

APPENDIX 5 – BIODIVERSITY

2015 Consultation with OEH (re. Biodiversity Offset Areas)

Date	Form of communication	Summary
2 nd June 2015	Letter to WCPL from OEH	Letter discussing terms for transfer of land from WCPL to OEH
13 th November 2015	Letter to WCPL from OEH	Letter discussing terms for transfer of land from WCPL to OEH
11 th December 2015	Letter to OEH from WCPL	WCPL acceptance of terms for transfer of lands from WCPL to OEH
21 st December 2015	Email to OEH from WCPL	Biodiversity Assessment Reports

Note: multiple onsite meetings held between OEH & WCPL to discuss progress in 2015

2015 Consultation with DPE (re. Biodiversity Management Plan)

Date	Form of communication	Summary
22 nd April 2015	Email DP&E to WCPL	Request for Biodiversity Management Plan (BMP) to be resent to DP&E
23 rd April 2015	Email WCPL to DP&E	BMP sent to DP&E
28 th July 2015	Email DP&E to WCPL	DP&E Comments regarding BMP
26 th October 2015	Email WCPL to DP&E	Response to comments and revision of BMP
17 th December 2015	Email DP&E to WCPL	DP&E comments on WCPL revised BMP

Biodiversity Monitoring Report

WILPINJONG COAL BIODIVERSITY MONITORING PROGRAM

Spring 2015

Prepared for
Wilpinjong Coal Pty Ltd

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Abbreviations

Abbreviation	Description
BOA	Biodiversity Offset Area
BOM	Bureau of Meteorology
DNG	Derived Native Grassland
ECA	Enhancement and Conservation Area
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
LFA	Landscape Function Analysis
LOI	Landscape Organisation Index
ML	Mining Lease
MOP	Mining Operations Plan
NSW	New South Wales
PA	Project Approval
SSA	Soil Surface Assessment
TSC Act	<i>Threatened Species Conservation Act 1995</i>
WCBMP	Wilpinjong Coal Biodiversity Management Plan
WCPL	Wilpinjong Coal Pty Ltd

1 Introduction

Eco Logical Australia (ELA) was engaged by Wilpinjong Coal Pty Ltd (WCPL) to undertake biodiversity monitoring during spring 2015, consistent with the Wilpinjong Coal Biodiversity Management Plan (WCBMP) (WCPL 2014).

WCPL is a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (Peabody), situated approximately 40 kilometres (km) north-east of Mudgee, within the Mid-Western Regional Council Local Government Area, in the Western Coalfields of New South Wales (NSW). Project Approval (PA) 05-0021 was granted by the Minister for Planning under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* on 1 February 2006. Modifications have been made to the original PA, with the most recent being Modification 6 (“Mod 6”) approved in November 2014.

The WCBMP was prepared to fulfil the requirements of the PA and in accordance with the Environmental Impact Statement (EIS) and Statement of Commitments. The WCBMP details the management strategies, procedures, controls and monitoring programs required to manage flora and fauna within the management domains, including Enhancement and Conservation Areas (ECAs), Biodiversity Offset Areas (BOAs), and Regeneration and Rehabilitation Areas (see **Figure 1-1**). Biodiversity monitoring during spring 2015 was undertaken within the following management domains:

- BOA-D – located approximately 12 km north-east of Mining Lease (ML) 1573;
- BOA-E – located approximately 3 km east of ML 1573;
- ECA-A – located in the south-eastern portion of the Wilpinjong exploration area;
- ECA-B – located in the northern section of the Wilpinjong exploration area, between Wilpinjong Creek and the common boundary with Goulburn River National Park to the immediate north;
- ECA-C – located in the southern and eastern portion of the Wilpinjong mine exploration area;
- Regeneration Area 1 – located adjacent to the eastern boundary of the approved disturbance area;
- Regeneration Area 2 – located on the western side of ECA-A;
- Regeneration Areas 3, 7 and 8 – located adjacent to the south and south western boundary of the approved disturbance area;
- Regeneration Area 4 – located on the north side of the mine, between the approved disturbance boundary and ECA-B;
- Regeneration Area 5 – located towards the western end of ECA-B;
- Regeneration Area 6 – located in the western portion of the Wilpinjong exploration lease area;
- Regeneration Area 9 – located in the northern part of the Wilpinjong exploration lease; and
- Rehabilitation Areas – includes areas within the approved disturbance area for the mine, including active and future mining areas, infrastructure areas and rehabilitation of disturbed areas that is undertaken on a progressive basis in accordance with the approved WCPL Mine Operations Plan (MOP).

Monitoring undertaken during spring 2015 collected the first season of baseline data for selected sites as outlined in the WCBMP (WCPL 2014). Baseline data will be used to assist with the development of site-specific completion criteria contained within the WCBMP and to inform ongoing management actions.

1.1 OBJECTIVES

The objective of biodiversity monitoring at WCPL is to ensure that the areas monitored are progressing towards the relevant Completion Criteria. Biodiversity monitoring includes native vegetation and habitat complexity, landscape stability and fauna diversity (WCPL 2014).

1.2 PREVIOUS MONITORING

Previously, monitoring was primarily undertaken to establish baseline conditions for the EIS (WCPL 2006) and to assess how rehabilitation was progressing over time. However, monitoring reports did not correlate monitoring data with performance criteria contained in the WCPL MOP. In addition, performance criteria for the ECA's or Regeneration Areas had not been established and, therefore, monitoring was ineffective at measuring the effect of management measures implemented in these areas to improve biodiversity values.

1.3 MANAGEMENT ACTIONS UNDERTAKEN DURING 2015

WCPL undertook a range of management actions throughout 2015 across their various management domains. This included pest animal control, implementing a baiting program for wild dogs and foxes, along with feral goat and kangaroo management. A weed management program was also implemented targeting noxious weed species found across WCPL owned properties. In addition to pest animal and weed control programs, disused properties and associated infrastructure was also demolished and removed across WCPLs BOAs.

1.4 INTERIM PERFORMANCE TARGETS

The WCBMP outlines Interim Performance Targets which will be used to determine progression towards the Completion Criteria and overall mine closure objectives. The Interim Performance Targets provide ongoing targets for which the progression of rehabilitation and regeneration activities can be assessed against over time. The Completion Criteria will be used to determine the establishment of rehabilitation and regeneration areas against the proposed final land use.

Progression of rehabilitation towards the Interim Performance Targets is assessed using Landscape Function Analysis (Tongway & Hindley 2004). The Completion Criteria and associated monitoring program was developed based upon the BioMetric methodology (Gibbons et al 2009 and WCPL 2014) (**Section 2.1**).

The BioMetric methodology is a quantitative method developed to compare the condition of vegetation and habitat values of native vegetation against pre-defined benchmarks (i.e. pre European settlement). Vegetation and habitat condition is quantitatively evaluated by ten readily measurable 'site attributes' considered to reflect the relative health or level of disturbance of a specific vegetation class (**Table 1-1**) (WCPL 2014).

Table 1-1: BioMetric site attributes & Measurement Parameters (WCPL 2014)

Site Attribute	Abbreviation	Measurement parameter
Native Plant Species Richness	NSR	Species within 400 m ² plot (count)
Native Over-storey Cover	NOC	Projected foliage cover above 10 m height along a 50 m transect (%) – measured every 5 m
Native Mid-storey Cover	NMC	Projected foliage cover between 1 and 10 m height along a 50 m transect (%) – measured every 5 m

Site Attribute	Abbreviation	Measurement parameter
Native Ground Stratum Cover (grasses)	NGCG	Cover below 1 m along a 50 m transect (%) – measured every metre
Native Ground Stratum Cover (shrubs)	NGCS	Cover below 1 m along a 50 m transect (%) – measured every metre
Native Ground Stratum Cover (other)	NGCO	Cover below 1 m along a 50 m transect (%) – measured every metre
Exotic Plant Cover	EC	Cover along a 50 m transect (%) – measured every metre
Over-storey Regeneration	OR	Overstorey canopy species <5 cm diameter at breast height (DBH) within a 1,000 m ² plot (score 0 to 1)
Number Of Trees With Hollows	NTH	Number of trees containing hollows within a 1,000 m ² plot (count)
Total Length of Fallen Logs	FL	Log length touching ground >10 cm diameter and >0.5 m in length within a 1,000 m ² plot (metres)

The BioMetric method can be used to determine the effectiveness of management actions through either individually examining the attributes at each site, or through calculated site value scores. A site value score is calculated using a specific algorithm and the results for each site attribute. This allows a collective quantitative evaluation of condition against a desired outcome. Site value scores range from one (i.e. low condition) to a maximum of 100 (i.e. benchmark condition). The site value scores used to determine condition state thresholds are broadly defined in **Table 1-2**.

Table 1-2: BioMetric site value scores & description (WCPL 2014)

Site Value Score	Description
<34	Lands having low condition, requiring substantial management intervention. Low condition vegetation lacks the basic building blocks for a functioning ecosystem. Such vegetation is characterised by having few site attributes in addition to moderate exotic plant cover.
34-70	Lands having moderate to good condition with capacity for continued improvement. Sub-categories include: <ul style="list-style-type: none"> • Moderate to good – poor (site value score >34-45) • Moderate to good – medium (site value score >45-56) • Moderate to good – good (site value score >56-70) Vegetation and habitat in this condition generally requires targeted management intervention to restore ecological function to a self-sustaining level.
>70	Lands having high condition approaching a benchmark state, with continued improvement restricted to the long term development of specific habitat features (i.e. development of hollow bearing trees, larger woody debris and species richness). Sub-categories include: <ul style="list-style-type: none"> • High (site value score 71-78) • High – benchmark (site value score >78) Vegetation and habitat in this condition generally comprises sufficient ecological function similar to an undisturbed patch belonging to the same vegetation class. Such vegetation is considered to require limited management intervention as ongoing improvement would be largely passive (e.g. tree hollow development). A site value score of 78 denotes vegetation and habitat in benchmark condition for all site attributes (Table 1-1) with the exception of trees with hollows. As it takes up to 120 years to develop hollow bearing trees it is considered unrealistic to expect a site value score above 78 where the management period is not of this timeframe or a significant proportion thereof.

To determine benchmark BioMetric condition values for the Interim Performance Targets and overall Completion Criteria targets, the remnant vegetation within the project area was split into the dominant Keith vegetation classes; Western Slopes Dry Sclerophyll Forests and Western Slopes Grassy Woodlands. The benchmark condition classes for these two Keith vegetation classes are in **Table 1-3**.

Table 1-3: Vegetation class benchmark condition state (WCPL 2014)

Vegetation Class	Site Attribute									
	NSR (count)	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH (count)	OR	FL (m)
Western Slopes Dry Sclerophyll Forests	≥32	15 - 40	10 – 55	3 - 10	5 - 15	5 - 25	<5%	≥3	1	≥70
Coastal Valley Grassy Woodlands	≥23	10 - 45	5 – 60	5 - 45	2 - 10	5 -35	<5%	≥2	1	≥50

The WCBMP establishes a 20 year management period, comprising four sequential five-year management periods. It is expected that the trajectory of change as a result of implementing management activities will be towards benchmark condition. The monitoring undertaken during spring 2015 forms baseline survey for the first management period (Establishment Period) Years 0-5. This management period will target managing lands with poor to no ecosystem resilience and those areas requiring rehabilitation. Management activities to be undertaken in this period will generally be intensive and include:

- Direct seeding;
- Soil improvement (e.g. organic matter, nutrients, pH);
- Tubestock plantings; and
- Broad acre weed management.

The Interim Performance Targets established for the Establishment Period have been split between low, moderate to good and high condition vegetation. **Table 1-4** and **Table 1-5** show the site attributes for the Interim Performance Targets for low, moderate to good and high condition vegetation for each of the two Keith vegetation classes across the site.

Within this monitoring report, these benchmarks (**Table 1-4** and **Table 1-5**) have been used to rank individual floristic monitoring sites against the Interim Performance Targets. **Table 1-6** outlines the ranking system established for monitoring sites within low condition vegetation, moderate to good condition vegetation and high condition vegetation. This system has been developed to identify sites that are meeting or exceeding (high), trending towards (moderate) or falling significantly short of (low) their relevant interim performance and therefore overall completion criteria.

A traffic light colour coding system has been applied to all sites, with under-performing sites requiring management intervention highlighted red, amber sites performing satisfactorily but may require management intervention depending on future monitoring results, and green sites performing well and not requiring further intervention.

Table 1-4: Interim Performance Targets for Western Slopes Dry Sclerophyll Forests

Management Period	Interim Performance Target (site value score)	Site Attributes (% cover)									
		NSR (count)	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH (count)	OR	FL (m)
Low Condition Vegetation											
Year 0 (Baseline)	6	<8	0	0	1	0	0	60	0	0	0
Years 1-5	34	12	0	3-10	1-2	1-5	1-3	60	0	1	10
Benchmark	>78	≥32	15-40	10-55	3-10	5-15	5-25	<5	≥3	1	≥70
Moderate to Good Condition Vegetation											
Year 0 (Baseline)	34	12	0	10	<3	<5	<4	60	0	1	10
Years 1-5	45	16	0	10-55	3-10	5-15	5-25	40	0	1	10
Benchmark	>78	≥32	15-40	10-55	3-10	5-15	5-25	<5	≥3	1	≥70
High Condition Vegetation											
Year 0 (Baseline)	70	18-32	15-40	10-55	3-10	5-15	5-25	≤5	0	1	≥70
Years 1-20	70	18-32	15-40	10-55	3-10	5-15	5-25	≤5	0	1	≥70
Benchmark	>78	≥32	15-40	10-55	3-10	5-15	5-25	≤5	≥3	1	≥70

Table 1-5: Interim Performance Targets for Western Slopes Grassy Woodlands

Management period	Interim Performance Target (Site value score)	Site Attributes (% cover)									
		NSR (count)	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH (count)	OR	FL (m)
Low Condition Vegetation											
Year 0 (Baseline)	7	<9	0	0	5	0	0	60	0	0	0
Years 1-5	34	12	0	<4	60+	<2	<2	60	0	1	10
Benchmark	>78	≥23	10-45	5-60	5-45	2-10	5-35	<5	≥2	1	≥50
Moderate to Good Condition Vegetation											
Year 0 (Baseline)	34	12	0	≤3	60+	<2	<2	60	0	1	10
Years 1-5	45	12	0	5-60	45-60	<2	<2	40	0	1	10
Benchmark	>78	≥23	10-45	5-60	5-45	2-10	5-35	<5	≥2	1	≥50
High Condition Vegetation											
Year 0 (Baseline)	70	20-22	10-45	5-60	5-45	2-10	5-35	≤20	0	1	≥50
Years 1-20	70	20-23	10-45	5-60	5-45	2-10	5-35	≤20	0	1	≥50
Benchmark	>78	≥23	10-45	5-60	5-45	2-10	5-35	<5	≥2	1	≥50

Table 1-6: Ranking system for monitoring sites

Variable	Score		
	Low	Moderate	High
Native plant species richness	<29% of interim performance range	30% - 69% or >150% of interim performance range	70%-<100% of interim performance
Native overstorey cover	0-29% or >200% of interim performance range	30% - 69% or >150% of interim performance range	70%-<100% of interim performance or 100%- 150% of interim performance
Native midstorey cover	0-29% or >200% of interim performance range	30% - 69% or >150% of interim performance range	70%-<100% of interim performance or 100%- 150% of interim performance
Native ground cover (grasses)	0-29% or >200% of interim performance range	30% - 69% or >150% of interim performance range	70%-<100% of interim performance or 100%- 150% of interim performance
Native ground cover (shrubs <1m)	0-29% or >200% of interim performance range	30% - 69% or >150% of interim performance range	70%-<100% of interim performance or 100%- 150% of interim performance
Native ground cover (other)	0-29% or >200% of interim performance range	30% - 69% or >150% of interim performance range	70%-<100% of interim performance or 100%- 150% of interim performance
Exotic cover	>66%	33-66%	0-32%

