = Royal Botanical Gardens, Sydney – 10 km buffer of study area
Bionet = Office of Environment and Heritage Bionet Atlas – 10 km buffer of study area

(4) Likelihood of occurrence as described in Section 2.8 of this report.

Appendix D 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 Climate Change 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 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 2006, *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 Climate Change and Water 2010, *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, LF & Bennett, AF 1995, 'Bats of a semi-arid environment in south-eastern Australia: biogeography, ecology and conservation', *Wildlife Research*, vol. 22, pp. 217-40.

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

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

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

NSW National Parks and Wildlife Service 2001, *Grey-headed Flying Fox 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 2013, *Final Determination listing of Black Falcon Falco subniger G.R. Gray, 1843 as a Vulnerable Species in Part 1 of Schedule 2 of the Act*, Office of Environemnt and Heritage, 08/11/2013,

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

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, JS & Whitehead, GS 2004, 'The influence of past and present hydrological conditions on Sphagnum recolonization and succession in a block-cut bog, Quebec', *Hydrological Processes*, vol. 18, no. 2, pp. 315-28.

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.

Simpson, K & Day, N 1996, *Field Guide to the Birds of Australia*, 5th edn, Viking. Penguin Books Australia Ltd., Ringwood.

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 F

Investigation in to the effective long-term restoration of degraded remnants of Box Gum Woodland EEC

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
1. Substrate	1a. Poor soil chemistry – depleted soil nutrients (Eddy, 2002)/	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Avoidance of soils with high or low pH, high salinity, low fertility or sodic soils. ▪ Rehabilitation trials ▪ Nutrient management options: ‣ Amelioration of soils with agricultural gypsum, compost (i.e. mulch saved during clearing activities) or fertilisers depending on the nutrient deficiency. ‣ Addition of woody debris to increase carbon levels (Harmon et al. 1986; Debeljak, 2006; Manning et al. 2013; Goldin and Brookhouse, 2014). ‣ Use of Biochar to increase soil carbon	The RMP will: ▪ Provide parameters for the physical and chemical characteristics of topsoils and overburden based on likely suitable characteristics for establishment of Box Gum Woodland. ▪ Provide for soil testing to be undertaken on topsoil and overburden to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Describe options for ameliorating soils to improve the suitability of the soils as a growth media (e.g. amelioration with agricultural gypsum, compost (i.e. mulch saved during clearing activities) or fertilisers depending on the nutrient deficiency). ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch. ▪ Provide for selective use of slow-release native plant fertiliser (e.g. rock minerals) to promote plant growth (if required).
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ Limited and selective use of specific fertilisers to facilitate growth of tube stock (Eddy, 2002). ▪ Placement of woody debris to increase carbon and moisture levels (Goldin and Brookhouse, 2014).	The BMP will: ▪ Provide for soil testing to be undertaken on soils in revegetation areas to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Provide for selective use of slow-release fertiliser to promote plant growth (if required). ▪ Describe procedures to reuse timber/hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA).
	1b. Poor soil chemistry - elevated soil nutrients, salinity and acid soils (Rawlings et al. 2010; Department of the Environment, Climate Change and Water [DECCW], 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Avoidance of soils with high or low pH, high salinity, low fertility or sodic soils. ▪ Application of minimum topsoil and subsoil depths ▪ Soil handling processes for removal, storage and re-layering of topsoil and subsoil ▪ Rehabilitation trials.	The RMP will: ▪ Provide parameters for the physical and chemical characteristics of topsoils and overburden based on likely suitable characteristics for establishment of Box Gum Woodland. ▪ Provide for soil testing to be undertaken on topsoil and overburden to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Describe minimum topsoil and subsoil depths for revegetation. ▪ Provide soil handling processes for removal, storage and re-layering of topsoil and subsoil, including the length and mode of topsoil storage. ▪ Provide for rehabilitation trials
	1c. Poor soil chemistry - elevated soil nutrients (Prober et al. 2002; Rawlings et al. 2010; DECCW, 2010)	Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ No application of fertilizers on soils with elevated concentrations of the same nutrients (Rawlings et al. 2010). ▪ Nutrient management options to lower soil nitrogen and phosphorus levels: ‣ Crash grazing periodically to remove nutrients locked in weeds (Rawlings et al. 2010). ‣ Restriction of livestock access to limit further nutrient enrichment (Rawlings et al. 2010). ‣ Hay cutting (Rawlings et al. 2010) ‣ Controlled burns (Rawlings et al. 2010). ‣ Carbohydrate addition (Rawlings et al. 2010) ‣ Topsoil removal (scalping) (corridor enhancement zone only) (Gibson-Roy *et al.* 2010; Rawlings *et al.* 2010)	The BMP will: ▪ Provide for soil testing to be undertaken on soils in revegetation areas to identify issues with physical and chemical characteristics as well as determine amelioration requirements and rates. ▪ Describe the following nutrient reduction options: ‣ crash grazing periodically to remove nutrients locked in weeds; ‣ restriction of livestock access to limit further nutrient enrichment; ‣ controlled burns.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
	1d. Erosion and sedimentation (Rawlings et al. 2010; DECCW, 2010; Tongway and Ludwig, 2011)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Establishing vegetation cover as soon as practicable. ▪ Adjust seed and planting densities to maximise ground cover. ▪ Treatment of dispersive soils and spoils. ▪ Design of the batter slopes to be stable. ▪ Use of structural erosion controls (e.g. channel banks, slope drains and energy dissipaters). ▪ Exclusion of livestock (Rawlings et al. 2010). ▪ Use of benign (hard rock) mulch to stabilise batter surfaces. ▪ Ecological monitoring of mine rehabilitation	The RMP will: ▪ Provide for establishing vegetation cover as soon as practicable following disturbance to minimise the potential for erosion and weeds. This will involve the application of a temporary sterile cover crop (or native grasses) using species that are not likely to impede revegetation of the Box Gum Woodland. ▪ Provide options for remediating erosion including adjust seed and planning densities to maximise ground cover. ▪ Provide options for minimising the risk of erosion including treatment of dispersive soils and spoils, as well as use of use of structural erosion controls (e.g. channel banks, slope drains and energy dissipaters). ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Consider the use of benign (hard rock) mulch to stabilise batter surfaces that has been sourced onsite (i.e. salvaged from clearing areas or from waste material). ▪ Include ecological monitoring of mine rehabilitation.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ Targeting revegetation along drainage lines. ▪ Remediation of scalded areas. ▪ Restriction of livestock access (particularly along drainage lines) (Rawlings et al. 2010). ▪ Maximised re-use of existing infrastructure (e.g. access roads) instead of creating new infrastructure. ▪ Ecological analysis to identify constraints and requirements for specific management measures (Tongway and Ludwig, 2011).	The BMP will: ▪ Describe restriction of livestock access. ▪ Aim to maximise the re-use of existing infrastructure (e.g. access roads) instead of creating new infrastructure.
	1e. Soil compaction - inhibits germination of seeds or growth of seedlings (Eddy, 2002; Department of Sustainability and the Environment [DSE], 2005; Rawlings et al. 2010; DECCW, 2010)	Mine Rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Restriction of vehicle access to avoid compacting soil (Eddy, 2002; DSE, 2005). ▪ Pre-planting site preparation (e.g. ripping) (Rawlings *et al.* 2010). ▪ Exclusion of livestock (Rawlings *et al.* 2010). ▪ Mulching (Rawlings *et al.* 2010). ▪ Use of spiked rollers/ air jetting to aerate soils to depth of 30 cm.	The RMP will: ▪ Describe that vehicle access will be predominantly restricted to designated tracks on mine landforms that have been revegetated to minimise ground disturbance (e.g. compaction). ▪ Describe site preparation (e.g. ripping or use of spiked rollers) to reduce soil compaction impacting the success of the revegetation. ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Restriction of vehicle access to avoid compacting soil (Eddy, 2002; DSE, 2005). ▪ Restriction of livestock access (Rawlings *et al.* 2010). ▪ Options for reducing compaction: ‣ Mulching (Rawlings et al. 2010) ‣ Hand aeration (Rawlings et al. 2010) ‣ Deep air-jetting and mulching (Rawlings et al. 2010) ‣ Cultivation followed by mulching (Rawlings *et al.* 2010).	The BMP will: ▪ Describe that vehicle access will be predominantly restricted to designated tracks to minimise ground disturbance (e.g. compaction). ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Describe site preparation in cleared land (e.g. ripping or use of spiked rollers) and (where relevant) in derived grassland (e.g. use of spiked rollers) to reduce soil compaction impacting the success of the revegetation.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat management and habitat restoration zones	▪ Restriction of vehicle access to avoid compacting soil (Eddy, 2002; DSE, 2005). ▪ Restriction of livestock access (Rawlings *et al.* 2010).	
	1f. Ground disturbance (Eddy, 2002; Rawlings et al. 2010)	Biodiversity offset areas - re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Restriction of vehicle access to avoid unnecessary ground disturbance (Eddy, 2002; DSE, 2005). ▪ Fencing and signage.	The BMP will: ▪ Describe that vehicle access will be predominantly restricted to designated tracks to minimise ground disturbance (e.g. compaction).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and habitat management zones	▪ Avoidance of revegetation techniques that involve high level of physical disturbance (i.e. cultivation, ripping and excavation) (Eddy, 2002; DECCW, 2010). ▪ Restriction of vehicle access to avoid unnecessary ground disturbance (DSE, 2005; Eddy, 2002). ▪ Fencing and signage.	▪ Describe provision of fencing and signage around the perimeter of the offset areas to manage livestock and avoid accidental clearance. ▪ Restrict the use of revegetation techniques that involve high level of physical disturbance in existing Box Gum Woodland and derived grasslands.
	1g. Depleted soil seed bank (DECCW, 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Management of topsoil seed resource. ▪ Soil seed bank germination testing (rehabilitation trials). ▪ Supplementary seeding/tube stock planting (Gibson-Roy et al. 2010).	The RMP will: ▪ Provide soil handling processes for removal, storage and re-layering of topsoil and subsoil ▪ Provide for soil seed bank germination testing to be undertaken on topsoil stockpiles. ▪ Describe a contingency for supplementary seeding/tube stock planting if the regeneration from the soil seed bank is not sufficient.
		Biodiversity offset areas - re-establishment of Box Gum Woodland within habitat restoration and corridor enhancement zones in biodiversity offset areas	▪ Supplementary seeding/tube stock planting.	The BMP will: ▪ Favour natural regeneration in the habitat management and habitat restoration zones over seeding or planting in the first instance, followed by seeding or planting where applicable.
	1h. Insufficient topsoil and/or topsoil depth (DECCW, 2010)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Application of minimum topsoil and subsoil depths ▪ Soil handling processes for removal, storage and re-layering of topsoil and subsoil	The RMP will: ▪ Describe minimum topsoil and subsoil depths for revegetation. ▪ provide soil handling processes for removal, storage and re-layering of topsoil and subsoil
	1i. Poor soil water holding capacity (Eddy, 2002)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Amelioration of soils with compost/woody debris. ▪ Selective placement of soils. ▪ Addition of woody debris (Harmon et al. 1986; Debeljak, 2006; Manning et al. 2013; Goldin and Brookhouse, 2014)	The RMP will: ▪ Describe options for ameliorating soils to improve the suitability of the soils as a growth media (e.g. amelioration with agricultural gypsum, compost or fertilisers depending on the nutrient deficiency). ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch. ▪ Describe matching flora to landform position.
	1j. Instability of the final landform	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Design of the batter slopes to be stable. ▪ Selective placement of soils. ▪ Use of benign (hard rock) mulch to stabilise batter surfaces.	The RMP will: ▪ Describe how the batter slopes have been designed to minimise instability of the final landform. ▪ Provide for selective identification and placement (burial) of soils unsuitable for use as a growth media. ▪ Consider the use of benign (hard rock) mulch to stabilise batter surfaces that has been sourced onsite (i.e. salvaged from clearing areas or from waste material).
	1k. Poor drainage of the final landform (Eddy, 2002)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Design of the batter slopes to be stable. ▪ Amelioration of soils with compost.	The RMP will: ▪ Describe how the batter slopes have been designed to minimise instability of the final landform. ▪ Describe options for ameliorating soils to improve the suitability of the soils as a growth media (e.g. amelioration with agricultural gypsum, compost or fertilisers depending on the nutrient deficiency).
	1l. Lack of soil mycorrhizae (Jasper, 2007)	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Application of minimum topsoil and subsoil depths ▪ Soil handling processes for removal, storage and re-layering of topsoil and subsoil ▪ Use of rhizobia bacteria inoculants for acacia (CSIRO, 2005).	The RMP will: ▪ describe minimum topsoil and subsoil depths for revegetation ▪ Provide soil handling processes for removal, storage and re-layering of topsoil and subsoil.