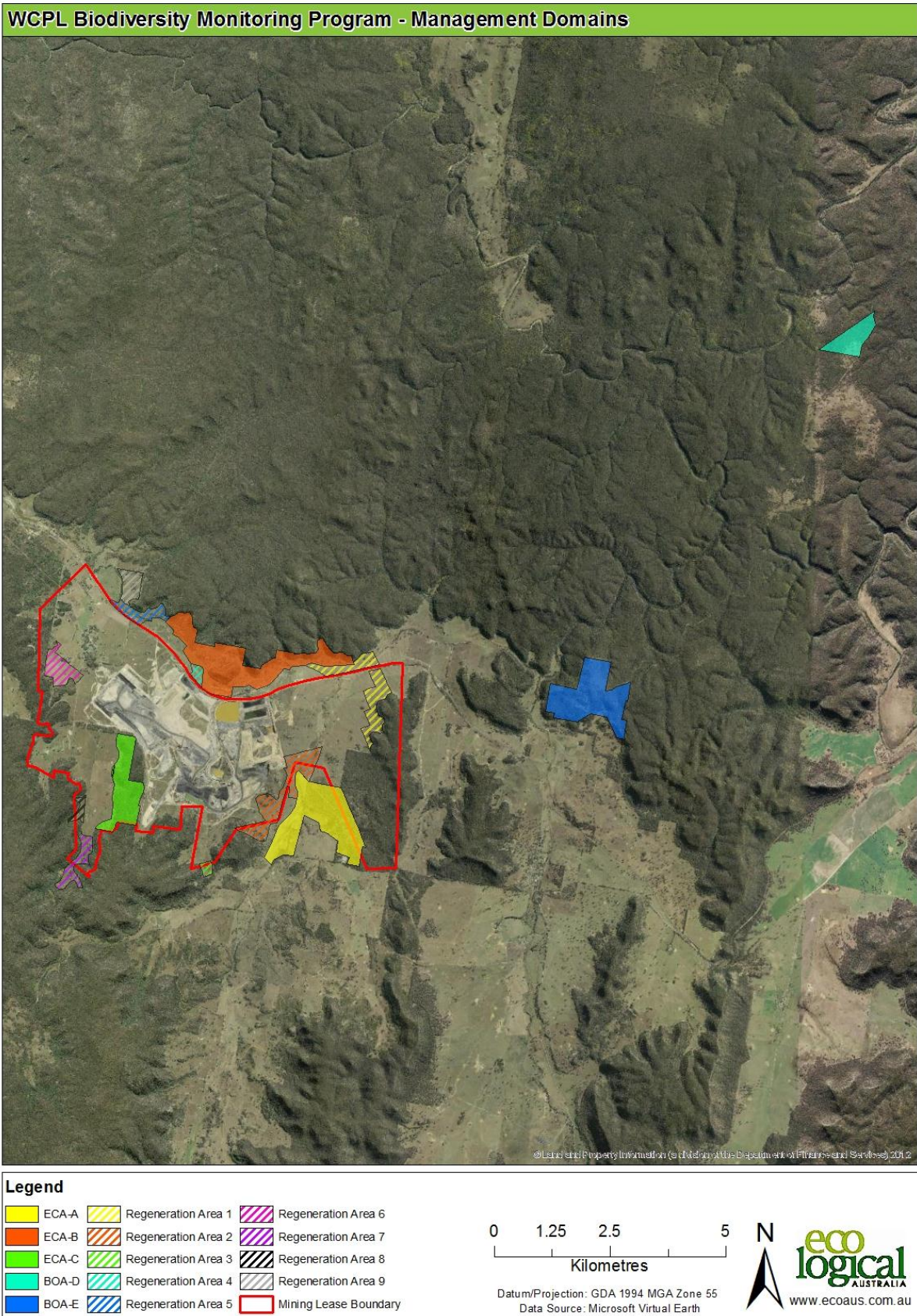


Figure 1-1: WCPL Management Domains

2 Methodology

The spring 2015 biodiversity monitoring program was undertaken in accordance with the methods and survey techniques prescribed in the WCBMP. As per the requirements of the WCBMP, the biodiversity monitoring program was comprised of the following components:

- Vegetation (floristic) monitoring using BioMetric assessment
- Landscape Stability using Landscape Function Analysis
- Fauna (birds, ground fauna and bats)

2.1 FLORISTIC MONITORING

Floristic surveys were undertaken over one week from the 23rd November to the 27th November 2015. The surveys were conducted by Bruce Mullins, Tammy Paartalu and Dr Enhua Lee of ELA.

2.1.1 Monitoring sites

As spring 2015 floristic monitoring formed the baseline survey for WCPL, floristic monitoring plots were identified and established for the first time. The floristic monitoring program outlined within the WCBMP split monitoring between spring and autumn to allow for seasonal variation in the results, whilst still meeting the requirements of WCBMP.

During spring 2015, 25 floristic monitoring sites were established (**Figure 2-1**) within the WCPL management domains, with **Table 2-1** summarising these sites, their management domain, the Keith vegetation class and the on ground vegetation communities. Vegetation communities were identified for each monitoring site to direct management actions to a finer level and to allow for development of specific Interim Performance Targets and Completion Criteria based on vegetation communities, if required in the future.

Table 2-1: Spring 2015 floristic monitoring sites, management domains & vegetation class

Site	Management Domain	Condition	Keith Vegetation Class	Vegetation Community	Easting	Northing
D_100	BOA-D	Native Vegetation	Western Slopes Dry Sclerophyll Forest (WSDSF)	Narrow-leaved Ironbark - Box Woodland	784857	6427722
D_102	BOA-D	Regeneration	Western Slopes Grassy Woodland (WSGW)	Grassy White Box Woodland	784563	6427262
E_101	BOA-E	Regeneration	WSDSF	Shrubby Regeneration	778761	6419564
E_102	BOA-E	Regeneration	WSGW	Yellow Box Woodland	779053	6419319
E_104	BOA-E	Native Vegetation	WSGW	Grassy White Box Woodland	779148	6419734
A_100	ECA-A	Regeneration	WSGW	DNG - other native (non EEC)	771861	6416276

Site	Management Domain	Condition	Keith Vegetation Class	Vegetation Community	Easting	Northing
A_104	ECA-A	Native Vegetation	WSGW	Narrow-leaved Ironbark Forest	773695	6416293
B_100	ECA-B	Native Vegetation	WSGW	Sandstone Ranges Shrubby Woodland	770111	6420997
B_101	ECA-B	Regeneration	WSGW	DNG - other native (non EEC)	770542	6420592
B_105	ECA-B	Regeneration	WSDSF	DNG - other native (non EEC)	773141	6420468
C_100	ECA-C	Native Vegetation	WSDSF	Sandstone Ranges Shrubby Woodland	768682	6418083
C_102	ECA-C	Native Vegetation	WSGW	Shrubby White Box Woodland	768940	6417281
R1_101	Regeneration Area 1	Regeneration	WSGW	DNG - other native (non EEC)	774053	6419239
R2_101	Regeneration Area 2	Regeneration	WSGW	DNG - other native (non EEC)	772639	6418355
R4_100	Regeneration Area 4	Regeneration	WSGW	DNG - other native (non EEC)	770347	6420268
R5_101	Regeneration Area 5	Regeneration	WSDSF	DNG - other native (non EEC)	769500	6421595
R7_101	Regeneration Area 7	Regeneration	WSDSF	DNG - other native (non EEC)	767446	6415726
R9_100	Regeneration Area 9	Regeneration	WSDSF	DNG - other native (non EEC)	768975	6422067
R8	Rehabilitation Area	Rehabilitation – Grassland	WSGW	N/A	770231	6418596
R10	Rehabilitation Area	Rehabilitation – Grassland	WSGW	N/A	768433	6419301
R11	Rehabilitation Area	Rehabilitation – Grassland	WSGW	N/A	768896	6419664

Four sites within the Rehabilitation area were set up during spring 2015 to monitoring a trial cattle grazing program (**Table 2-2** and **Figure 2-1**). The four sites were set up using the BioMetric methodology; two within the cattle grazing area and two within an area fenced off from the grazing.

Table 2-2: Spring 2015 floristic monitoring sites, management domains & vegetation class

Site	Management Domain	Condition	Keith Vegetation Class	Vegetation Community	Easting	Northing
R1_C	Rehabilitation Area	Rehabilitation – Cattle excluded	WSDSF	N/A	770478	6419353
R2_C	Rehabilitation Area	Rehabilitation – Cattle	WSDSF	N/A	770373	6419418

Site	Management Domain	Condition	Keith Vegetation Class	Vegetation Community	Easting	Northing
R3_C	Rehabilitation Area	Rehabilitation – Cattle excluded	WSDSF	N/A	770396	6419246
R5_C	Rehabilitation Area	Rehabilitation – Cattle	WSDSF	N/A	770315	6419331

Additionally, 12 reference sites were established with the wider region surrounding WCPL operations (**Figure 2-2**). These sites were established within vegetation that aligned with the two Keith vegetation classes present within the management domain (**Table 2-1**). **Table 2-2** below provides a summary of the number of reference monitoring sites, their location, the Keith vegetation class and respective vegetation communities.

Table 2-3: Spring 2015 floristic reference monitoring sites, locations & vegetation class

Site	Location	Vegetation Class	Vegetation Community	Easting	Northing
Ref_1	Turill SCA	WSGW	Blakely's Red Gum Grassy Woodland	775261	6451958
Ref_2	Goulburn River NP	WSDSF	Narrow-leaved Ironbark - Box Woodland	224152	6424015
Ref_3	Goulburn River NP	WSDSF	Sandstone Ranges Shrubby Woodland	217853	6424354
Ref_4	Turill SCA	WSGW	Grassy White Box Woodland	773477	6449770
Ref_5	WCPL Offset Area	WSDSF	Ironbark Bloodwood Red gum Woodland	779353	6419938
Ref_6	Goulburn River NP	WSDSF	Ironbark Bloodwood Red gum Woodland	222265	6422430
Ref_7	Goulburn River NP	WSDSF	Narrow-leaved Ironbark - Box Woodland	218145	6425455
Ref_8	Goulburn River NP	WSGW	White Box Shrubby Woodland	781932	6414688
Ref_9	Goulburn River NP	WSDSF	Sandstone Ranges Shrubby Woodland	221614	6422152
Ref_10	Goulburn River NP	WSDSF	Narrow-leaved Ironbark - Box Woodland	220576	6428690
Ref_11	Turill SCA	WSGW	Blakely's Red Gum – White Box DNG	775036	6451459
Ref_12	Turill SCA	WSGW	Rough-barked Apple DNG	773663	6449945

2.1.2 BioMetric Methodology

Floristic monitoring was undertaken utilising the standardised BioMetric methodology. Permanent BioMetric plots, comprising a 20 m x 20 m (0.04 ha) plot nested within a 20 m x 50 m plot, were established and monitored in accordance with the methods described in Section 9.1 of the WCBMP. Within each plot, the following data was collected:

- Native species richness, cover and abundance within 20 m x 20 m plot;
- Native and exotic tree cover and native mid-storey cover – at regular 5 m intervals along 50 m transect (10 points);
- Native ground (grass, shrub, other) and exotic cover – at regular 1 m intervals along 50 m transect (50 points); and
- Habitat features (number of trees with hollows, length of fallen logs) and proportion of over-storey species regeneration – within 20 m x 50 m plot

All vascular plants species were recorded and identified to the lowest taxonomic level possible, with samples of unknown species collected for further identification. Nomenclature followed the Flora of New South Wales (Harden 1992; 1993; 2000; 2002), and any subsequent recent taxonomic changes as presented on PlantNET (RBGDT 2015).

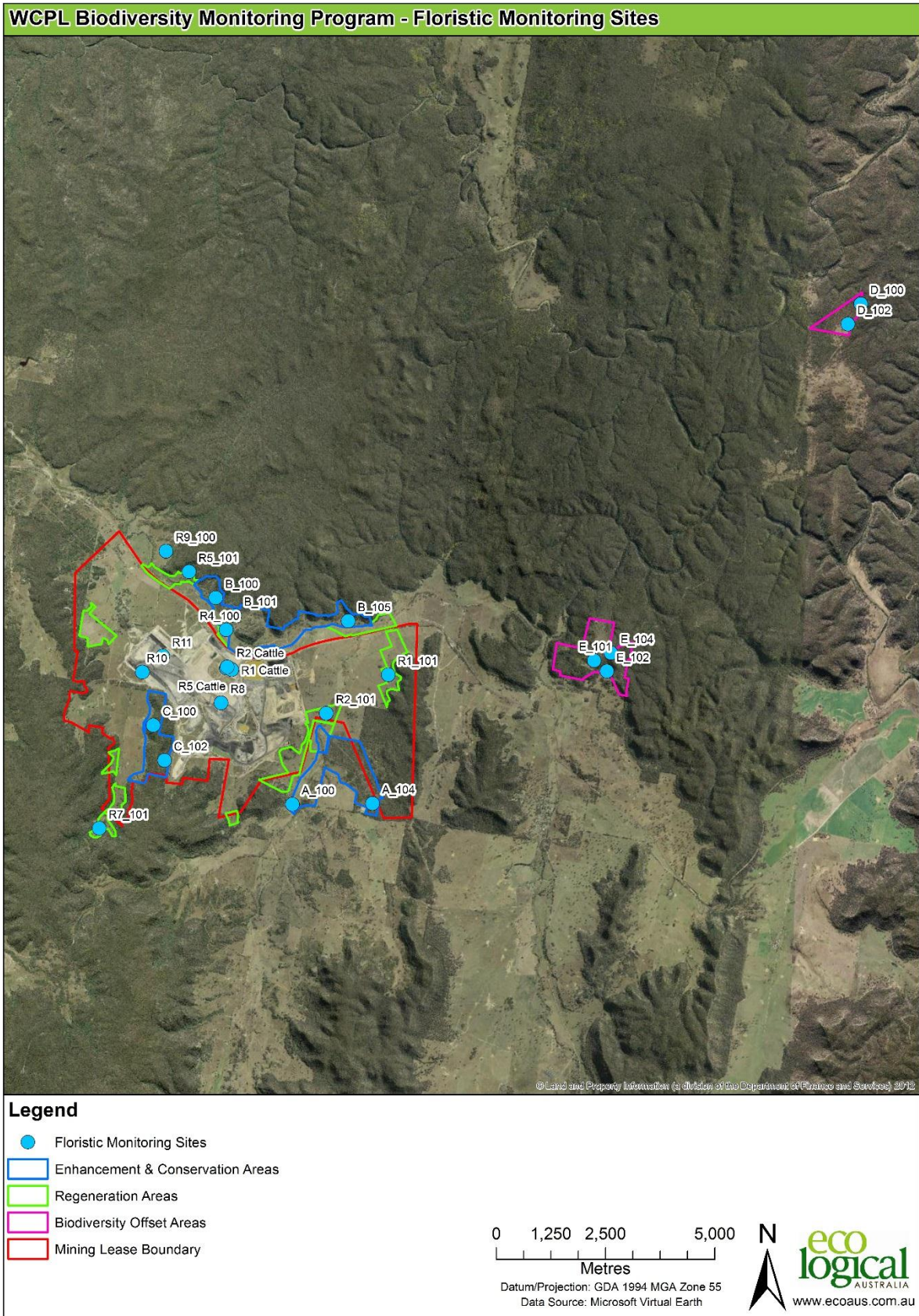


Figure 2-1: Spring 2015 floristic monitoring site locations

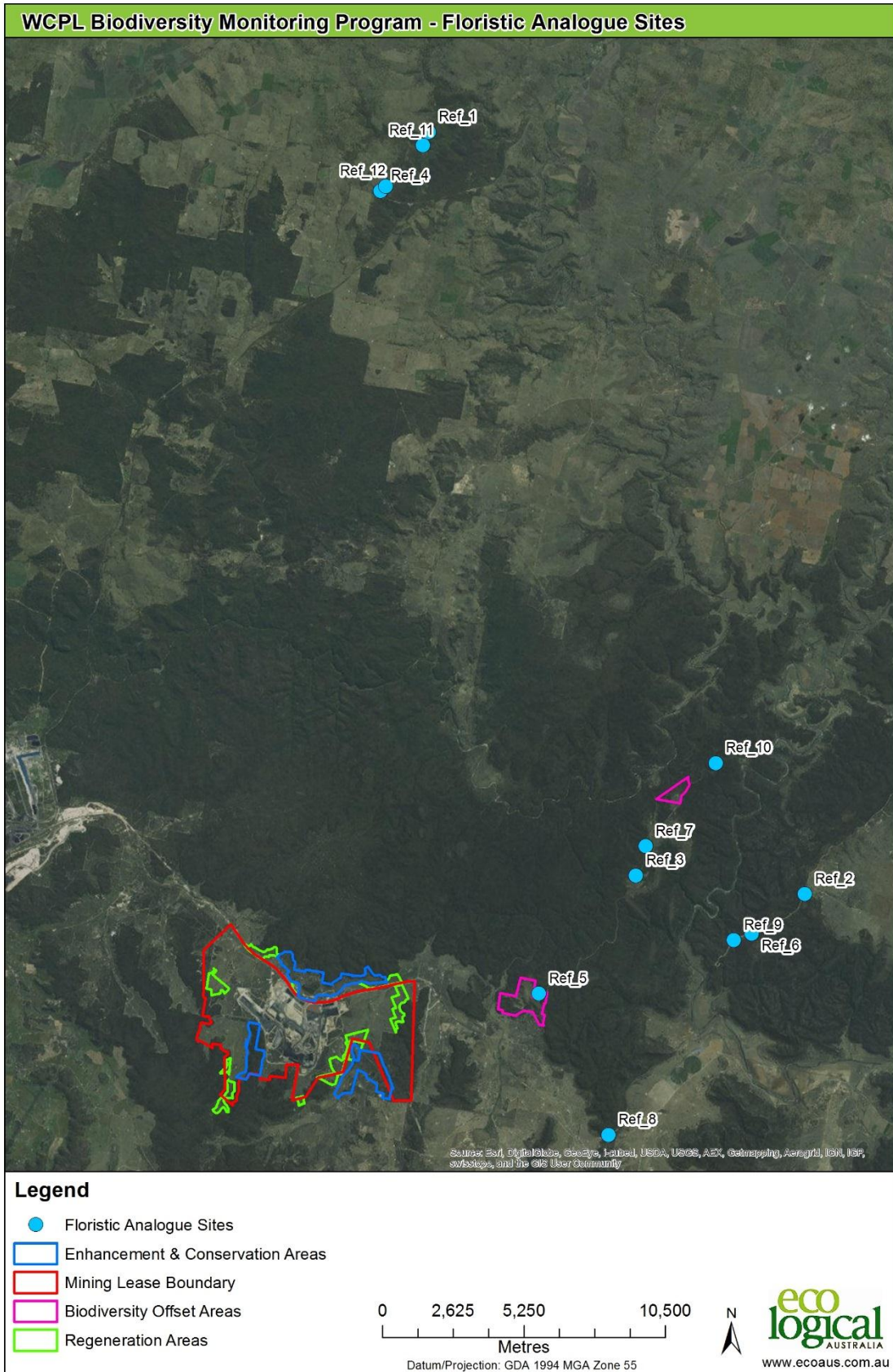


Figure 2-2: Spring 2015 floristic monitoring reference sites

2.2 LANDSCAPE FUNCTION ANALYSIS

Landscape Function Analysis was undertaken over one week from the 30th November to the 4th December 2015. The surveys were conducted by Dr Enhua Lee and Melissa Bruton of ELA.

LFA is a monitoring tool that assesses landscape stability, structure and function at the soil level. LFA data enables analysis of the trajectory of change in regeneration and rehabilitation areas towards (or otherwise) comparable reference sites. LFA assessment was undertaken along a 50 m transect that either corresponded with the BioMetric plots established during spring 2015 monitoring, or proposed BioMetric plot locations to be established during autumn 2016.

In total, 25 LFA assessments were undertaken, of which 13 are located in WCPL management domains and 12 are reference sites (**Figure 2-3**). **Table 2-3** below summarises the sites located in each management domain and the reference sites.

Table 2-4: LFA assessments within WCPL management domains & reference sites

Site	Management domain/Location	Vegetation Class	Vegetation Community	Easting	Northing
E_105	BOA-E	WSGW	Grassy White Box Woodland	779002	6419978
A_100	ECA-A	WSGW	DNG - other native (non EEC)	771861	6416276
B_106	ECA-B	WSGW	DNG - other native (non EEC)	771571	6420001
R1_100	Regeneration Area 1	WSGW	DNG - other native (non EEC)	774228	6420095
R4_100	Regeneration Area 4	WSGW	DNG - other native (non EEC)	770347	6420268
R6_101	Regeneration Area 6	WSGW	DNG - other native (non EEC)	767406	6420303
R5_C	Rehabilitation	WSDSF	N/A	770315	6419331
R6	Rehabilitation	WSDSF	N/A	769562	6419517
R8	Rehabilitation	WSDSF	N/A	770231	6418596
R9	Rehabilitation	WSDSF	N/A	769118	6418973
R10	Rehabilitation	WSGW	N/A	768433	6419301
R11	Rehabilitation	WSGW	N/A	768896	6419664
R13	Rehabilitation	WSGW	N/A	770872	6418901
Ref_1	Turill SCA	WSGW	Blakely's Red Gum Grassy Woodland	775261	6451958
Ref_2	Goulburn River NP	WSDSF	Narrow-leaved Ironbark - Box Woodland	224152	6424015
Ref_3	Goulburn River NP	WSDSF	Sandstone Ranges Shrubby Woodland	217853	6424354
Ref_4	Turill SCA	WSGW	Grassy White Box Woodland	773477	6449770
Ref_5	WCPL Offset Area	WSDSF	Ironbark Bloodwood Red gum Woodland	779353	6419938
Ref_6	Goulburn River NP	WSDSF	Ironbark Bloodwood Red gum Woodland	222265	6422430
Ref_7	Goulburn River NP	WSDSF	Narrow-leaved Ironbark - Box Woodland	218145	6425455

Site	Management domain/Location	Vegetation Class	Vegetation Community	Easting	Northing
Ref_8	Goulburn River NP	WSGW	White Box Shrubby Woodland	781932	6414689
Ref_9	Goulburn River NP	WSDSF	Sandstone Ranges Shrubby Woodland	221614	6422152
Ref_10	Goulburn River NP	WSDSF	Narrow-leaved Ironbark - Box Woodland	220576	6428690
Ref_13	Turill SCA	WSGW	Narrow-leaved Ironbark Forest	777201	6449998
Ref_14	Goulburn River NP	WSDSF	Ironbark Bloodwood Red gum Woodland	782171	6421992

The LFA assessment included:

- Rain splash protection
- Perennial vegetation cover
- Structural classification of vegetation, including the height of each canopy layer
- Litter
- Cryptogam cover
- Crust brokenness
- Soil erosion type and severity
- Deposited materials
- Soil surface roughness
- Surface nature (resistance to disturbance)
- Description of ephemeral drainage lines
- Slake test
- Soil texture

Each of these parameters was assigned a simple score in the field. These scores were then summed to give an overall score for the site with regard to Slope Stability, Soil Infiltration and Nutrient Cycling.

LFA also included an assessment of the extent and arrangement of ground cover (including vegetation and non-vascular ground cover) which was converted into a Landscape Organisation Index.

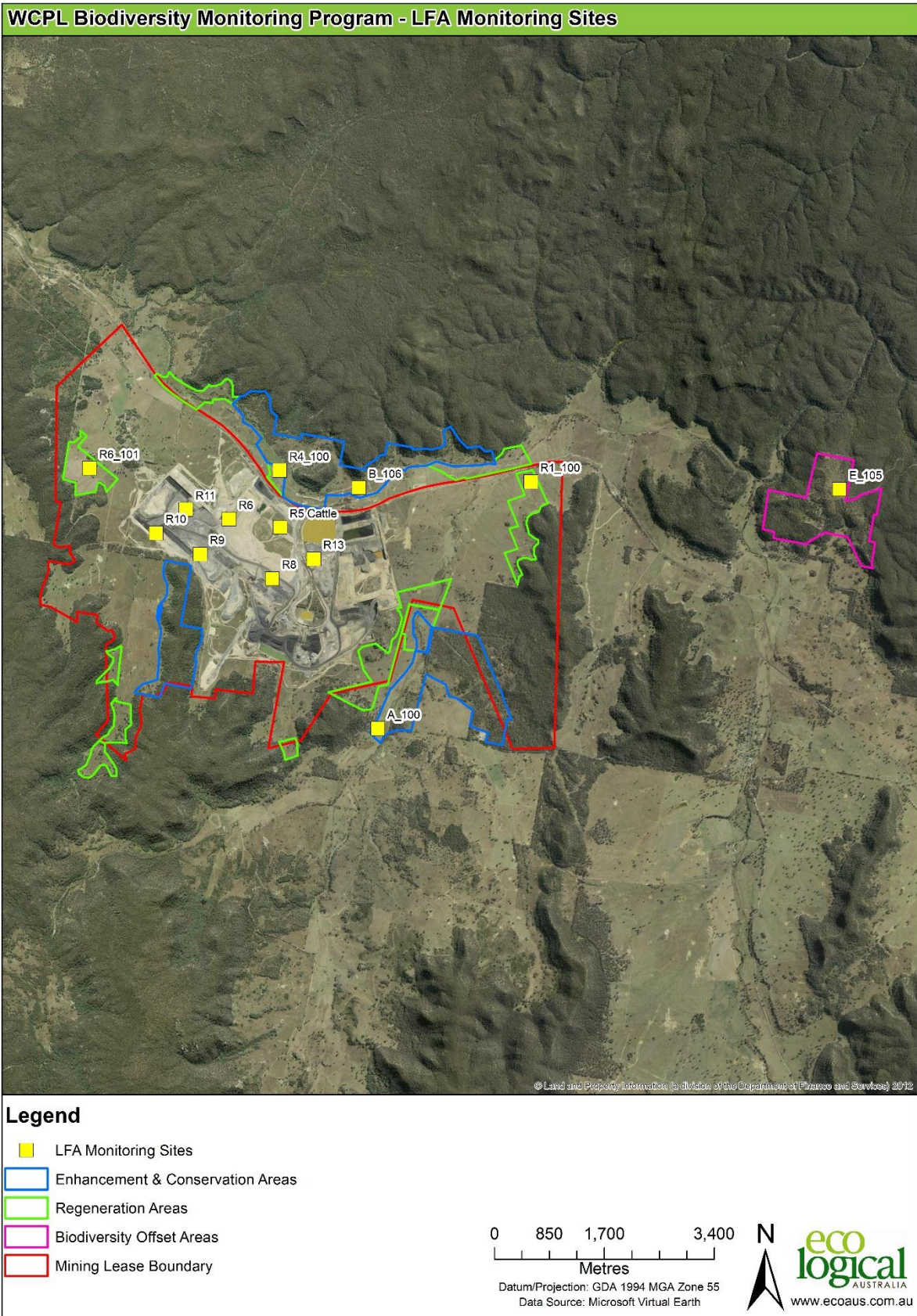


Figure 2-3: Spring 2015 LFA assessments within the WCPL management domains

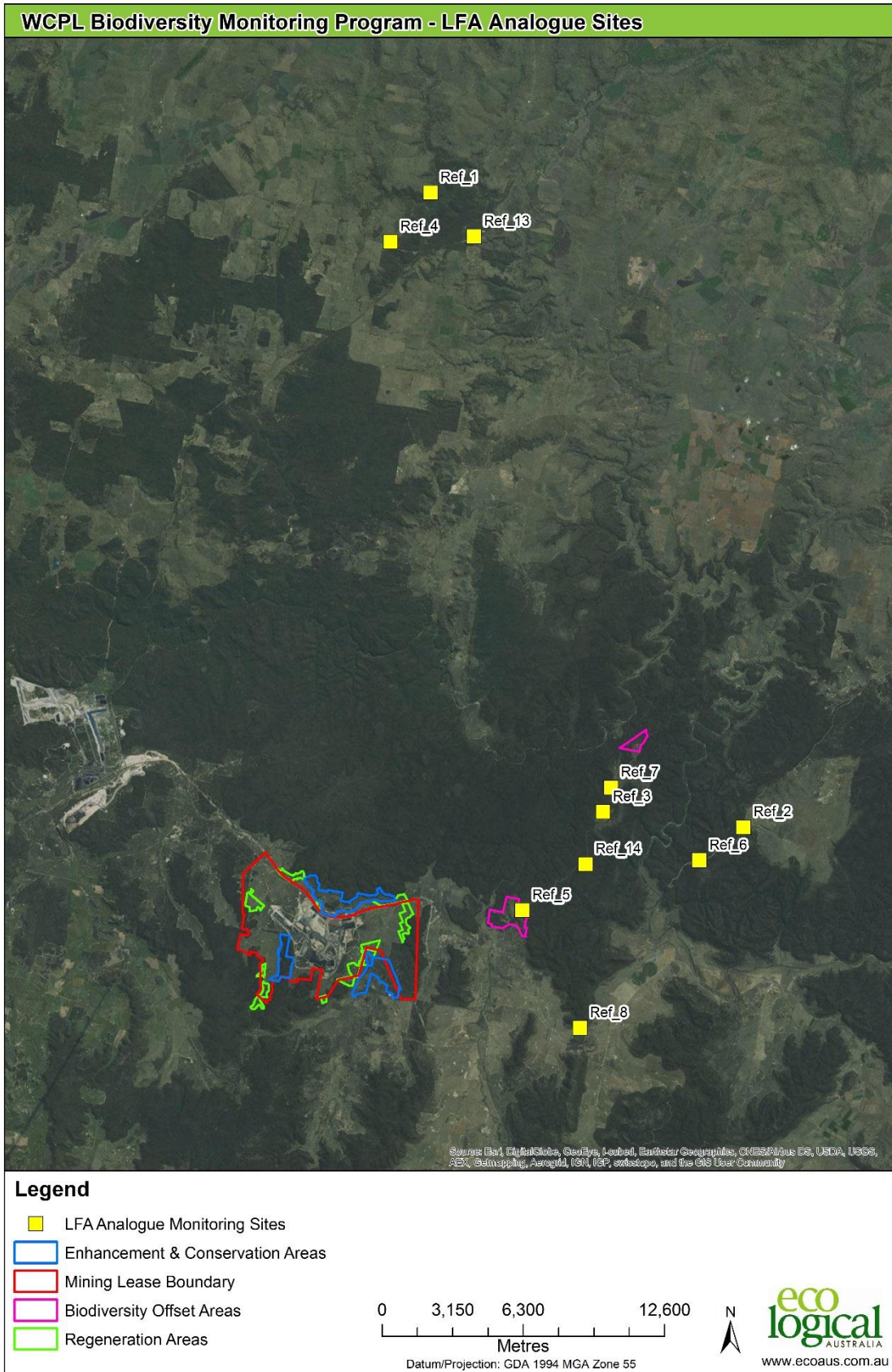


Figure 2-4: Spring 2015 LFA assessment reference sites

2.3 FAUNA

Fauna monitoring was undertaken over a two week period from the 17th November to the 22nd November and the 23rd November to the 27th November 2015. The surveys were conducted by Tomas Kelly, Melissa Bruton, Ranid May and Mitchell Scott of ELA.

Table 2-4 below outlines the methodology and survey effort for each target species, and is based upon the methods prescribed within the WCBMP. The WCBMP prescribed that 26 general fauna monitoring sites should be established to target birds and ground fauna (amphibians, ground mammals and reptiles) within the WCPL management domains. However, operational restrictions and poor weather conditions prevented all 26 general fauna monitoring sites from being established. The monitoring sites surveyed were, therefore, reduced to 21 general fauna monitoring sites and four sites only targeting birds. The four bird sites were located in grassland and it was determined that the use of pit fall traps targeting ground fauna in these locations were not appropriate due to the location and inclement weather that was experienced during the week of survey (**Table 2-5** and **Figure 2-5**). One site required within the WCBMP was removed from the program due to access issues as a result of continued mining operations (relocation of access to a mining pit) at ECA-C.

Microbat monitoring was undertaken at a selected number of monitoring sites within the WCPL management domains as required by the WCBMP. Six monitoring sites were surveyed in conjunction with the general fauna monitoring activities (**Table 2-5** and **Figure 2-5**). Anabat analysis was undertaken by ELA ecologist Alicia Scanlon. The WCBMP also required that six reference sites be surveyed for microbats; however, these sites were not surveyed during spring 2015. These reference sites will be established during autumn 2015, with reference sites aligned to similar vegetation (as a result of the spring floristic monitoring) of the six monitoring sites located within the WCPL management domains.