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
2. Clearing	2a. Incidental clearing, fragmentation and fire wood collection	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Restriction on clearing.	The RMP will: ▪ Describe that mine rehabilitation would not be cleared (unless for ecological thinning, maintenance or access for monitoring).
		Biodiversity offset area – re-establishment of Box Gum Woodland within corridor enhancement habitat restoration and habitat management zones	▪ Restriction on clearing. ▪ Restriction on fire wood collection. ▪ Fencing and signage. ▪ Maximise re-use of existing infrastructure (e.g. access roads) ▪ Where necessary, new infrastructure should be installed in cleared land (e.g. access roads) ▪ Use of low disturbance methods for site preparation in derived grasslands and existing Box Gum Woodland.	The BMP will: ▪ Describe a restriction of clearing (unless for ecological thinning of density regrowth [i.e. selective removal of regrowth trees or shrubs], maintenance or access for monitoring). ▪ Not permit firewood collection. ▪ Describe provision of fencing and signage around the perimeter of biodiversity offset areas to manage livestock (i.e. exclusion or controlled entry of livestock for specific purposes) and avoid accidental clearance. ▪ Aim to maximise the re-use of existing infrastructure (e.g. access roads) instead of creating new infrastructure. ▪ Aim to locate new offset area management infrastructure (e.g. access roads) preferentially in cleared land.
3. Livestock	3a. Grazing by cattle – ground disturbance, remove or destroy seeds, seedlings or plantings (DSE, 2005; Rawlings *et al.* 2010)	Biodiversity offset area – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Fencing of areas undergoing revegetation to exclude grazing livestock and prevent grazing of seedlings (Eddy, 2002). ▪ Maintenance of fencing used to exclude livestock.	The BMP will: ▪ Describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ Describe restriction of livestock access to areas not already subject to grazing. ▪ Describe management of livestock to maintain ground cover and diversity of native plants. ▪ Describe restriction of livestock access to protect plants that are known to be sensitive to grazing. ▪ describe the following controlled grazing management options: ‣ Rotational grazing system to promote and maintain plant diversity and cover. ‣ Removal of grazing livestock.
		Biodiversity offset areas re-establishment of Box Gum Woodland within habitat restoration zones	▪ Restriction of livestock access (particularly along drainage lines) (Rawlings *et al.* 2010). ▪ Restriction of livestock access to protect plants that are known to be sensitive to grazing (Rawlings *et al.* 2010). ▪ Restriction of livestock access to maintain ground cover. ▪ Maintenance of fencing used to exclude livestock. ▪ Controlled grazing management options: ‣ Crash grazing periodically to remove nutrients locked in weeds (Rawlings *et al.* 2010). ‣ High intensity short duration rotational grazing (Rawlings *et al.* 2010). ‣ Removal of grazing livestock. ▪ Low stocking rates.	
		Biodiversity offset areas - restoration of habitat management zones	▪ Exclusion of livestock grazing along watercourses (McIvor and McIntyre, 2002). ▪ Exclusion of livestock grazing in areas not already subject to grazing (DECCW, 2010). ▪ Maintenance of fencing used to exclude livestock. ‣ Controlled grazing management (low stocking rates).	
		Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Weed control ▪ Establishing vegetation cover as soon as practicable following disturbance ▪ Application of a temporary sterile cover crop, or native grass cover crop established from native hays. ▪ Minimal unnecessary ground disturbance that may create opportunities for weeds (Rawlings *et al.* 2010; DECCW, 2010). ▪ Nutrient management (e.g. exclusion of grazing livestock which add nutrients) (Prober *et al.* 2002; Rawlings *et al.* 2010). ▪ General weed hygiene (e.g. avoiding driving through weed infestations) (DECCW, 2010).	The RMP will ▪ Describe procedures to prevent, monitor and control weeds. The RMP will also describe relevant targets and performance indicators for weed management ▪ Provide for establishing vegetation cover as soon as practicable following disturbance to minimise the potential for erosion and weeds. ▪ Provide application rates for seeds as well as planting densities for tube stock to avoid excessive shading. ▪ Include sowing of Kangaroo Grass (as this species is known to out-compete annual grass weeds and provide inter tussock spaces for a diversity of ground cover species [e.g. wildflowers).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
			▪ Correct spacing for species when planting seedlings to avoid excessive shading (Rawlings *et al.* 2010). ▪ Provisions to identify new invasive plant species (e.g. weed monitoring). ▪ Weed management options: ‣ Physical Removal (e.g. removing weeds by felling or pulling) (Gibson-Roy *et al.* 2010; Rawlings *et al.* 2010). ‣ Herbicide (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings *et al.* 2010; DECCW, 2010). ▪ Sowing of Kangaroo Grass to outcompete annual grass weeds (Prober *et al.* 2002; Rawlings *et al.* 2010).	
4. Introduced flora species (weeds)	4a. Weed invasion – perennial and annual grasses, perennial herbs, annual and biennial herbs and woody weeds (DSE, 2005; Rawlings *et al.* 2010; Gibson-Roy *et al.* 2010; DECCW, 2010)	Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Minimal unnecessary ground disturbance that may create opportunities for weeds (Eddy, 2002; DSE, 2005; Rawlings *et al.* 2010). ▪ Correct spacing for species when planting seedlings to avoid excessive shading (DECCW, 2010). ▪ Weed management options: ‣ Crash grazing periodically to reduce annual and perennial grass weeds (Rawlings et al. 2010). ‣ Nutrient management (e.g. exclusion of grazing livestock which add nutrients) (Rawlings et al. 2010). ‣ Controlled burns during spring to reduce annual and perennial grass weeds (not broadleaf exotics) (Rawlings et al. 2010). ‣ Physical Removal (e.g. removing weeds by felling or pulling) (Gibson-Roy et al. 2010; Rawlings et al. 2010). ‣ Herbicide (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings et al. 2010; DECCW, 2010). ‣ Sowing of Kangaroo Grass to outcompete annual grass weeds (Prober et al. 2002; Rawlings et al. 2010). ‣ Scalping to remove weed seed bank (Gibson-Roy et al. 2010).	The BMP will: ▪ Provide application rates for seeds as well as planting densities for tube stock to avoid excessive shading. ▪ provide the following weed management options: ‣ Crash grazing periodically to reduce annual and perennial grass weeds. ‣ Nutrient management (e.g. exclusion of grazing livestock which add nutrients). ‣ Controlled burns (except in revegetation areas) during spring to reduce annual and perennial grass weeds (not broadleaf exotics). ‣ Physical Removal (e.g. removing weeds by felling or pulling). ‣ Targeted and timely herbicide application. ‣ Include sowing of Kangaroo Grass (as this species is known to out-compete annual grass weeds and provide inter tussock spaces for a diversity of ground cover species [e.g. wildflowers]).
		Biodiversity offset areas – re-establishment of Box Gum Woodland within habitat restoration and habitat management zones	▪ Minimal unnecessary ground disturbance that may create opportunities for weeds (Eddy, 2002; DSE, 2005; Rawlings *et al.* 2010). ‣ Light grazing in autumn and/or winter to reduce vigour of annual grass weeds (Rawlings *et al.* 2010).	The BMP will: ▪ Include provision to lightly graze derived grasslands in times of suitable climatic conditions for weed growth (e.g. autumn and/or winter) to reduce vigour of annual grass weeds.
5. Herbicide	5a. Excessive herbicides – may have a negative effects on native species (Eddy, 2002)	All areas	▪ Use herbicides sparingly (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings *et al.* 2010; DECCW, 2010).	The RMP and BMP will: ▪ Provide methods for the use of herbicides (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods).
6. Impacts from animals	6a. Grazing by feral pigs and goats – remove or destroy seeds, seedlings or plantings (Eddy, 2002; Rawlings *et al.* 2010; DECCW, 2010; DSE 2005)	All areas	▪ Monitoring and control feral pigs and goats (Eddy, 2002; Rawlings *et al.* 2010; DSE, 2005). ▪ Use of tree guards to protect young seedlings from browsing or grazing (Rawlings *et al.* 2010).	The RMP and BMP will: ▪ Describe procedures to prevent, monitor and control feral animals (including feral pigs, goats, rabbits and foxes). ▪ Provide an option for using tree guards to protect young seedlings from browsing or grazing native animals.
	6b. Feral foxes and cats (Eddy, 2002; DECCW, 2010)	All areas	▪ Monitoring and control of feral foxes and cats (Eddy, 2002; Rawlings *et al.* 2010).	The RMP and BMP will: ▪ Describe procedures to monitor and control feral animals (including feral pigs, goats, rabbits and foxes).
	6c. Other Invasive Fauna	All areas	▪ Provisions to identify new invasive fauna species (e.g. ecological monitoring).	The RMP and BMP will: ▪ Provide provisions to identify new invasive fauna species (e.g. ecological monitoring).
7. Fire		Mine rehabilitation - establishment of Box Gum	▪ No controlled burns whilst vegetation is establishing.	The RMP will:

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
	7a. Uncontrolled bushfire (DECCW, 2010)	Woodland on the post-mine landform	▪ Maintain fire breaks and access. ▪ Assess fuel loads.	▪ Describe measures to prevent fires, such as maintaining fire breaks and access (i.e. no controlled burns would be undertaken on the mine rehabilitation whilst vegetation is establishing).
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement and habitat restoration zones	▪ Not controlled burns whilst vegetation is establishing. ▪ Maintain fire breaks and access. ▪ Controlled grazing to reduce biomass (Rawlings *et al.* 2010).	▪ The BMP will: ‣ describe measures to prevent fires, such as maintaining fire breaks and access. ‣ provision for maintenance of fire breaks and fire trails. ▪ provide an option for using controlled grazing to reduce biomass.
8. Floristics	8a. Poor diversity in the seed mix or tube stock	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Monitoring of plant growth and survival (Rawlings *et al.* 2010). ▪ Strategic and long term seed collection, management and storage. ▪ Site preparation and depth of sowing seed. ▪ Supplementary planting or reseeding of absent species.	The RMP will: ▪ Describe how the growth and survival of the vegetation sown or planted will be monitored. ▪ Describe procedures for seed collection, management and storage.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Strategic and long term seed collection, management and storage. ▪ Site preparation and depth of sowing seed. ▪ Supplementary planting or reseeding of absent species.	The BMP will: ▪ Describe procedures for seed collection, management and storage. ▪ Describe procedures for sowing seed. ▪ Favour natural regeneration in the habitat restoration and habitat management zones over seeding or planting in the first instance followed by seeding or planting if required.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within habitat restoration zones	▪ Favour natural regeneration over seeding or planting in the first instance followed by seeding or planting if required (McIntyre, 2002).	
	8b. Unsuitable species in the seed mix or tube stock	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Preferential use of local endemic (adapted) species (Rawlings *et al.* 2010).	The RMP will: ▪ Provide for the preferential use of local endemic (adapted) species.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement zones	▪ Preferential use of local endemic (adapted) species (Rawlings *et al.* 2010).	The BMP will ▪ Provide for the preferential use of local endemic (adapted) species. ▪ Favour natural regeneration in habitat restoration and habitat management zones over seeding or planting in the first instance followed by seeding or planting if required.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within habitat restoration zones	▪ Favour natural regeneration over seeding or planting in the first instance followed by seeding or planting if required (McIntyre, 2002).	
	8c. Shortage of sufficient seed or tube stock	All areas	▪ Review commercial seed and tube stock availability.	The RMP and BMP will: ▪ Describe a seed and tube stock supply strategy.
	8d. Poor understorey diversity	All areas	▪ Planting of trees and shrubs at appropriate densities (DECCW, 2010). ▪ Use local endemic (adapted) species (Eddy, 2002; Rawlings *et al.* 2010). ▪ Restore linkages to existing woodland patches. ▪ Assess whether ecological thinning is necessary (Rawlings *et al.* 2010). ▪ Consider causing disturbance (e.g. through fire or grazing) (Eddy, 2002). ▪ Include a wide diversity of species in the seed mix (Gibson-Roy *et al.* 2010).	The RMP and BMP will: ▪ Provide for the preferential use of local endemic (adapted) species. ▪ Include provision to assess vegetation density and undertake ecological thinning if necessary. ▪ Provide measures to improve understorey diversity (e.g. replanting, causing disturbance through fire or grazing). ▪ Aim to include a wide diversity of species in the seed mix.
9. Native plant growth	9a. Poor native plant growth	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Site preparation and depth of sowing seed. ▪ Correct spacing for species when planting seedlings to avoid excessive shading (Rawlings et al. 2010). ▪ Supplementary seeding or planting. ▪ Revegetation trials	The RMP will: ▪ Describe procedures for seed collection, management and storage. ▪ Provide for the preferential use of local endemic (adapted) species, ▪ Provide for selective use of slow-release fertiliser to promote plant growth (if required).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
			▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010) ▪ Selective use of specific fertilisers only.	
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement and habitat restoration zones	▪ Site preparation and depth of sowing seed. ▪ Fencing of areas undergoing revegetation to exclude grazing livestock. ▪ Correct spacing for species when planting seedlings to avoid excessive shading (Rawlings et al. 2010). ▪ Supplementary seeding or planting. ▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010).	The BMP will ▪ Describe procedures for seed collection, management and storage. ▪ Describe how livestock will be excluded from areas undergoing active restoration (i.e. planting or seeding). ▪ Provide application rates for seeds as well as planting densities for tube stock to avoid excessive shading. ▪ Favour natural regeneration in habitat restoration and habitat management over seeding or planting in the first instance followed by seeding or planting if required. ▪ Provide for the preferential use of local endemic (adapted) species.
	9b. Poor seed germination	All areas	▪ Supplementary seeding or planting. ▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010). ▪ Seed scarification for acacia or heat treatment.	The RMP and BMP will: ▪ Favour natural regeneration in habitat restoration and habitat management zones over seeding or planting in the first instance followed by seeding or planting if required. ▪ The RMP and BMP will provide for the preferential use of local endemic (adapted) species.
	9c. Dense overstorey and midstorey revegetation (e.g. White Cypress Pine) – sometimes regeneration is too successful and trees may compete with each other for light, water and nutrients (Rawlings *et al.* 2010; DECCW, 2010)	All areas	▪ Assess whether ecological thinning is necessary (Rawlings et al. 2010). ▪ Thinning with fire or manually (Rawlings et al. 2010).	The RMP and BMP will: ▪ Include provision to assess vegetation density and undertake ecological thinning (e.g. through selective clearance or fire) if necessary.
	9d. Dense grass cover	All areas	▪ Consider causing disturbance (e.g. through fire or grazing) (Rawlings et al. 2010).	The RMP and BMP will: ▪ Provide measures to improve understorey diversity (e.g. replanting, causing disturbance).
	9e. Disease (e.g. *Phytophthora cinnamomi*) (DECCW, 2010)	All areas	▪ Hygiene protocols to minimise the risk of plant diseases (Rawlings et al. 2010).	The RMP and BMP will: ▪ Include hygiene protocols to minimise the risk of plant diseases (i.e. restricting site access).
	9f. Fungi or pathogens – may cause germination failure (seeds) (Rawlings *et al.* 2010).	All areas	▪ Preferential use of local endemic (adapted) species (Rawlings et al. 2010).	The RMP and BMP will: ▪ Provide for the preferential use of local endemic (adapted) species.
10. Fauna habitat	10a. Lack of bush rocks (Michael *et al.* 2011)	All areas	▪ Maximise salvage and reuse of bush rocks (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures for the reuse of bush rocks salvaged during vegetation clearing activities (consistent with Condition 36] Schedule 3 of Project CoA).
	10b. Lack of fallen timber/hollow logs (DECCW, 2010)	All areas	▪ Maximise salvage and reuse of woody debris/ hollow logs (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures for the reuse of woody debris/ hollow logs salvaged during vegetation clearing activities (consistent with Condition 36 Schedule 3 of Project CoA),
	10c. Lack of structural diversity (Manning *et al.* 2011; Michael *et al.* 2011; Freudenberger *et al.* 2004)	All areas	▪ Planting of scattered low shrubs, mid-sized shrubs and tall trees (Freudenberger *et al.* 2004). ▪ Maximise salvage and reuse timber/hollow logs (Condition 36 Schedule 3 of Project CoA). ▪ Increase woodland patch size within biodiversity offset areas (Prober *et al.* 2002).	The RMP and BMP will: ▪ Describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create structurally diverse habitat. ▪ Describe procedures to reuse of bush rocks salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA).