Opportunistic fauna sightings, including fauna evidence such as scats or tracks were also recorded across all fauna monitoring sites.

Table 2-5: Fauna monitoring methods summary

Target species	Fauna site	Methodology	Total Survey Effort
Birds	General fauna	Bird census consisting of 10 minutes recording all birds seen/heard within 50 m radius of central plot point, and further 10 minutes recording all birds seen/heard within balance of a 2 ha plot.	80 minutes per site (20 minutes per survey, per person, per site), over two mornings (25 sites)
Ground fauna (amphibians, mammals, reptiles)	General fauna	Pit fall/funnel trap line of 30 m drift fence and five 20 L buckets/10 funnel traps spaced 5 m apart covering both sides of the drift fence.	Twice daily inspections of traps (morning and afternoon) for five days (25 sites)
Bats	Bat	Automated ultrasonic acoustic recording (Anabat) to identify all bat species occurring.	Recording for 4 Anabat nights (6pm – 6am) (6 sites)
All	Opportunistic	Any sightings of fauna recorded whilst moving throughout the Project Area and located using a GPS.	Opportunistic

Target species	Fauna site	Methodology	Total Survey Effort
Mammals	Opportunistic	Opportunistic collection of scats and observations of tree scratching's, animal tracks and paw prints.	Opportunistic

Table 2-6: Fauna monitoring site locations

Site	Management Domain	Fauna Monitoring			Easting	Northing
		General Fauna	Birds only	Microbats		
D_100	BOA-D	x			784857	6427722
D_101	BOA-D	x			784306	6427422
D_103	BOA-D	x		x	784083	6427173
E_100	BOA-E	x			778299	6419408
E_104	BOA-E	x		x	779148	6419734
E_106	BOA-E	x			778854	6420399
A_100	ECA-A	x			771861	6416276
A_102	ECA-A	x			772926	6417078
A_104	ECA-A	x		x	773695	6416293
B_100	ECA-B	x			770111	6420997
B_101	ECA-B	x		x	770542	6420592
B_103	ECA-B	x			771072	6420157
B_105	ECA-B		x		773141	6420468
C_100	ECA-C	x		x	768682	6418083
C_101	ECA-C	x			768377	6416929
C_102	ECA-C	x			768940	6417281
R1_101	Regeneration Area 1	x			774053	6419239
R3_100	Regeneration Area 3	x			770500	6415898
R4_100	Regeneration Area 4		x		770347	6420268
R5_100	Regeneration Area 5		x		769191	6421422
R5_101	Regeneration Area 5		x		769500	6421595
R6_101	Regeneration Area 6	x			767406	6420303
R7_100	Regeneration Area 7	x		x	767907	6416557
R7_101	Regeneration Area 7	x			767446	6415726
R6	Rehabilitation Area	x			769562	6419517
R9	Rehabilitation Area	x			769118	6418973

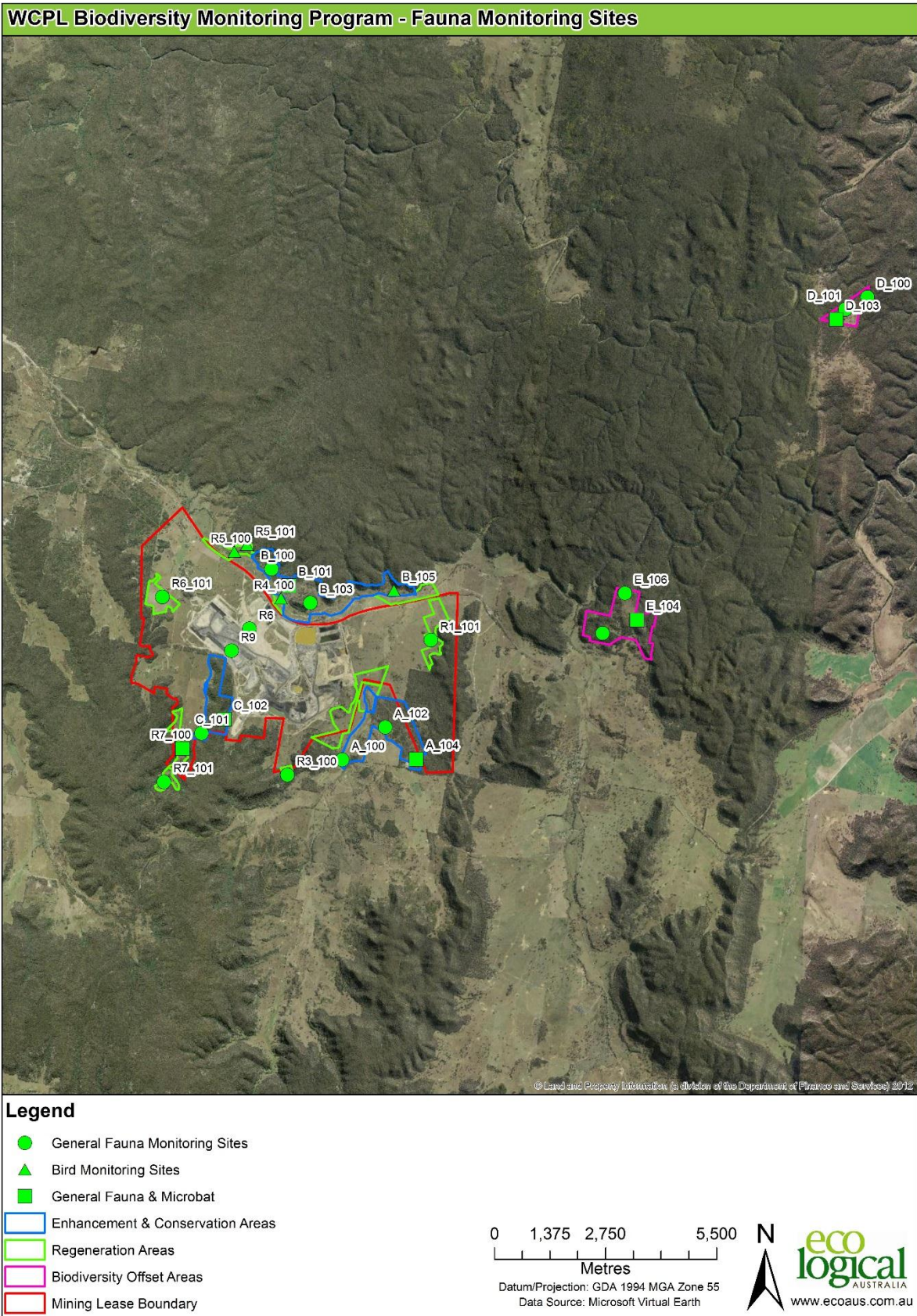


Figure 2-5: Spring 2015 fauna monitoring sites

2.4 WEATHER CONDITIONS

Weather conditions in the three months preceding the monitoring period (August-October) were relatively warm, with above average minimum temperatures recorded during October and slightly above average maximum temperatures recorded during August, September and October.

Rainfall was variable in the three months preceding the monitoring period with above average rainfall occurring in August and October, whilst September recorded well below average rainfall. Successive significant rainfall events were recorded in early November and mid-late December resulting in above average total monthly rainfall for these months (**Table 2-6**).

Temperature and wind data were taken from the WCPL weather station, with historical averages taken from the Gulgong Post Office Bureau of Meteorology (BOM) station (BOM, 2015a). Rainfall data was recorded at the WCPL weather station (August-December 2015) and the Wollar (Barrigan St) BOM station (BOM, 2015b).

Table 2-7: 2015 monthly mean and historical average weather conditions

Month	2015 Monthly Mean		Total Rainfall (mm)	Historical Averages		
	Min Temp (°C)	Max Temp (°C)		Min Temp (°C)	Max Temp (°C)	Rainfall Median (mm)
August	3.0	16.6	53.8	3.4	16.5	41.9
September	4.7	20.0	7.8	6.1	19.8	39.1
October	11.8	27.4	61.0	9.3	23.7	49.5
November	14.6	28.4	59.0	12.3	26.8	52.0
December	15.4	30.0	118.4	14.9	29.7	52.8

Weather conditions that occurred during the spring 2015 monitoring program (**Table 2-8**) were considered suitable for both fauna and flora surveys. Temperatures recorded during the undertaking of the monitoring were very warm, with 13 of 16 days exceeding the long-term maximum temperature average. Conditions were extremely dry with only 0.2 mm of rainfall recorded. Wind conditions were ideal throughout the monitoring program, characterised by calm to light winds.

Table 2-8: Weather conditions during the 2015 Spring Biodiversity Monitoring Program

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Average Wind Speed (km/hr)
17 November 2015	9.6	28.3	0.0	0.3
18 November 2015	10.6	33.7	0.0	3
19 November 2015	13.7	37.3	0.0	1.9
20 November 2015	14.7	38.1	0.0	4.0
21 November 2015	17.7	32.2	0.0	1.1
22 November 2015	16.9	27.1	0.0	3.3
23 November 2015	12.4	28.6	0.0	2.1
24 November 2015	16.1	30.3	0.0	0.3
25 November 2015	11.4	34.3	0.0	2.2
26 November 2015	15.5	34.9	0.0	4.5
27 November 2015	16.3	28.3	0.0	1.8
30 November 2015	11.7	32.9	0.0	1.7
1 December 2015	12.2	36.5	0.0	2.9

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Average Wind Speed (km/hr)
2 December 2015	16.8	27.3	0.2	1.5
3 December 2015	15.0	23.3	0.0	4.8
4 December 2015	13.4	27.0	0.0	3.3

Annual rainfall data for the past three years is shown in **Table 2-9**. During 2015, above average rainfall was recorded, with the rainfall that occurred during the months when the monitoring program was undertaken, significantly exceeding the historical mean.

Table 2-9: Monthly Rainfall from 2013 – 2015 (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2013	73.6	54.2	61.4	12.2	17.4	77.9	20.8	6.6	33.0	8.8	78.6	27.6	472.1
2014	15.6	60.0	112.6	62.8	13.8	29.8	28.6	28.8	14.6	15.4	24.4	126.7	533.1
2015	127.6	11.6	9.4	108.4	42.8	42.8	38.0	53.8	7.8	61.0	59.0	118.4	680.6
Historical Mean	66.7	63.1	55.2	39.5	37.7	44.0	42.5	41.3	40.3	51.1	56.1	59.0	587.7

3 Results & discussion

3.1 FLORISTIC MONITORING

A full list of all flora species recorded during the spring 2015 biodiversity monitoring program is included in **Appendix A**.

3.1.1 Species richness

A total of 426 species (317 native species and 109 exotic species) were recorded across all floristic monitoring sites during the spring 2015 survey, with total species ranging from 17 to 70 species within individual sites.

Higher native species richness was associated with reference sites, along with sites located within BOAs. Native species richness within the ECA sites reflected their varied condition, with sites located in remnant bushland recording high native species numbers, whilst exotic species dominated sites located within regenerating paddocks. Monitoring sites located within the Regeneration and Rehabilitation management domains recorded relatively poor native species richness, reflecting the initial stage of their current management under the WCBMP.

3.1.2 Vegetation structure

Vegetation structural data, incorporating the height range and percent foliage cover of all structural layers within each monitoring site is presented in **Appendix B**.

Generally, sites located within the BOAs and ECAs demonstrated complex vegetation structure with native species present in multiple stratum. Sites within Regeneration and Rehabilitation management domains recorded lower scores due to the absence of canopy and mid-storey species and an abundance of exotic species within the ground cover layer. Despite this, the majority of Regeneration and Rehabilitation sites exceeded the relevant Interim Performance Targets for vegetation structure, established in the WCBMP.

3.1.3 Exotic species

A total of 109 exotic species were recorded within floristic plots during spring 2015 monitoring. Of these, four are declared noxious weeds within the Mid-Western Regional Council area:

- *Heliotropium amplexicaule* (Blue Heliotrope) at site R2_101 within Regeneration Area 2;
- *Rosa rubiginosa* (Sweet briar) at site R1_C within Regeneration Area 1;
- *Hypericum perforatum* (St Johns Wort) at reference site R2_C, Regeneration sites R1_101, R1_C, R4_100, R5_101, R7_101, Rehabilitation sites R10 and R11, site E104 in BOA-E and sites B101 and B105 in ECA-B.
- *Senecio madagascariensis* (Fireweed) at Rehabilitation sites R5_C and R8 and site D102 within BOA-D.

3.1.4 Rehabilitation sites – cattle monitoring plots

Following the establishment of floristic monitoring sites during spring 2015, a trial management program will be undertaken across sites R1_C, R2_C, R3_C and R5_C in order to gauge the ability of cattle grazing to manage exotic grass species. Cattle will be released onto sites R1_C and R5_C, with cattle

excluded from the remaining two sites for reference. These sites have been progressively rehabilitated with sites R1_C and R2_C seeded in 2008 and sites R3_C and R5_C seeded in 2014.

During spring 2015 floristic monitoring, sites R1_C and R2_C contained both regenerating overstorey and midstorey native species. A range of eucalypt species form the overstorey regeneration with a height range of 2 - 6 m. Midstorey regeneration is dominated by *Acacia* species with various other native species present, including *Cassinia arcuata* and *Pultenaea cinerascens*. No overstorey or midstorey regeneration is present within sites R3_C and R5_C due to their early stage of rehabilitation. The groundcover layer at all four sites is dominated by exotic species, particularly exotic grass species including *Bromus catharticus*, *Eragrostis curvula* and *Phalaris aquatica*.

Two noxious weed species were recorded at sites R1_C and R2_C *Hypericum perforatum* and *Rubus fruticosus* (Species complex). *Senecio madagascariensis* was also found at site R5_C. The presence of these species will require active management in line with legislative requirements. WCPL should be aware that *Senecio madagascariensis* may be spread by cattle and other animal movement.

These four sites will be monitored following the completion of the trial cattle management program.

3.1.5 Assessment against Interim Performance Target

Table 3-1 displays BioMetric site attribute results for all sites across the BOAs, ECAs, Regeneration and Rehabilitation management domains and their ranking against Interim Performance Targets for Year 0 (Baseline). The overall performance of the monitoring sites against the Interim Performance Targets for Year 0 is good, with the majority of sites either exceeding or on par with the Interim Performance Targets. Native Overstorey Cover targets for Year 0 are relatively low, therefore, sites that have a canopy or regenerating canopy (specifically within the BOAs and ECAs) illustrate a higher current cover percentage than that established for the Year 0 Interim Performance Target.

Table 3-2 displays BioMetric site attribute results for all sites across BOAs, ECAs, Regeneration and Rehabilitation management domains and their ranking against benchmark targets (or overall Completion Criteria). As monitoring within the management domains continues over time and management actions are undertaken, this ranking against the overall targeted benchmark scores (**Table 3-2**) should become similar to **Table 3-1**.