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
				▪ Describe procedures to reuse of timber/hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA ▪ Focus on increasing woodland patch size within biodiversity offset areas and aim to enhance ecological connectivity.
11. Surrounding land uses	11a. Agriculture - pesticides and herbicides	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010).	The BMP will: ▪ Focus on increasing woodland patch size within biodiversity offset areas and aim to enhance ecological connectivity.
	11b. Agriculture -exotic species (including incursions of stock and feral animals)	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010). ▪ Fencing and signage.	
	11c. Agriculture - increased runoff	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010).	
	11d. Agriculture - nutrient enrichment	Offset Areas	▪ Increase woodland patch size within the offset area (Rawlings *et al.* 2010).	
12. Weather	12a. Drought	Mine rehabilitation - establishment of Box Gum Woodland on the post-mine landform	▪ Monitoring for signs of water stress (dieback). ▪ Irrigation. ▪ Mulch.	The RMP will: ▪ Describe how the growth and survival of the vegetation sown or planted will be monitored. ▪ Describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch.
		Biodiversity offset areas – re-establishment of Box Gum Woodland within corridor enhancement and habitat restoration zones	▪ Monitoring for signs of water stress (dieback). ▪ Limit grazing livestock during drought periods (DECCW, 2011). ▪ Irrigation. ▪ Mulch.	The BMP will ▪ Describe how the growth and survival of the vegetation sown or planted will be monitored. ▪ Discuss an adaptive management framework and monitoring program for the management of the Box Gum Woodland EEC. ▪ Provide a mechanism to reduce livestock grazing during drought periods.
	12b. Flood/major rainfall	All areas	▪ Refer to 1d. Erosion and sedimentation.	
	12c. Wind	All areas	▪ Only use healthy seedlings (Rawlings *et al.* 2010).	The RMP and BMP will: ▪ provide for establishing vegetation cover as soon as practicable following disturbance to minimise the potential for erosion and weeds, using species that are not likely to impede revegetation of the Box Gum Woodland.
	12d. Climate change (DECCW, 2010)	All areas	▪ Restoration of Box Gum Woodland (DECCW, 2010). ▪ Use of genetically diverse collections of seed sourced from large and healthy populations. ▪ Increase woodland patch size within biodiversity offset areas (to provide links for movement of plant propagules and fauna).	The RMP and BMP will: ▪ Focus on increasing woodland patch size within biodiversity offset areas and aim to enhance ecological connectivity. ▪ Provide for the preferential use of local endemic (adapted) species.
13. Management	13a. Unclear objectives	All areas	▪ Define objectives (Eddy, 2002; Rawlings *et al.* 2010). ▪ Management for patchiness (diversity) (Rawlings *et al.* 2010).	The RMP and BMP will: ▪ Define the objectives for the Box Gum Woodland. ▪ Discuss an adaptive management framework and monitoring program for the management of the Box Gum Woodland.
	13b. Lack of maintenance	All areas	▪ Adaptive management (Rawlings *et al.* 2010; Tongway and Ludwig, 2011).	
	13c Poor monitoring design (measurement of success)	All areas	▪ Monitor to determine effectiveness (Eddy, 2002; DECCW, 2010). ▪ Monitoring closely linked to objectives. ▪ Use of photo-points to monitor changes over time (Eddy, 2002).	
	13d. Unqualified personnel	All areas	▪ Engage suitability qualified personnel	The RMP and BMP will: ▪ describe roles for suitability qualified personnel