Table 3-1: Assessment against Interim Performance Targets (Year 0 (Baseline))

Site	Site attributes (% cover)										
	Vegetation condition	NSR	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH	OR	FL (M)
D100	MOD-GOOD	27	7	20.5	6	16	20	0	0	1	27
D102	MOD-GOOD	60	12	0	38	0	50	6	0	0	12
E101	MOD	57	4	10.5	68	6	28	10	0	1	6
E102	LOW	28	0	0	34	0	14	88	0	0	0
E104	MOD-GOOD	35	21	0	44	0	28	22	1	1	14
A100	LOW	4	0	0	0	0	4	100	0	0	0
A104	MOD-GOOD	38	15.5	6	20	0	4	0	0	1	138
B100	GOOD	24.5	6.1	18	4	2	0	0	0	0.75	15
B101	MOD-GOOD	36	0	0	34	0	18	20	0	0	0
B105	LOW	8	0	0	6	0	8	90	0	0	0
C100	GOOD	24	26	9.7	2	8	8	0	1	0.75	33
C102	MOD-GOOD	48	13	2.5	8	4	6	0	0	0.75	84

Site	Site attributes (% cover)										
	Vegetation condition	NSR	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH	OR	FL (M)
R1_101	LOW	32	0	0	16	0	16	48	0	0	0
R1_C	LOW	16	12	1.1	0	0	0	85	0	0.75	0
R2_101	LOW	12	0	0	40	0	12	74	0	0	0
R4_100	LOW	7	0	0	0	0	8	68	0	0	0
R5_101	LOW	25	0	0	72	0	8	26	0	0	0
R7_101	MODERATE	33	0	0	50	2	20	24	0	0.75	5
R9_100	MOD-GOOD	59	0	15	58	12	8	0	0	0	0
R5_C	LOW	3	0	0	0	0	2	60	0	0	0
R8	LOW	11	0	0	2	0	14	94	0	0	0
R10	LOW	18	0	0	12	0	4	48	0	0	12
R11	LOW	20	0	0	6	0	20	86	0	0	2.2
R2_C	LOW	15	0.6	4.5	0	0	0	74	0	1	0
R3_C	LOW	16	0	0	6	0	14	76	0	0	0

NSR = Native Plant Species Richness, NOC = Native Over-storey Cover, NMC = Native Mid-storey Cover, NGCG = Native Ground Stratum Cover (grasses), NGCS = Native Ground Stratum Cover (shrubs), NGCO = Native Ground Stratum Cover (other), EC = Exotic Plant Cover, NTH = Number Of Trees With Hollows, OR = Over-storey Regeneration and FL = Total Length of Fallen Logs

Table 3-2: Assessment against Benchmark Targets

Site	Site attributes (% cover)										
	Vegetation condition	NSR	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH	OR	FL (M)
D100	MOD-GOOD	27	7	20.5	6	16	20	0	0	1	27
D102	MOD-GOOD	60	12	0	38	0	50	6	0	0	12
E101	MOD	57	4	10.5	68	6	28	10	0	1	6
E102	LOW	28	0	0	34	0	14	88	0	0	0
E104	MOD-GOOD	35	21	0	44	0	28	22	1	1	14
A100	LOW	4	0	0	0	0	4	100	0	0	0
A104	MOD-GOOD	38	15.5	6	20	0	4	0	0	1	138
B100	GOOD	24.5	6.1	18	4	2	0	0	0	0.75	15
B101	MOD-GOOD	36	0	0	34	0	18	20	0	0	0
B105	LOW	8	0	0	6	0	8	90	0	0	0
C100	GOOD	24	26	9.7	2	8	8	0	1	0.75	33
C102	MOD-GOOD	48	13	2.5	8	4	6	0	0	0.75	84
R1_101	LOW	32	0	0	16	0	16	48	0	0	0
R1_C	LOW	16	12	1.1	0	0	0	85	0	0.75	0
R2_101	LOW	12	0	0	40	0	12	74	0	0	0
R4_100	LOW	7	0	0	0	0	8	68	0	0	0
R5_101	LOW	25	0	0	72	0	8	26	0	0	0
R7_101	MODERATE	33	0	0	50	2	20	24	0	0.75	5
R9_100	MOD-GOOD	59	0	15	58	12	8	0	0	0	0
R5_C	LOW	3	0	0	0	0	2	60	0	0	0
R8	LOW	11	0	0	2	0	14	94	0	0	0

Site	Site attributes (% cover)										
	Vegetation condition	NSR	NOC	NMS	NGCG	NGCS	NGCO	EC	NTH	OR	FL (M)
R10	LOW	18	0	0	12	0	4	48	0	0	12
R11	LOW	20	0	0	6	0	20	86	0	0	2.2
R2_C	LOW	15	0.6	4.5	0	0	0	74	0	1	0
R3_C	LOW	16	0	0	6	0	14	76	0	0	0

3.1.6 Discussion of flora monitoring results

The spring 2015 floristic monitoring established 37 permanent BioMetric survey plots. Baseline data was collected in these plots; the trajectory of change over time will be compared to baseline data during implementation of the WCBMP.

Sites across all management domains generally scored higher than the Interim Performance Targets. All sites met targets in a minimum of 7 (out of 10) site attribute scores, with 5 sites achieving targets in all 10 (**Table 3-1**). Site attributes that often did not meet Interim Performance Targets were exotic ground cover, native ground cover grasses and overstorey regeneration. This was particularly evident at disturbed sites across all management domains.

Low scores for native midstorey and shrub ground cover reflects the widespread clearing that has occurred across monitoring sites, as well as the naturally low occurrence of midstorey and shrub species in certain vegetation communities (grassy woodland).

The site attribute scores for reference sites are within the relative Interim Performance Target ranges outlined for High Condition vegetation in the WCBMP and thus, provide good benchmarks to guide management. Further work will include determining correspondence between floristic monitoring sites within management domains and any further reference sites required as a result of the requirements of the WCBMP, as well as the overall classification of these sites.

Previous monitoring undertaken on behalf of WCPL prior to the implementation of the WCBMP, utilised different methodology across different monitoring sites, to those used during spring 2015 baseline monitoring. As such, comparison of previous monitoring to that undertaken during spring 2015 is limited. Previous monitoring can however, be used as a broad reference for tracking progression of regeneration and rehabilitation at the management domain level.

Since the commencement of floristic monitoring in 2007 and 2011 respectively, disturbed areas within the ECA and Regeneration (formerly Regrowth areas) management domains have developed an increased ground cover species diversity as a result of the removal of grazing animals. Natural native tree regeneration across these disturbed areas has remained consistently low however, due to historical clearing and competition with exotic ground cover species. WCPLs Rehabilitation areas have demonstrated consistent development in ground cover, with an increased diversity of native species since monitoring commenced in 2009. Native midstorey and overstorey species have also increased in both coverage and diversity within the earlier Rehabilitation areas. Younger Rehabilitation areas on the other hand, contain a high percentage of exotic species which will likely continue whilst midstorey and overstorey species develop.

3.2 LANDSCAPE FUNCTION ANALYSIS

The Landscape Organisation Index (LOI) and Soil Surface Assessment (SSA) indices presented below form baseline data used to track site performance throughout successive monitoring periods.

In terms of interpreting the LFA results, the LOI provides a proportion of the transect occupied by patches - patches being landscape elements that are relatively permanent and provide stable, resource accumulating structures, such as grassy tussocks, ground cover and logs. Therefore, a higher LOI implies a more stable transect that is less prone to erosion.

The SSA results go one step further than this and provide an index (0-100) on slope stability, soil infiltration and nutrient cycling for the whole of landscape (transect). The WCBMP has established Completion Criteria for a self-sustaining landform to be achieved when a score of 50 or more for SSA is recorded. The WCBMP states that incremental improvement (an increase of 5 or more annually) is anticipated, with achievement of Completion Criteria by Year 10.

3.2.1 Biodiversity Offset Areas (BOAs)

One LFA transect was established within the BOA Management Domain, site E_105 (see **Figure 2-3**). LOI and SSA results are displayed below in **Table 3-3**.

The LOI of 1.00 achieved at this site indicates that the entire transect is occupied by patches. Slope Stability and Nutrient Cycling indices have exceeded Completion Criteria (>50) whilst Soil Infiltration remains below Completion Criteria.

Table 3-3: Landscape Organisation and Soil Surface Assessment results for BOA transects

Site	Landscape Organisation Index	Soil Surface Assessment		
		Stability	Infiltration	Nutrients
E_105	1.00	57.9	45.0	54.8

3.2.2 Enhancement and Conservation Areas (ECAs)

Two LFA transects were established within the ECA Management Domain; site A_100 within ECA-A and site B_106 within ECA-B (see **Figure 2-3**). LOI and SSA results are displayed below in **Table 3-4**.

Both sites recorded a LOI of 1.00 indicating that the entire transects are located within patches. All SSA indices for site A_100 are exceeding Completion Criteria whilst for site B_106, only Slope Stability is above Completion Criteria.

Table 3-4: Landscape Organisation and Soil Surface Assessment results for ECA transects

Site	Landscape Organisation Index	Soil Surface Assessment		
		Stability	Infiltration	Nutrients
A_100	1.00	58.5	54.8	57.8
B_106	1.00	55.5	43.0	41.3

3.2.3 Regeneration Areas

Three LFA transects were established within the Regeneration Area Management Domain, site R1_100 within Regeneration Area 1, site R4_100 within Regeneration Area 4 and site R6_101 within Regeneration Area 6 (see **Figure 2-3**). LOI and SSA results are displayed below in **Table 3-5**. All three sites recorded very high LOI scores. This indicates that each transect was almost entirely

comprised of patches. All 3 sites are exceeding Completion Criteria for Slope Stability. Soil Infiltration scores are below Completion Criteria for all 3 sites, along with Nutrient Cycling scores for all sites excluding R6_101.

Table 3-5: Landscape Organisation and Soil Surface Assessment results for Regeneration Area transects

Site	Landscape Organisation Index	Soil Surface Assessment		
		Stability	Infiltration	Nutrients
R1_100	0.99	57.1	44.9	33.2
R4_100	0.98	55.6	43.5	47.0
R6_101	0.98	56.7	43.2	50.1

3.2.4 Rehabilitation Areas

Seven LFA transects were established within the Rehabilitation Management Domain, site R5, R6, R8, R9, R10, R11 and R13 (see **Figure 2-3**). LOI and SSA results are displayed below in **Table 3-6**.

LOI scores for sites R5 – R10 are very high (0.85-0.99) indicating a dominance of patches along the respective transects. Sites R11 and R13 recorded noticeably lower LOI scores, particularly site R11 which recorded a score of only 0.07. Slope Stability scores for all sites were above the Completion Criteria, whilst Soil Infiltration and Nutrient Cycling indices were below for all sites with the exception of site R9 (only Soil Infiltration was below Completion Criteria).

Table 3-6: Landscape Organisation and Soil Surface Assessment results for Rehabilitation Area transects

Site	Landscape Organisation Index	Soil Surface Assessment		
		Stability	Infiltration	Nutrients
R5	0.85	57.6	30.6	28.4
R6	0.93	54.1	32.1	32.3
R8	0.88	52.2	46.4	43.8
R9	0.99	60.6	44.7	51.7
R10	0.98	56.4	32.5	37.7
R11	0.07	50.1	13.0	9.6
R13	0.67	54.9	24.6	34.9

3.2.5 Reference sites

Ten (10) LFA transects were established at local reference sites to provide comparative data to assist in guiding management of WCPLs management areas (see **Figure 2-4**). LOI and SSA results are displayed below in **Table 3-7**.

Both LOI and SSA scores for the reference sites have achieved the Completion Criteria and as such are considered to provide effective benchmarks for LFA sites within the various management domains.

Table 3-7: Landscape Organisation and Soil Surface Assessment results for Reference site transects

Site	Landscape Organisation Index	Soil Surface Assessment		
		Stability	Infiltration	Nutrients
BRGA23	0.95	53.8	64.9	62.2
GBNL130	0.98	57.6	63.7	60.7
GBNLIA25	0.95	51.9	78.2	58.4
GBNLSTR	0.96	52.4	83.2	63.3
GWBA20	1.00	56.6	63.9	58.4
IBBWDEAL	0.98	64.0	81.1	52.8
IBBWG29	0.99	52.6	70.2	54.4
IBBWG-EAL	0.88	51.2	80.8	58.7
NLIBOX2	0.98	55.5	66.3	62.9
WBSH27	0.89	52.5	64.2	61.1

3.2.6 Discussion of LFA monitoring results

LFA transects were established at 13 sites within the BOA, ECA, Regeneration and Rehabilitation Management Domains as well as 12 reference sites (see **Figure 2-3** and **Figure 2-4**).

All LFA sites have exceeded the Completion Criteria established in the WCBMP (minimum score of 50) for Slope Stability, with scores also comparable to scores from the reference sites monitored. With the exception of two Rehabilitation sites (R11 and R13), LOI scores were high and correspond well with scores from reference sites. High LOI scores indicate a stable, functioning landform covered by patches. LOI should be considered as only an indicator with correlation of these scores against vegetation data important in determining the species composition and structure, and to gain a more detailed understanding of the overall function of the site.

Scores for Soil Infiltration and Nutrient Cycling were much more variable and overall quite low compared to both Completion Criteria and reference site scores. Low Soil Infiltration and Nutrient Cycling scores are likely the result of historical clearing and livestock usage throughout the BOA, ECA and Regeneration sites. Low scores recorded within Rehabilitation sites are due to the compacted artificial soils in which the Rehabilitation areas are located.

Previous monitoring undertaken on behalf of WCPL prior to the implementation of the WCBMP, has not incorporated the use of LFA methodology, limiting the capacity for comparison with the results from spring 2015 baseline monitoring. Data captured during previous monitoring regarding ground coverage and erosion, can however be used as a broad reference for tracking progression of regeneration and rehabilitation at the management domain level.

Ground coverage in the form of living flora species, litter and rock material has been monitored within ECA areas since 2007, Rehabilitation areas since 2009 and Regeneration areas (formerly Regrowth areas) since 2011. This data can be correlated with LOI data captured during spring 2015, with both data sets demonstrating consistently high scores since monitoring commenced. Similarly, low levels of erosion observed throughout previous monitoring (2007-2013), can be correlated with high SSA Stability scores recorded during spring 2015 monitoring. This combined data demonstrates the existence of consistently stable landforms across WCPL management domains.

3.3 FAUNA

During spring 2015, 119 individual fauna species were recorded, comprising two amphibian, 12 mammal, 17 reptile, 74 bird and 14 microchiropteran bat species. Of the species recorded, eight introduced species were identified along with eight species listed as vulnerable under the TSC Act, including one listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Threatened fauna species recorded during monitoring are listed below in **Table 3-8**.

Table 3-8: Threatened fauna recorded

Assemblage	Scientific Name	Common Name	Site Recorded	TSC Act Listed	EPBC Act Listed
Microchiropteran Bat	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	A_104	x	x
	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	A_104 D_103	x	
	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	A_104	x	
	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	D_103	x	
Birds	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper	D_100 D_101 D_103 E_104	x	
	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	D_103	x	
	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	R7_101	x	
	<i>Stagonopleura guttata</i>	Diamond Firetail	R7_101	x	

3.3.1 Biodiversity Offset Area D (BOA-D)

Across the monitoring sites within this domain, a total of 41 species were recorded, comprising 21 bird species, 5 mammal species, 5 reptile species and 10 microchiropteran bat species. All sites occur in remnant eucalypt and *Callitris* dominated dry sclerophyll forest which contains a range of habitat features suitable for supporting various fauna assemblages (**Table 3-9**).

Brown Treecreeper was recorded at all three monitoring sites within this BOA (**Table 3-8**). The presence of this species within this site is consistent with local records and reflects its preferred woodland habitat (ALA, 2016). Grey-crowned Babbler was recorded at one site within this BOA, D_103. Two threatened microchiropteran bat species were recorded at site D103, the Eastern Bentwing Bat and Greater Broad-nosed Bat.

Oryctolagus cuniculus (Rabbit) scats were observed at site D_101; however, no further evidence of feral activity was recorded across the remaining monitoring sites in BOA-D.

Table 3-9: Habitat features at BOA-D fauna monitoring sites

Site Number	Habitat Features
D100	<p>High floristic and forage resource diversity. Abundant canopy and shrub layer foliage with minimal ground vegetation coverage. The presence of litter and fallen logs provides good habitat features for ground fauna. No surface water present.</p> <p>The site is adjacent to Goulburn River National Park and surrounded by significant tracts of remnant woodland.</p>
D101	<p>High floristic and forage resource diversity present with abundant canopy and shrub layer foliage. Abundant litter along with the presence of fallen logs provides good habitat features for ground fauna. Minimal rock coverage and no surface water available.</p> <p>The site is adjacent to Goulburn River National Park and surrounded by significant tracts of remnant woodland.</p>
D103	<p>High floristic and forage resource diversity. Dominant shrub layer vegetation with good canopy coverage (30%). Abundant litter and fallen logs provides good habitat features for ground fauna. No surface water present.</p> <p>The site is adjacent to Goulburn River National Park and surrounded by significant tracts of remnant woodland.</p>

3.3.2 Biodiversity Offset Area E (BOA-E)

Across the monitoring sites within this domain, a total of 40 species were recorded, comprising 29 bird species, 2 mammal species, 5 reptile species and 4 microchiropteran bat species. Site E100 is located within remnant dry sclerophyll forest with sites E104 and E106 located in remnant grassy woodland communities. All three fauna monitoring sites contain significant habitat features for a variety of fauna assemblages (**Table 3-10**).

Brown Treecreeper was recorded at site E104. No evidence of feral animal activity was recorded within BOA-E during the monitoring period.