Appendix G

Investigation in to the effective long-term provision of suitable habitats for threatened fauna

Broad factor	Factors likely to impede	Relevant objective	Factors likely to enhance	Actions
1. Adequate availability of prey species The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform, together with the salvage and re-use of woody debris and hollows, will over time provide a range of suitable habitats for invertebrates and vertebrates that provide a potential source of food for various threatened fauna species.	1a. Lack of invertebrates as a food source (Spotted Harrier, Little Eagle, Barking Owl, Brown Treecreeper, Painted Honeyeater, Grey-crowned Babbler, Varied Sittella, Squirrel Glider, hollow-dependent and cave dependent microchiropteran bats) (OEH, 2015)	Primarily relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities to encourage invertebrate habitation that provide a potential food source (Condition 36 Schedule 3 of Project CoA). ▪ Mulching to encourage invertebrates that provide a potential food source.	▪ The RMP and BMP will describe procedures to reuse woody debris and hollow logs salvaged during vegetation clearing (consistent with Condition 36 Schedule 3 of Project CoA). ▪ The RMP will describe the incorporation of vegetative material (cleared at the mine site) into the soil used for rehabilitation or as mulch.
	1b. Lack of reptiles as a food source (Pale-headed Snake, Spotted Harrier, Little Eagle) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of bush rocks from the mine vegetation clearing activities to encourage reptile habitation that provide a potential food source (Condition 36 Schedule 3 of Project CoA). ▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities to encourage reptiles that provide a potential food source (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures to reuse bush rocks, woody debris and hollow logs salvaged during vegetation clearing activities (consistent with Condition 36 Schedule 3 of Project CoA).
	1c. Lack of birds as a food source (Square-tailed Kite, Spotted Harrier, Little Eagle, Barking Owl) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Plant scattered low shrubs, mid-sized shrubs and tall trees to encourage birds that provide a potential food source. ▪ Provision of large areas of suitable woodland within biodiversity offset areas and mine rehabilitation areas to encourage birds that provide a potential food source (Prober *et al.* 2002).	▪ The RMP and BMP will describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create a structurally diverse habitat.
	1d. Lack of small mammals as a food source (Pale-headed Snake, Spotted Harrier, Little Eagle, Masked Owl, Barking Owl) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities to encourage small mammals that provide a potential food source (Condition 36 Schedule 3 of Project CoA). ▪ Placement of nest boxes and/or hollow limbs (in young trees without hollows) from the mine vegetation clearing activities to encourage small mammals that would provide a potential food source for predators.	▪ The RMP and BMP will describe procedures to reuse woody debris and hollow logs salvaged during vegetation clearing and/or suitable nest boxes (consistent with Condition 36 Schedule 3 of Project CoA), including placement of hollow limbs and some select trees without hollows and/or appropriate nest boxes.
2. Nesting habitat (mainly birds) The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform will over time provide suitable vegetation in which some threatened fauna species may nest. Additionally, salvage and re-use of logs and hollows could facilitate other threatened fauna species to nest in the short-term.	2a. Lack of suitable vegetation (Spotted Harrier, Little Eagle, Speckled Warbler, Regent Honeyeater) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ As part of a diverse seed mix/tube stock planting list plant: ‣ Tall tree species. ‣ Low, dense species (Speckled Warbler). ‣ Eucalypts (Masked Owl, Regent Honeyeater, Painted Honeyeater, Grey-crowned Babbler). ‣ Native, tussocky grasses (Speckled Warbler). ‣ Allocasuarina/*Casuarina* species (Regent Honeyeater, Painted Honeyeater). ‣ *Acacia* species (Painted Honeyeater).	The RMP and BMP will: ▪ Describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create structurally diverse habitats. ▪ Include the planting (in appropriate soil landscapes) of a variety of eucalypt species. ▪ Include the planting of a variety of native grasses including tussock grass species. ▪ Include the planting of *Allocasuarina* and *Casuarina* species. ▪ Include the planting of *Acacia* species, including both tree and shrub varieties.
	2b. Lack of hollows (Brown Treecreeper, Little Lorikeet, Turquoise Parrot, Barking Owl, Masked Owl, Squirrel Glider, hollow dependent microchiropteran bats, Pale-headed Snake) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of woody debris/hollow logs from the mine vegetation clearing activities (Condition 36 Schedule 3 of Project CoA), including placement of nest boxes and/or hollow limbs in select trees without hollows.	▪ The RMP and BMP will describe procedures to reuse woody debris and hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA), including placement of hollow limbs or artificial hollows in some select trees without hollows.