Table 3-10: Habitat features at BOA-E fauna monitoring sites

Site Number	Habitat Features
E100	<p>High floristic and forage resource diversity present with abundant canopy and shrub layer foliage. Litter, fallen logs and abundant rock coverage (70%) provides good habitat features for ground fauna. No surface water present.</p> <p>The site is located immediately south of Goulburn River National Park and is surrounded by significant patches of remnant native vegetation.</p>
E104	<p>Moderate floristic and forage resource diversity dominated by ground cover vegetation (99%). Limited litter, rock and fallen log coverage on ground. No surface water present.</p> <p>The site is located immediately south of Goulburn River National Park and is surrounded by significant patches of remnant native vegetation.</p>

Site Number	Habitat Features
E106	<p>Moderate floristic and forage resource diversity with dominant ground vegetation layer. Limited presence of litter, fallen logs and rocks. No surface water present. Abundant rock cover with only limited presence of litter and fallen logs. Large dam located on periphery of site.</p> <p>The site is located immediately south of Goulburn River National Park and is surrounded by significant patches of remnant native vegetation.</p>

3.3.3 Enhancement and Conservation Area A (ECA-A)

Across the monitoring sites within this domain sites A100 and A102 are located within regenerating paddocks whilst A104 is located in remnant *Callitris* forest with abundant lichen coverage in the ground layer. Landscape features within ECA-A provide habitat for a range of fauna assemblages (**Table 3-11**).

A total of 46 species were recorded, comprising 26 bird species, 5 mammal species, 3 reptile species and 12 microchiropteran bat species.

Three threatened microchiropteran bat species were recorded at site A100 during the monitoring period, the Eastern Bentwing Bat, Large-eared Pied Bat and the Yellow-bellied Sheath-tail Bat. Introduced fauna species were recorded at all three sites, comprising one bird species *Sturnus vulgaris* (Common Starling) and two mammals *Sus scrofa* (Pig) and Rabbit.

Table 3-11: Habitat features at ECA-A fauna monitoring sites

Site Number	Habitat Features
A100	Low floristic and forage resource diversity as site is situated in a cleared paddock with no canopy or shrub layer foliage. No surface water present.
A102	Low floristic and forage resource diversity as site is situated in a cleared paddock with no canopy or minimal shrub layer foliage. Rocks and fallen logs absent. No surface water present.
A104	High floristic and forage resource diversity dominated by abundant canopy coverage (70%). Shrub layer present with abundant litter coverage over ground. The presence of fallen logs and abundant lichen coverage adds further habitat value to the site.

3.3.4 Enhancement and Conservation Area B (ECA-B)

Landscape features present within ECA-B provide habitat for a range of fauna assemblages (**Table 3-12**). ECA-B is located immediately south of Goulburn River National Park, providing enhanced habitat values for the area through landscape connectivity. Sites B101 and B105 are located within regenerating paddocks whilst B100 and B103 are located in remnant eucalypt/*Callitris* forest.

A total of 43 species were recorded, comprising 33 bird species, 6 mammal species and 4 reptile species. No threatened fauna species were recorded within ECA-B during the monitoring period. Introduced fauna species were recorded at site B101, comprising one bird species (Common Starling) and two mammals (Pig and Rabbit).

Table 3-12: Habitat features at ECA-B fauna monitoring sites

Site Number	Habitat Features
B100	High floristic and forage resource diversity with abundant canopy, shrub and ground layer cover. Litter cover and the presence of fallen logs provides further habitat values for ground fauna. No surface water present.
B101	Moderate floristic and forage resource diversity with only limited canopy coverage but abundant shrub and ground layer coverage. Dam located on southern border of the site.
B103	High floristic and forage resource diversity with dominant canopy coverage (80%). The site is located on a rocky ridge which combined with the presence of fallen logs and litter coverage, provides good habitat features for ground fauna. No surface water present.
B105	Low floristic and forage resource diversity as site has been extensively cleared. A creek line borders the southern and western edges of the site which contain bulrushes and some canopy coverage.

3.3.5 Enhancement and Conservation Area C (ECA-C)

Across the monitoring sites within this domain, landscape features provide habitat for a range of fauna assemblages (**Table 3-13**). ECA-C is located adjacent to Munghorn Gap Nature Reserve which provides enhanced habitat values for the area through landscape connectivity. Site C101 is located within a regenerating paddock whilst site C102 is located in remnant eucalypt/*Callitris* forest.

A total of 35 species were recorded, comprising 25 bird species, 6 mammal species, 1 amphibian species and 3 reptile species. No threatened fauna species were recorded within ECA-C during the monitoring period. Introduced fauna species were recorded at both sites, comprising two mammal species (Rabbit at C102 and *Mus musculus* (Common House Mouse) at C101).

Table 3-13: Habitat features at ECA-C fauna monitoring sites

Site Number	Habitat Features
C101	Low floristic and forage resource diversity as site has been cleared. Limited litter, fallen log and rock cover. No surface water present.
C102	High floristic and forage resource diversity with abundant canopy, shrub and ground layer coverage. The site is located on a rocky ridge which combined with the presence of fallen logs and litter coverage, provides good habitat features for ground fauna. No surface water present.

3.3.6 Regeneration Area 1

Landscape features at site R1_101 provides habitat for a range of fauna assemblages (**Table 3-14**). The site is located within a regenerating paddock with a weed-dominated ground cover.

A total of 20 species were recorded, comprising 16 birds, three mammals and one reptile.

No threatened fauna species were recorded within Regeneration Area 1. Three introduced mammal species were recorded during monitoring which were *Vulpes vulpes* (Fox), Pig and *Lepus capensis* (Brown Hare).

Table 3-14: Habitat features at Regeneration Area 1 fauna monitoring site

Site Number	Habitat Features
R1_101	Low floristic and forage resource diversity as the site has been extensively cleared (no canopy or shrub layer present). Scattered rock cover provides habitat value across the site with small pools of water present in several rock cavities.

3.3.7 Regeneration Area 3

Site R3_100 within Regeneration Area 3 was located within a regenerating paddock with a weed-dominated ground cover (**Table 3-15**).

A total of 26 species were recorded, comprising 20 birds and 6 mammal species.

No threatened fauna species were recorded within Regeneration Area 1 during the monitoring period. Three introduced mammal species were recorded during monitoring which were the Fox, *Dama dama* (Fallow Deer) and Rabbit.

Table 3-15: Habitat features at Regeneration Area 3 fauna monitoring site

Site Number	Habitat Features
R3_100	Low floristic and forage resource diversity due to minimal canopy (2%) and shrub (5%) coverage. Limited presence of litter and rock cover. No surface water present on site.

3.3.8 Regeneration Area 4

One fauna monitoring site was established within Regeneration Area 4, site R4_100 during spring 2015. The site is located within a regenerating paddock with a weed-dominated ground cover (**Table 3-16**).

A total of 21 species were recorded, comprising 20 birds and 1 mammal species (**Appendix D**). Regeneration Area 4 is located south of Goulburn River National Park.

No threatened fauna species were recorded within Regeneration Area 4 during the monitoring period. One introduced bird species (Common Starling) was recorded during monitoring.

Table 3-16: Habitat features at Regeneration Area 4 fauna monitoring site

Site Number	Habitat Features
R4_100	Low floristic and forage resource diversity as the site has been extensively cleared. Creek lines border the site to the north and east.

3.3.9 Regeneration Area 5

Regeneration Area 5 is located immediately south of Goulburn River National Park which provides enhanced habitat values for the area through landscape connectivity. Both sites in this management domain are located within regenerating paddocks (**Table 3-17**).

A total of 34 species were recorded, comprising 30 birds, 1 reptile and 3 mammal species.

No threatened fauna species were recorded within Regeneration Area 5 during the 2015 Spring Biodiversity Monitoring Program. One introduced mammal species *Felis catus* (Cat) was recorded at site R5_101 with rabbit burrows and scats also visible at both sites.

Table 3-17: Habitat features at Regeneration Area 5 fauna monitoring sites

Site Number	Habitat Features
R5_100	Moderate floristic and forage resource diversity. Scattered canopy coverage, mostly on border of site. Creek along the southern and eastern edge of site with a large dam at the north of the site. Minimal litter and rock cover.
R5_101	Moderate floristic and forage resource diversity. Good canopy coverage, mostly on borders of site. Creek along the southern edge of site with a dam in the centre. Presence of litter, rocks and fallen logs provide good habitat features for ground fauna.

3.3.10 Regeneration Area 6

One fauna monitoring site was established within Regeneration Area 6, site R6_101 during spring 2015. The site is located within a regenerating paddock with a weed-dominated ground cover (**Table 3-18**).

A total of 13 species were recorded, comprising 12 birds and 1 mammal species.

No threatened fauna species were recorded within Regeneration Area 1 during the monitoring period. One introduced bird species (Common Starling) was recorded during monitoring.

Table 3-18: Habitat features at Regeneration Area 6 fauna monitoring site

Site Number	Habitat Features
R6_101	Low floristic and forage resource diversity due to absence of canopy and shrub cover. Minimal litter and rock cover present. Small dam situated in the eastern section of the site.

3.3.11 Regeneration Area 7

Landscape features within this management domain provide habitat for a range of fauna assemblages (**Table 3-19**). Regeneration Area 7 is located directly adjacent to the Munghorn Gap Nature Reserve which provides enhanced habitat values for the area through landscape connectivity. Both sites are located within regenerating paddocks.

A total of 29 species were recorded, comprising 20 bird, 7 reptile, 1 amphibian and 1 mammal species.

Two threatened fauna species were recorded within Regeneration Area 7 during the monitoring period, including the Gang-gang Cockatoo and Diamond Firetail. No introduced fauna species were observed during monitoring, although Rabbits were evident (scats and diggings) at site R7_101.

Table 3-19: Habitat features at Regeneration Area 7 fauna monitoring sites

Site Number	Habitat Features
R7_100	Moderate floristic and forage resource diversity. Scattered canopy and shrub coverage across site. Litter, rock and fallen logs present within site. No surface water present.
R7_101	Moderate floristic and forage resource diversity. Scattered canopy and shrub coverage across site. Litter cover and fallen logs present within site. No surface water present.

3.3.12 Rehabilitation Areas

A total of 19 species were recorded within this management domain, comprising 14 bird, 3 reptile and 2 amphibian species. Sites R6 and R9 are surrounded by active mine operations which presents limitations to landscape connectivity and fauna dispersal (**Table 3-20**).

No threatened fauna species were recorded within Regeneration Area 7 during the monitoring period. Similarly, no introduced fauna species were recorded during monitoring.

Table 3-20: Habitat features at Rehabilitation Area fauna monitoring sites

Site Number	Habitat Features
R6	Moderate floristic and forage resource diversity due to abundant shrub and ground vegetation cover and presence of litter and rock coverage. No surface water present.
R9	Moderate floristic and forage resource diversity due to abundant shrub and ground vegetation cover and presence of litter, rock and fallen log coverage. No surface water present.

3.3.13 Fauna results discussion

Whilst survey effort varied across management domains, both fauna species diversity and abundance correlated positively with habitat condition and complexity (structural diversity, presence of hollows, presence of fallen logs). This was demonstrated through the high species counts and diversity recorded within BOA and ECA monitoring sites. Regeneration and Rehabilitation areas did not have such complexity and were often isolated from larger tracts of native vegetation.

The occurrence of introduced fauna species was negatively correlated with habitat quality, with disturbed sites in ECA, Regeneration and Rehabilitation Management Domains recording the highest numbers and diversity of introduced species.

Proximity to relatively intact remnants and patch size is likely to have influenced monitoring results, although this was not specifically measured. Several survey sites within ECA and Regeneration areas which contained relatively low habitat features but were close to Munghorn Gap National Park or Goulburn River National Park, recorded high bird observations. In contrast, isolated monitoring sites within Rehabilitation Areas (R6 and R9) which are surrounded by active mine operations, had low bird observations.

Fauna monitoring took place during a period of extreme heat, which is likely to have had some impact on the results. Diurnal bird surveys were restricted to mornings only limiting observations of species that may be more active during the late afternoon/dusk. Fauna traps were also closed during 4 of 5 days of the first week of monitoring for animal welfare reasons, limiting 'captures' of ground-dwelling fauna. Being the first year of monitoring, the impacts of these limitations on baseline data is unknown.

4 Recommendations

4.1 GENERAL RECOMMENDATIONS

To inform the recommendations for the offset areas, **Table 4-1** provides a review of the Interim Performance Targets, comments on the monitoring results and recommendations to direct monitoring to achieve the Interim Performance Criteria and progression towards the overall Completion Criteria.

Table 4-1: Review of monitoring results against Interim Performance Targets and recommendations

Interim Performance Target	Comment from results	Recommendations
Vegetation		
Interim Performance Targets are listed in the WCBMP for Western Slopes Dry Sclerophyll Forest and Western Slopes Grassy Woodlands based on vegetation condition. BioMetric site attributes scores are used as the basis for assessment.	All sites across the management domains are performing well in comparison to Interim Performance Targets. Sites where these targets are not being achieved can largely be attributed to high coverage of exotic species and historical clearing within these locations.	Widespread weed management is recommended across all Management Domains. This should be carried out in the form of selective herbicide use incorporating a pre-emergent herbicide to target in situ exotic seed stock. Targeted planting of native canopy species is also recommended to accelerate regeneration of this strata. These recommendations are in line with short term biodiversity management strategies outlined in the WCBMP. Further assessment of the correlation between floristic monitoring sites within management domains and reference sites is recommended. This will enable improved Interim Performance Targets and completion criteria that better reflect the individual sites.
The management of noxious weeds is listed as a priority in the WCBMP in accordance with the legal responsibility of WCPL under the <i>Noxious Weeds Act 1993</i> .	Noxious weed species were recorded in all Management Domains (see Section 3.1.3).	Targeted weed management is recommended. Noxious weed locations have been noted and their presence reviewed during future monitoring periods.
LFA		
Completion criteria for SSA indices (Slope Stability, Soil Infiltration and Nutrient Cycling) are listed in the WCBMP as a	Slope Stability is above completion criteria for all sites. Soil Infiltration and Nutrient Cycling scores are much more variable and well below completion criteria for the majority of sites.	Continue monitoring of sites. Annual improvement of >5 is the threshold for management intervention under the WCBMP.

Interim Performance Target	Comment from results	Recommendations
minimum score of 50.		
Fauna		
Landforms and vegetation structure within WCPL Management Domains are inhabited or frequented by local fauna.	A broad variety of species were recorded in monitoring sites across the various Management Domains. These results demonstrated that the condition of landforms and vegetation structure at the monitoring sites, including the surrounding environment, was a key factor in determining species numbers and diversity.	Continue monitoring fauna sites, targeting fauna groups such as birds and microbats. Birds and microbats are common and diverse throughout Australia. Due to the ease of surveying birds and microbats, they are regularly a focus of monitoring surveys and are analysed as an indicator of biodiversity. Comparison of bird and microbat assemblages can be undertaken and tracking of trends over time can indicate sites moving from.
Introduced feral species control is essential to environmental management works with targeted programs implemented.	Introduced feral species were observed throughout all Management Domains. Both carnivore and herbivore species were recorded.	Ongoing management of introduced species is recommended. Management methods are to be implemented as per the WCBMP and recommendations from this report. Control of herbivore populations should be prioritised within regeneration and rehabilitation areas to increase resilience.

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Appendix A: Flora species recorded within floristic monitoring sites, spring 2015

Family	Species Name	Common Name
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet
Adiantaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern
Adiantaceae	<i>Cheilanthes sieberi</i>	Mulga Fern
Adiantaceae	<i>Cheilanthes</i> sp.	
Amaranthaceae	<i>Alternanthera nana</i>	Hairy Joyweed
Amaranthaceae	<i>Alternanthera pungens</i> *	Khaki Weed
Amaranthaceae	<i>Alternanthera</i> sp.	
Anthericaceae	<i>Arthropodium minus</i>	
Anthericaceae	<i>Arthropodium</i> sp. A	
Anthericaceae	<i>Arthropodium</i> sp. B	
Anthericaceae	<i>Dichopogon fimbriatus</i>	Nodding Chocolate Lily
Anthericaceae	<i>Dichopogon strictus</i>	Chocolate Lily
Anthericaceae	<i>Dichopogon</i> sp.	
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily
Anthericaceae	<i>Thysanotus tuberosus</i>	Common Fringe Lily
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Rush-lily
Apiaceae	<i>Cyclospermum leptophyllum</i> *	Slender Celery
Apiaceae	<i>Daucus glochidiatus</i>	Australian Carrot
Apiaceae	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
Apiaceae	<i>Platysace ericoides</i>	Heath Platysace
Apiaceae	<i>Platysace</i> sp.	
Asteraceae	<i>Bidens bipinnata</i> *	Bipinnata Beggar's Ticks
Asteraceae	<i>Bidens subalternans</i> *	Greater Beggar's Ticks
Asteraceae	<i>Bidens</i> sp. *	
Asteraceae	<i>Brachyscome</i> sp.	
Asteraceae	<i>Calotis cuneata</i>	Mountain Burr-daisy
Asteraceae	<i>Calotis cuneifolia</i>	Purple Burr-daisy
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy
Asteraceae	<i>Carthamus lanatus</i> *	Saffron Thistle
Asteraceae	<i>Cassinia arcuata</i>	Sifton Bush
Asteraceae	<i>Cassinia cunninghami</i>	Cunninghams Everlasting
Asteraceae	<i>Cassinia quinquefaria</i>	
Asteraceae	<i>Cassinia uncata</i>	Sticky Cassinia

Family	Species Name	Common Name
Asteraceae	<i>Cassinia</i> sp.	
Asteraceae	<i>Centaurea melitensis</i> *	Cockspur Thistle
Asteraceae	<i>Centaurea solstitialis</i> *	St Barnaby's Thistle
Asteraceae	<i>Chondrilla juncea</i> *	Skeleton Weed
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting
Asteraceae	<i>Chrysocephalum semipapposum</i>	Clustered Everlasting
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle
Asteraceae	<i>Conyza bonariensis</i> *	Fleabane
Asteraceae	<i>Conyza</i> sp.*	Fleabane
Asteraceae	<i>Coronidium scorpioides</i>	Button Everlasting
Asteraceae	<i>Cymbonotus lawsonianus</i>	Bears Ears
Asteraceae	<i>Euchiton sphaericus</i>	
Asteraceae	<i>Euchiton</i> sp.	
Asteraceae	<i>Gamochaeta antillana</i> *	
Asteraceae	<i>Gamochaeta coarctata</i> *	
Asteraceae	<i>Gamochaeta</i> sp.*	
Asteraceae	<i>Hypochaeris glabra</i> *	Smooth Cats Ear
Asteraceae	<i>Hypochaeris radicata</i> *	Cats Ear
Asteraceae	<i>Lactuca saligna</i> *	Willow-leaved Lettuce
Asteraceae	<i>Lactuca serriola</i> *	Prickly Lettuce
Asteraceae	<i>Lactuca serriola</i> f. <i>serriola</i> *	
Asteraceae	<i>Lactuca</i> sp.*	
Asteraceae	<i>Lagenophora stipitata</i>	Common Lagenophora
Asteraceae	<i>Olearia viscidula</i>	Wallaby Weed
Asteraceae	<i>Ozothamnus</i> sp.	
Asteraceae	<i>Podolepis neglecta</i>	
Asteraceae	<i>Podolepis</i> sp.	
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed
Asteraceae	<i>Senecio pinnatifolius</i> var. <i>pinnatifolius</i>	Variable Groundsel
Asteraceae	<i>Senecio quadridentatus</i>	Cotton Fireweed
Asteraceae	<i>Senecio</i> sp.*	
Asteraceae	<i>Sigesbeckia orientalis</i>	Indian Weed
Asteraceae	<i>Sigesbeckia</i> sp.	
Asteraceae	<i>Solenogyne bellioides</i>	
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion
Asteraceae	<i>Tolpis barbata</i> *	Yellow Hawkweed
Asteraceae	<i>Tolpis umbellata</i> *	Milkwort
Asteraceae	<i>Triptilodiscus pygmaeus</i>	Common Sunray
Asteraceae	<i>Unknown</i> sp. L	
Asteraceae	<i>Unknown</i> sp. N*	
Asteraceae	<i>Unknown</i> sp. Q*	
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	Fuzzweed

Family	Species Name	Common Name
Asteraceae	<i>Vittadinia muelleri</i>	
Asteraceae	<i>Vittadinia</i> sp.	
Boraginaceae	<i>Cynoglossum australe</i>	
Boraginaceae	<i>Echium plantagineum</i> *	Paterson's Curse
Boraginaceae	<i>Echium vulgare</i> *	Vipers Bugloss
Boraginaceae	<i>Heliotropium amplexicaule</i> *	Blue Heliotrope
Brassicaceae	<i>Brassica</i> sp.*	
Brassicaceae	<i>Hirschfeldia incana</i> *	Hairy Brassica
Brassicaceae	<i>Lepidium africanum</i> *	
Brassicaceae	<i>Lepidium bonariense</i> *	
Brassicaceae	<i>Lepidium pseudohyssopifolium</i>	Peppergrass
Brassicaceae	<i>Lepidium</i> sp.*	
Brassicaceae	Unknown sp. R*	
Cactaceae	<i>Opuntia</i> sp.*	Prickly Pear
Campanulaceae	<i>Wahlenbergia luteola</i>	
Campanulaceae	<i>Wahlenbergia</i> sp.	
Caryophyllaceae	<i>Arenaria serpyllifolia</i> *	Thyme-leaved Sandwort
Caryophyllaceae	<i>Paronychia brasiliensis</i> *	Chilean Whitlow Wort
Caryophyllaceae	<i>Petrorhagia nanteuillii</i> *	
Caryophyllaceae	<i>Petrorhagia nautilus</i> *	
Caryophyllaceae	<i>Petrorhagia</i> sp.*	
Caryophyllaceae	<i>Polycarpon tetraphyllum</i> *	Four-leaved Allseed
Caryophyllaceae	<i>Polycarpon</i> sp.*	
Caryophyllaceae	<i>Silene gallica</i> *	French Catchfly
Caryophyllaceae	<i>Stellaria media</i> *	Common Chickweed
Caryophyllaceae	Unknown sp. G*	
Casuarinaceae	<i>Allocasuarina gymnanthera</i>	
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bullock
Casuarinaceae	<i>Allocasuarina</i> sp.	
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush
Chenopodiaceae	<i>Chenopodium album</i> *	Fat Hen
Chenopodiaceae	<i>Chenopodium carinatum</i>	Keeled Goosefoot
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush
Chenopodiaceae	<i>Einadia polygonoides</i>	
Chenopodiaceae	<i>Einadia trigonos</i>	Fishweed
Chenopodiaceae	<i>Einadia</i> sp.	
Chenopodiaceae	<i>Salsola australis</i>	
Clusiaceae	<i>Hypericum gramineum</i>	Small St Johns Wort
Clusiaceae	<i>Hypericum perforatum</i> *	St Johns Wort
Colchicaceae	<i>Wurmbea dioica</i>	Early Nancy
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed

Family	Species Name	Common Name
Convolvulaceae	<i>Dichondra</i> sp. A	Kidney Weed
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine
Cyperaceae	<i>Carex appressa</i>	Tall Sedge
Cyperaceae	<i>Carex inversa</i>	
Cyperaceae	<i>Carex</i> sp.	
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge
Cyperaceae	<i>Gahnia</i> sp.	
Cyperaceae	<i>Lepidosperma gunnii</i>	
Cyperaceae	<i>Lepidosperma laterale</i>	
Dilleniaceae	<i>Hibbertia acicularis</i>	
Dilleniaceae	<i>Hibbertia circumdans</i>	
Dilleniaceae	<i>Hibbertia monogyna</i>	
Dilleniaceae	<i>Hibbertia riparia</i>	
Epacridaceae	<i>Acrotriche rigida</i>	
Epacridaceae	<i>Acrotriche</i> sp.	
Epacridaceae	<i>Melichrus erubescens</i> *	Ruby Urn-heath
Epacridaceae	<i>Melichrus urceolatus</i>	Urn-heath
Epacridaceae	<i>Styphelia triflora</i>	Pink Five-Corners
Ericaceae	<i>Astroloma humifusum</i>	Native Cranberry
Ericaceae	<i>Brachyloma daphnoides</i>	Daphne Heath
Ericaceae	<i>Leucopogon muticus</i>	Blunt Neared-heath
Ericaceae	<i>Leucopogon</i> sp.	
Ericaceae	<i>Monotoca scoparia</i>	
Euphorbiaceae	<i>Chamaesyce drummondii</i>	Caustic Weed
Euphorbiaceae	<i>Phyllanthus hirtellus</i>	Thyme Spurge
Euphorbiaceae	<i>Phyllanthus occidentalis</i>	
Euphorbiaceae	<i>Phyllanthus virgatus</i>	
Euphorbiaceae	<i>Phyllanthus</i> sp.	
Euphorbiaceae	<i>Poranthera microphylla</i>	
Fabaceae	<i>Acacia difformis</i>	Drooping Wattle
Fabaceae	<i>Acacia doratoxylon</i>	Currawang
Fabaceae	<i>Acacia implexa</i>	Hickory Wattle
Fabaceae	<i>Acacia ixiophylla</i>	Sticky-leaved Wattle
Fabaceae	<i>Acacia leucolobia</i>	
Fabaceae	<i>Acacia linearifolia</i>	Narrow-leaved Wattle
Fabaceae	<i>Acacia montana</i>	Mallee Wattle
Fabaceae	<i>Acacia neriifolia</i>	Silver Wattle
Fabaceae	<i>Acacia penninervis</i>	Mountain Hickory
Fabaceae	<i>Acacia triptera</i>	Spur-wing Wattle
Fabaceae	<i>Acacia uncinata</i>	Round-leaved Wattle
Fabaceae	<i>Acacia verniciflua</i>	Varnish Wattle

Family	Species Name	Common Name
Fabaceae	<i>Acacia</i> sp.	
Fabaceae	<i>Bossiaea buxifolia</i>	
Fabaceae	<i>Chorizema parviflorum</i>	Eastern Flame Pea
Fabaceae	<i>Daviesia genistifolia</i>	Broom Bitter Pea
Fabaceae	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
Fabaceae	<i>Desmodium brachypodum</i>	Large Tick-trefoil
Fabaceae	<i>Desmodium varians</i>	Slender Tick-trefoil
Fabaceae	<i>Desmodium</i> sp.	
Fabaceae	<i>Glycine clandestina</i>	
Fabaceae	<i>Glycine tabacina</i>	
Fabaceae	<i>Gompholobium huegelii</i>	Pale Wedge Pea
Fabaceae	<i>Gompholobium virgatum</i>	Leafy Wedge Pea
Fabaceae	<i>Gompholobium</i> sp.	
Fabaceae	<i>Hardenbergia violacea</i>	False Sarsaparilla
Fabaceae	<i>Hovea apiculata</i>	
Fabaceae	<i>Hovea lanceolata</i>	
Fabaceae	<i>Kennedia</i> sp.	
Fabaceae	<i>Lotus australis</i>	Australian Trefoil
Fabaceae	<i>Medicago minima</i> *	Woolly Burr Medic
Fabaceae	<i>Medicago sativa</i> *	Lucerne
Fabaceae	<i>Medicago</i> sp.*	
Fabaceae	<i>Ornithopus compressus</i> *	Yellow Serradella
Fabaceae	<i>Oxylobium pulteneae</i>	Wiry Shaggy Pea
Fabaceae	<i>Podolobium ilicifolium</i>	Prickly Shaggy Pea
Fabaceae	<i>Pultenaea cinerascens</i>	
Fabaceae	<i>Swainsona monticola</i>	Notched Swainson-pea
Fabaceae	<i>Trifolium angustifolium</i> *	Narrow-leaved Clover
Fabaceae	<i>Trifolium arvense</i> *	Haresfoot Clover
Fabaceae	<i>Trifolium campestre</i> *	Hop Clover
Fabaceae	<i>Trifolium glomeratum</i> *	Clustered Clover
Fabaceae	<i>Trifolium scabrum</i> *	Rough Clover
Fabaceae	<i>Trifolium striatum</i> *	Knotted Clover
Fabaceae	<i>Trifolium</i> sp.*	
Fabaceae	<i>Zornia dyctiocarpa</i>	Zornia
Fabaceae	<i>Zornia</i> sp.	
Gentianaceae	<i>Centaurium erythraea</i> *	Common Centaury
Gentianaceae	<i>Centaurium</i> sp.*	
Geraniaceae	<i>Erodium crinitum</i>	Blue Storksbill
Geraniaceae	<i>Erodium</i> sp.*	
Geraniaceae	<i>Geranium solanderi</i> var. <i>solanderi</i>	Native Geranium
Geraniaceae	<i>Geranium</i> sp.	
Goodeniaceae	<i>Dampiera</i> sp.	
Goodeniaceae	<i>Goodenia hederacea</i>	Forest Goodenia

Family	Species Name	Common Name
Goodeniaceae	<i>Goodenia ovata</i>	Hop Goodenia
Goodeniaceae	<i>Goodenia pinnatifida</i>	
Goodeniaceae	<i>Goodenia rotundifolia</i>	
Goodeniaceae	<i>Goodenia</i> sp.	
Haloragaceae	<i>Gonocarpus elatus</i>	
Haloragaceae	<i>Haloragis heterophylla</i>	Rough Raspwort
Haloragaceae	<i>Haloragis</i> sp.	
Iridaceae	<i>Sisyrinchium</i> sp.*	
Juncaceae	<i>Juncus usitatus</i>	
Juncaceae	<i>Juncus</i> sp.*	
Lamiaceae	<i>Ajuga australis</i>	Austral Bugle
Lamiaceae	<i>Marrubium vulgare</i> *	White Horehound
Lamiaceae	<i>Mentha diemenica</i>	Slender Mint
Lamiaceae	<i>Mentha satureioides</i>	Creeping Mint
Lamiaceae	<i>Oncinocalyx betchei</i>	
Lamiaceae	<i>Salvia reflexa</i> *	Mintweed
Lamiaceae	<i>Salvia verbenaca</i> *	Vervain
Lamiaceae	<i>Scutellaria humilis</i>	Dwarf Skullcap
Lamiaceae	<i>Scutellaria mollis</i>	Soft Skullcap
Lauraceae	<i>Cassytha pubescens</i>	
Linaceae	<i>Linum marginale</i>	Native Flax
Linaceae	<i>Linum trigynum</i> *	French Flax
Linaceae	<i>Linum</i> sp.*	
Lomandraceae	<i>Lomandra confertifolia</i>	Mat Rush
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat Rush
Lomandraceae	<i>Lomandra glauca</i>	Pale Mat Rush
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat Rush
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat Rush
Lomandraceae	<i>Lomandra</i> sp.	
Loranthaceae	<i>Amyema miquelii</i>	
Loranthaceae	<i>Amyema</i> sp.	
Loranthaceae	<i>Mistletoe</i> sp.	
Malvaceae	<i>Brachychiton populneus</i>	Kurrajong
Malvaceae	<i>Modiola caroliniana</i> *	Carolina Mallow
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida
Malvaceae	<i>Sida cunninghamii</i>	Ridged Sida
Malvaceae	<i>Sida</i> sp.	
Myoporaceae	<i>Eremophila debilis</i>	Winter Apple
Myrsinaceae	<i>Anagallis arvensis</i> *	Scarlet Pimpernel
Myrtaceae	<i>Calytrix tetragona</i>	Common Fringe Myrtle
Myrtaceae	<i>Corymbia trachyphloia</i>	White Bloodwood
Myrtaceae	<i>Eucalyptus albens</i>	White Box