	2c. Lack of fallen timber (Speckled Warbler, Brown Treecreeper) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Maximise salvage and reuse of fallen timber/hollow logs from the mine vegetation clearance activities (Condition 36 Schedule 3 of Project CoA).	▪ The RMP and BMP will describe procedures to reuse fallen timber/hollow logs salvaged during vegetation clearance (consistent with Condition 36 Schedule 3 of Project CoA).
	2d. Lack of suitable vegetation along/near watercourses (Square-tailed Kite, Barking Owl) (OEH, 2015)	Predominantly relevant to watercourses in the biodiversity offset areas.	▪ As part of a diverse seed mix/tube stock planting list, plant trees (particularly eucalypts) along water courses (Square-tailed Kite, Barking Owl).	▪ The RMP and BMP will include the planting of eucalypt species along water courses where applicable within the rehabilitation area.
3. Foraging and roosting habitat The restoration of native vegetation communities in biodiversity offset areas and rehabilitation of the post mine landform will over time provide suitable vegetation in which some threatened fauna species may forage and roost.	3a. Lack of suitable tree species (Square-tailed Kite, Spotted Harrier, Little Eagle, Little Lorikeet, Turquoise Parrot, Superb Parrot, Masked Owl, Barking Owl, Brown Treecreeper, Speckled Warbler, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Hooded Robin, Grey-Crowned Babbler, Varied Sittella, Diamond Firetail, Koala, Squirrel Glider, Eastern Bentwing-bat, Greater Long-eared Bat, Large-eared Pied Bat, Little Pied Bat, Eastern False Pipistrelle, Eastern Cave Bat) (Marchant & Higgins, 1993; Garnett & Crowley 2000; Higgins, 1999; Barea, 2008; Churchill, 2008; Department of Environment and Climate Change, 2008a; OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Plant eucalypts (Pale-headed Snake, Little Eagle, Turquoise Parrot, Superb Parrot, Rainbow Bee-eater, Satin Flycatcher, Masked Owl, Brown Treecreeper, Speckled Warbler, Painted Honeyeater, Hooded Robin, Grey-crowned Babbler, Varied Sittella, Koala, Squirrel Glider, Greater Long-eared Bat, Eastern Cave Bat), in particular: ‣ box, ironbark and gum species (Square-tailed Kite, Black-chinned Honeyeater, Painted Honeyeater, Squirrel Glider); ‣ White Box (*Eucalyptus albens*) (Little Lorikeet, Swift Parrot, Superb Parrot, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Grey-Crowned Babbler, Diamond Firetail, Large-eared Pied Bat); ‣ Yellow Box (*E. melliodora*) (Little Lorikeet, Superb Parrot, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Grey-Crowned Babbler, Diamond Firetail, Large-eared Pied Bat); ‣ *Angophora floribunda* (Little Lorikeet); ‣ Blakely's Red Gum (*E. blakelyi*) (Superb Parrot, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Grey-Crowned Babbler, Diamond Firetail, Large-eared Pied Bat); ‣ rough-barked species (Brown Treecreeper, Varied Sittella); ‣ River Red Gum (*E. camaldulensis*) (Superb Parrot, Brown Treecreeper, Squirrel Glider, Corben's Long-eared Bat, Little Pied Bat); ‣ Western Grey Box (*E. microcarpa*) (Superb Parrot, Black-chinned Honeyeater); ‣ smooth-barked gum species (Black-chinned Honeyeater, Varied Sittella); ▪ Plant *Acacia* tree species (Spotted Harrier, Little Eagle, Barking Owl, Brown Treecreeper, Painted Honeyeater, Squirrel Glider and Little Pied Bat) ▪ Plant Allocasurina/ Casurina species (Little Eagle, Barking Owl, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater)	The RMP and BMP will: ▪ include the planting (in appropriate soil landscapes) of a variety of box, ironbark and gum eucalypt species which are all known to occur in the Leard State Forest and biodiversity offset areas, and may include: ▪ White Box (Eucalyptus *albens*); ▪ Yellow Box (*E. melliodora*); ▪ *Angophora floribunda* (Rough-barked Apple); ▪ Blakely's Red Gum (*E. blakelyi*) ▪ Dwyer's Red Gum (*E. dwyeri*) ▪ River Red Gum (*E.* camaldulensis); ▪ Western Grey Box (*E. microcarpa*) ▪ Include the planting of *Acacia* species, including both tree and shrub varieties including tree varieties. ▪ Include the planting of *Allocasuarina* / *Casuarina* species ▪ Include the planting of *Melaleuca* species ▪ Describe that seed and tube stock used in revegetation will include a variety of grasses, low shrubs, mid-sized shrubs and tall trees to create structurally diverse habitat.
	3b. Lack of suitable ground cover (Spotted Harrier, Turquoise Parrot, Brown Treecreeper, Speckled Warbler, Hooded Robin, Grey-crowned Babbler, Diamond Firetail) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Plant native grasses. ▪ Plant native herbs (Turquoise Parrot, Diamond Firetail). ▪ Plant native forbs (Grey-crowned Babbler). ▪ Correct spacing for species when planting seedlings.	▪ The RMP and BMP will include the planting of a variety of native grasses, herbs and forbs. ▪ The RMP will provide application rates for seeds as well as planting densities for tube stock.
	3c. Dense shrub layer (Brown Treecreeper) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform;	▪ Correct spacing for species when planting seedlings.	▪ The RMP will provide application rates for seeds as well as planting densities for tube stock.

		▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties		
	3d. Poor floristic diversity (Koala) (Department of Environment and Climate Change, 2008a; OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Control for floristic diversity be means of planting a high number of both eucalypt and non-eucalypt species.	▪ The RMP and BMP will aim to include a wide diversity of species in the seed mix.
4. Remnant Area and Ecological Connectivity The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform will over time increase the size of the existing vegetation patches.	4a. Small patch area size (Barking Owl, Speckled Warbler,, Brown Treecreeper Black-chinned Honeyeater, Grey-crowned Babbler, Squirrel Glider) (OEH, 2015)	Predominantly relevant to: ▪ rehabilitation of habitat on the post-mine landform; ▪ re-establishment of habitat in habitat restoration and corridor enhancement zones in biodiversity offset properties	▪ Increase woodland patch area within biodiversity offset areas. ▪ Increase woodland patch area in mine rehabilitation area.	▪ The BMP will focus on increasing woodland patch size within the offset area and aim to enhance ecological connectivity.
5. Structural Diversity The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform, together with the salvage and re-use of woody debris, hollows and bush rock, will over time provide a range of suitable habitats for threatened fauna species.	5a. Lack of dead stumps or fallen timber (Turquoise Parrot, Barking Owl, Brown Treecreeper, Speckled Warbler, Hooded Robin, Diamond Firetail) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Maximise salvage and reuse of woody debris and hollow logs from the mine vegetation clearing activities (Condition 36 Schedule 3 of Project CoA). ▪ Restriction on firewood collection (OEH, 2015). ▪ Place nest boxes and/ or hollow limbs in young eucalypt trees without hollows in particular:	▪ The BMP will not permit firewood collection. ▪ The RMP and BMP will describe procedures to reuse woody debris/ hollow logs salvaged during vegetation clearing activities (consistent with Condition 36 Schedule 3 of Project CoA), including placement of hollow limbs or artificial hollows in some select trees without hollows.
	5b. Lack of tree hollows (Pale-headed Snake, Squirrel Glider, Superb Parrot, Brown Treecreeper, Yellow-bellied Sheathtail-bat, Corben's Long-eared Bat, Little Pied Bat, Eastern False Pipistrelle) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.		
6. Feral Animals The BMP will describe procedures to monitor, prevent and control feral animals in the restoration and rehabilitation phase of the project.	6a. Predation by feral animals including foxes, cats and dogs (Turquoise Parrot, Speckled Warbler, Koala) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Undertake feral predator control.	▪ The RMP and BMP will describe procedures to prevent, monitor and control feral animals including foxes, cats and dogs
	6b. Disturbance to roosting sites by feral goats and pigs (Eastern Cave Bat, Large-eared Pied Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Monitoring and control feral pigs and goats (Eddy, 2002; Rawlings *et al.* 2010).	▪ As above.
7. Weeds The RMP and BMP will describe procedures to prevent, monitor and control weeds. They will also describe relevant targets and performance indicators for weed management.	7a. Invasion of weeds, resulting in loss of important food plants (Diamond Firetail) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Weed control (Condition 49 Schedule 3 of Project CoA).	▪ The BMP will detail a weed management strategy, including relevant targets and performance indicators for weed management (Condition 49 Schedule 3 of Project CoA).
	7b. Loss of food sources or indirect poisoning as a result of use of pesticides, insecticides or herbicides (Spotted Harrier, Little Eagle, Masked Owl, Yellow-bellied Sheathtail-bat, Eastern Bentwing-bat, Corben's Long-eared Bat, Large-eared Pied Bat, Little Pied Bat, Eastern False Pipistrelle, Eastern Cave Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Limit use of pesticides used in suitable native habitat (OEH, 2015). ▪ Use herbicides sparingly (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods) (DSE, 2005; Rawlings *et al.* 2010; DECCW, 2010.	▪ The BMP will detail methods for the safe use pesticides and herbicides (minimised through spot-spraying, basal spraying, stem injection or cut and paint application methods).
8. Regeneration The restoration of native vegetation communities in the biodiversity offset areas and rehabilitation of the post mine landform, together with the salvage and re-use of woody debris, hollow logs and bush rock, will over time provide a range of suitable habitats for threatened fauna species.	8a. Poor regeneration of habitat (Turquoise Parrot, Speckled Warbler, Brown Treecreeper, Black-chinned Honeyeater, Diamond Firetail, Hooded Robin, Barking Owl, Little Lorikeet, Swift Parrot, Squirrel Glider, Koala, Pale-headed Snake) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Encourage regeneration by fencing (OEH, 2015). ▪ Undertake new plantings (OEH, 2015), ▪ Reduce intensity of grazing (OEH, 2015).	▪ Encouraging regeneration of native fauna habitat is an aim of the RMP and BMP through measures such as fencing, planting and grazing management.

9. Management	9a. Too frequent grazing management (Spotted Harrier, Turquoise Parrot, Masked Owl, Barking Owl, Brown Treecreeper, Speckled Warbler, Black-chinned Honeyeater, Regent Honeyeater, Painted Honeyeater, Hooded Robin, Grey-crowned Babbler, Varied Sittella, Diamond Firetail, Large-eared Pied Bat, Eastern Cave Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ Fencing of areas undergoing revegetation to exclude grazing livestock and prevent grazing of seedlings (Eddy, 2002). ▪ Maintenance of fencing used to exclude livestock. ▪ Restriction of livestock access to maintain ground cover. ▪ Low stocking rates.	▪ The RMP and BMP will describe how livestock will be excluded from areas undergoing active revegetation (i.e. planting or seeding). ▪ The BMP will describe management of livestock to maintain ground cover and diversity of native plants.
	9b. Too frequent burning management (Pale-headed Snake, Square-tailed Kite, Masked Owl, Barking Owl, Speckled Warbler, Koala, Large-eared Pied Bat, Eastern Cave Bat) (OEH, 2015)	Relevant to the post-mine landforms and biodiversity offset areas.	▪ No controlled burns whilst vegetation is establishing. ▪ Assess fuel loads. ▪ DECCW (2010) suggests fire frequency should be a minimum interval of 5 years and a maximum interval of 40 years. Rawlings et al. (2010) recommends fire frequency in patches should be every 4 to 8 years. ▪ Controlled burns should be undertaken in a mosaic (i.e. retain some unburned areas (DECCW, 2010).	▪ The BMP and Biodiversity Offset Strategy will prescribe bushfire management strategies for rehabilitation of post-mine landforms and biodiversity offset areas respectively.