Family	Species Name	Common Name
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum
Myrtaceae	<i>Eucalyptus dwyeri</i>	Dwyer's Red Gum
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark
Myrtaceae	<i>Eucalyptus macrorhyncha</i>	Red Stringybark
Myrtaceae	<i>Eucalyptus microcarpa</i>	Grey Box
Myrtaceae	<i>Eucalyptus punctata</i>	Grey Gum
Myrtaceae	<i>Eucalyptus sparsifolia</i>	Narrow-leaved Stringybark
Myrtaceae	<i>Eucalyptus</i> sp. A	
Myrtaceae	<i>Eucalyptus</i> sp. B	
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush
Myrtaceae	<i>Leptospermum trinervium</i>	Slender Tea-tree
Myrtaceae	<i>Leptospermum</i> sp.	
Oleaceae	<i>Notelaea linearis</i>	
Onagraceae	<i>Oenothera mollissima</i> *	
Ophioglossaceae	<i>Ophioglossum</i> sp.	
Orchidaceae	<i>Microtis unifolia</i>	Common Onion Orchid
Orchidaceae	<i>Microtis</i> sp.	
Orchidaceae	<i>Orthoceras strictum</i>	Bird's-mouth Orchid
Orchidaceae	<i>Pterostylis</i> sp.	
Oxalidaceae	<i>Oxalis perennans</i>	
Oxalidaceae	<i>Oxalis</i> sp. A	
Oxalidaceae	<i>Oxalis</i> sp. B*	
Phormiaceae	<i>Dianella revoluta</i>	Blue Flax-Lily
Phormiaceae	<i>Dianella</i> sp.	
Pittosporaceae	<i>Billardiera scandens</i>	Hairy Apple Berry
Pittosporaceae	<i>Bursaria longisepala</i>	
Pittosporaceae	<i>Bursaria spinosa</i>	Blackthorn
Plantaginaceae	<i>Plantago debilis</i>	
Plantaginaceae	<i>Plantago gaudichaudii</i>	Narrow Plantain
Plantaginaceae	<i>Plantago hispida</i>	
Plantaginaceae	<i>Plantago lanceolata</i> *	Lamb's Tongue
Plantaginaceae	<i>Plantago varia</i>	
Plantaginaceae	<i>Plantago</i> sp.	
Poaceae	<i>Aira</i> sp.*	
Poaceae	<i>Aristida leichhardtiana</i>	
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass
Poaceae	<i>Aristida warburgii</i> .	
Poaceae	<i>Aristida</i> sp.	
Poaceae	<i>Arundinella nepalensis</i>	Reedgrass
Poaceae	<i>Austrostipa scabra</i>	Speargrass

Family	Species Name	Common Name
Poaceae	<i>Austrostipa scabra</i> subsp. <i>falcata</i>	
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass
Poaceae	<i>Austrostipa</i> sp.	
Poaceae	<i>Bothriochloa macra</i>	Red Grass
Poaceae	<i>Briza minor</i> *	Quaking Grass
Poaceae	<i>Bromus catharticus</i> *	Prairie Grass
Poaceae	<i>Bromus</i> sp.*	
Poaceae	<i>Chloris gayana</i> *	Rhodes Grass
Poaceae	<i>Chloris truncata</i>	Windmill Grass
Poaceae	<i>Cleistochloa rigida</i>	
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass
Poaceae	<i>Cynodon dactylon</i>	Couch
Poaceae	<i>Cynodon</i> sp.*	
Poaceae	<i>Dichanthium sericeum</i>	Queensland Bluegrass
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass
Poaceae	<i>Dichelachne</i> sp.	
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass
Poaceae	<i>Digitaria ramularis</i>	
Poaceae	<i>Digitaria</i> sp.*	
Poaceae	<i>Echinochloa crus-galli</i> *	Barnyard Grass
Poaceae	<i>Elymus scaber</i>	
Poaceae	<i>Enneapogon nigricans</i>	Nine-awn Grass
Poaceae	<i>Enteropogon acicularis</i>	
Poaceae	<i>Entolasia stricta</i>	Wiry Panic
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass
Poaceae	<i>Eragrostis curvula</i> *	African Lovegrass
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass
Poaceae	<i>Eragrostis</i> sp.	
Poaceae	<i>Eulalia aurea</i>	Silky Browntop
Poaceae	<i>Rytidosperma pallidum</i>	Red-anther Wallaby Grass
Poaceae	<i>Lachnagrostis filiformis</i>	Blown Grass
Poaceae	<i>Lolium perenne</i> *	Perennial Ryegrass
Poaceae	<i>Lolium rigidum</i> *	Wimmera Ryegrass
Poaceae	<i>Lolium</i> sp.*	
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass
Poaceae	<i>Panicum queenslandicum</i>	Coolabah Grass
Poaceae	<i>Panicum simile</i>	Two-colour Panic
Poaceae	<i>Panicum</i> sp.	
Poaceae	<i>Paspalidium distans</i>	
Poaceae	<i>Paspalidium gracile</i>	Slender panic
Poaceae	<i>Paspalidium</i> sp.	
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum

Family	Species Name	Common Name
Poaceae	<i>Pennisetum clandestinum</i> *	Kikuyu
Poaceae	<i>Phalaris aquatica</i> *	Phalaris
Poaceae	<i>Phalaris minor</i> *	Lesser Canary Grass
Poaceae	<i>Poa sieberiana</i> var. <i>sieberiana</i>	Snow Grass
Poaceae	<i>Poa</i> sp.	
Poaceae	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass
Poaceae	<i>Rytidosperma fulvum</i>	Wallaby Grass
Poaceae	<i>Rytidosperma monticola</i>	
Poaceae	<i>Rytidosperma pilosum</i>	Smooth-flower Wallaby Grass
Poaceae	<i>Rytidosperma racemosum</i>	
Poaceae	<i>Rytidosperma racemosum</i> var. <i>obtusatum</i>	
Poaceae	<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	
Poaceae	<i>Rytidosperma setaceum</i>	Smallflower Wallaby Grass
Poaceae	<i>Rytidosperma</i> sp.	
Poaceae	<i>Setaria parviflora</i> *	Pigeon Grass
Poaceae	<i>Setaria</i> sp.*	
Poaceae	<i>Sporobolus creber</i>	Western Rat's Tail Grass
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass
Poaceae	Unknown sp. J	
Poaceae	Unknown sp. P	
Poaceae	<i>Vulpia</i> sp.*	
Polygonaceae	<i>Acetosella vulgaris</i> *	Sorrel
Polygonaceae	<i>Persicaria prostrata</i>	Creeping Knotweed
Polygonaceae	<i>Polygonum aviculare</i> *	Wireweed
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock
Polygonaceae	<i>Rumex</i> sp.*	
Proteaceae	<i>Grevillea sericea</i> subsp. <i>sericea</i>	Pink Spider Flower
Proteaceae	<i>Hakea dactyloides</i>	Finger Hakea
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard
Ranunculaceae	<i>Clematis glycinoides</i>	Headache Vine
Rosaceae	<i>Acaena agnipila</i>	
Rosaceae	<i>Acaena ovina</i>	
Rosaceae	<i>Acaena</i> sp.	
Rosaceae	<i>Rosa rubiginosa</i> *	Sweet Briar
Rosaceae	<i>Rubus anglocandicans</i> *	Blackberry
Rubiaceae	<i>Asperula conferta</i>	Common Woodruff
Rubiaceae	<i>Galium divaricatum</i> *	Slender Bedstraw
Rubiaceae	<i>Galium leptogonium</i>	
Rubiaceae	<i>Galium</i> sp. B*	
Rubiaceae	<i>Opercularia diphylla</i>	
Rubiaceae	<i>Opercularia hispida</i>	Hairy Stinkweed

Family	Species Name	Common Name
Rubiaceae	<i>Opercularia</i> sp.	
Rubiaceae	<i>Pomax umbellata</i>	
Rubiaceae	<i>Richardia stellaris</i> *	
Rutaceae	<i>Boronia rubiginosa</i>	
Rutaceae	<i>Phebalium squamulosum</i> subsp. <i>gracile</i>	Scaly Phebalium
Rutaceae	<i>Zieria</i> sp.	
Santalaceae	<i>Exocarpos strictus</i>	
Sapindaceae	<i>Dodonaea triangularis</i>	
Sapindaceae	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	Sticky Hopbush
Sapindaceae	<i>Dodonaea</i> sp.	
Scrophulariaceae	<i>Verbascum thapsus</i> *	Great Mullein
Scrophulariaceae	<i>Verbascum virgatum</i> *	Twiggy Mullein
Scrophulariaceae	<i>Veronica plebeia</i>	Creeping Speedwell
Scrophulariaceae	<i>Veronica</i> sp.	
Solanaceae	<i>Solanum aviculare</i>	Kangaroo Apple
Solanaceae	<i>Solanum campanulatum</i>	
Solanaceae	<i>Solanum cinereum</i>	Narrawa Burr
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade
Solanaceae	<i>Solanum</i> sp.	
Stackhousiaceae	<i>Stackhousia monogyna</i>	Creamy Stackhousia
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia
Thymelaeaceae	<i>Pimelea curviflora</i>	
Thymelaeaceae	<i>Pimelea curviflora</i> var. <i>sericea</i>	
Thymelaeaceae	<i>Pimelea</i> sp.	
Urticaceae	<i>Urtica urens</i> *	Small Nettle
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop
Verbenaceae	<i>Verbena</i> sp.*	
Xanthorrhoeaceae	<i>Xanthorrhoea</i> sp.	Grass Tree
Zamiaceae	<i>Macrozamia communis</i>	Burrawang
Zamiaceae	<i>Macrozamia</i> sp.	
Zygophyllaceae	<i>Tribulus terrestris</i> *	Caltrop

*Denotes introduced species ^Denotes threatened species

Appendix B: Vegetation structure, dominant species and estimated cover and abundance for each stratum, spring 2015

Site number	Stratum	Lower height (m)	Upper height (m)	Percent cover (%)	Dominant species
A100	M1	0.3	1.3	1	<i>Verbena bonariensis</i> *
	M2	0.3	1	5	<i>Carthamus lanatus</i> *
	L1	0.3	0.6	40	<i>Plantago lanceolata</i> *
	L2	0	0.5	40	<i>Bromus catharticus</i> *
A104	U	20	25	10	<i>Eucalyptus crebra</i>
	M1	1.5	1.7	30	<i>Callitris endlicheri</i>
	M2	1	1.5	10	<i>Cassinia arcuata</i>
	L1	0	1	1	<i>Austrostipa scabra</i>
	L2	0	0.2	1	<i>Microlaena stipoides</i>
B100	U1	10	13	15	<i>Eucalyptus blakelyi</i>
	U2	10	13	10	<i>Eucalyptus melliodora</i>
	M1	1	2	2	<i>Cassinia arcuata</i>
	M2	3	6	2	<i>Eucalyptus melliodora</i>
	L1	0	0.1	5	<i>Microlaena stipoides</i>
	L1	0	0.5	5	<i>Aristida ramosa</i>
B101	L1	0	0.2	30	<i>Rytidospermum racemosum</i>
	L2	0	0.1	35	<i>Hypochaeris radicata</i> *
B105	L1	0	0.1	15	<i>Oxalis</i> sp.
	L2	0	0.3	20	<i>Hypochaeris radicata</i> *
C100	U1	12	16	10	<i>Eucalyptus fibrosa</i>
	U2	12	16	10	<i>Eucalyptus punctata</i>
	M1	1	2	2	<i>Cassinia cunninghamii</i> .
	M2	1	2	2	<i>Dodonaea viscosa</i> subsp <i>cuneata</i>
	L1	0	1	5	<i>Dodonaea viscosa</i> subsp <i>cuneata</i> .
	L2	0	0.2	5	<i>Einadia hastata</i> .
C102	U1	6	8	10	<i>Eucalyptus albens</i>
	U2	8	10	5	<i>Eucalyptus</i> sp.
	M1	4	6	10	<i>Acacia linearifolia</i>
	M2	0.3	1.2	5	<i>Astroloma</i> sp.
	L1	0	0.5	1	<i>Rytidosperma</i> sp.
	L2	0	0.3	1	<i>Lomandra</i> sp.
D100	U1	18	20	5	<i>Eucalyptus crebra</i>
	U2	6	8	35	<i>Callitris endlicheri</i>

Site number	Stratum	Lower height (m)	Upper height (m)	Percent cover (%)	Dominant species
	M1	0.5	1.2	30	<i>Acrotriche rigida</i>
	M2	2	3	10	<i>Kunzea ambigua</i>
	L1	0	0.1	1	<i>Cheilanthes sieberi</i>
	L2	0	0.1	1	<i>Goodenia hederacea</i>
D102	U1	10	12	5	<i>Eucalyptus albens</i>
	U2	4	6	1	<i>Brachychiton populneus</i>
	L1	0	0.1	15	<i>Dichondra sp.A</i>
	L2	0	0.3	10	<i>Microlaena stipoides</i>
E101	U1	7	8	2	<i>Eucalyptus dealbata</i>
	U2	10	12	2	<i>Callitris endlicheri</i>
	M1	1	2	10	<i>Cassinia arcuata</i>
	M2	1	3	1	<i>Eucalyptus dealbata</i>
	L1	0	0.2	20	<i>Microlaena stipoides</i>
	L2	0	0.3	10	<i>Aristida ramosa</i>
E102	L1	0	0.3	50	<i>Hypochaeris radicata*</i>
	L2	0	0.1	10	<i>Trifolium glomeratum*</i>
E104	U	8	15	15	<i>Eucalyptus albens</i>
	L1	0.3	1	40	<i>Aristida sp.</i>
	L2	0	0.1	25	<i>Dichondra sp.</i>
R1_101	L1	0.1	0.5	90	<i>Aristida vagans, Microlaena stipoides</i>
	L2	0.1	0.5	25	<i>Hypochaeris radicata*</i>
R1_CAT1	U1	3	4	5	<i>Eucalyptus sp.</i>
	U2	3	6	20	<i>Eucalyptus albens</i>
	M1	4	6	5	<i>Acacia linearifolia</i>
	M2	0.5	3.5	1	<i>Acacia leucolobia</i>
	L1	0.6	1	50	<i>Eragrostis sp.</i>
	L2	0.6	1.6	20	<i>Phalaris aquatic*</i>
R2_101	L1	0	0.4	20	<i>Hypochaeris radicata*</i>
	L2	0	0.5	30	<i>Austrostipa scabra</i>
R4_100	L1	0	0.5	15	<i>Carthamus lanatus*</i>
	L2	0	0.5	15	<i>Plantago lanceolata*</i>
R5_101	M1	0	0.2	20	<i>Hypochaeris radicata*</i>
	L1	0	0.5	55	<i>Aristida vagans</i>

Site number	Stratum	Lower height (m)	Upper height (m)	Percent cover (%)	Dominant species
	L2	0	0.2	20	<i>Microlaena stipoides</i>
R7_101	L1	0.1	0.2	60	<i>Microlaena stipoides</i>
	L2	0.3	0.4	25	<i>Aristida vagans</i>
R9_100	U1	5	6	5	<i>Eucalyptus</i> sp.
	U2	6	8	5	<i>Angophora floribunda</i>
	M1	1	2	70	<i>Cassinia arcuata</i>
	M2	0	0.5	20	<i>Gahnia</i> sp.
	L1	0	0.5	10	<i>Carthamus lanatus</i> *
	L2	0	0.5	10	<i>Plantago lanceolata</i> *
R5	L1	1	1.3	10	<i>Phalaris aquatica</i>
	L2	0.1	0.5	15	<i>Conyza</i> sp.
R8	L1	0	0.5	40	<i>Plantago lanceolata</i> *
	L2	0	0.5	30	<i>Lepidium</i> sp.*
R10	M1	0.5	1	15	<i>Chloris gayana</i> *
	L1	0.1	0.3	20	<i>Trifolium arvense</i> *
	L2	0.6	1.3	40	<i>Eragrostis curvula</i> *
R11	M1	1	1.5	1	<i>Cassinia arcuata</i>
	M2	1	1.5	1	<i>Acacia decurrens</i>
	L1	0	0.5	35	<i>Pennisetum clandestinum</i> *
	L2	0	1.3	10	<i>Phalaris aquatica</i> *

Appendix C: Fauna species recorded spring 2015

Group	Scientific Name	Common Name
Amphibian	<i>Crinia signifera</i>	Common Eastern Froglet
Amphibian	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog
Bird	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater
Bird	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
Bird	<i>Acanthiza nana</i>	Yellow Thornbill
Bird	<i>Acanthiza pusilla</i>	Brown Thornbill
Bird	<i>Acrocephalus australis</i>	Australian Reed Warbler
Bird	<i>Alectura lathamii</i>	Australian Brush-turkey
Bird	<i>Alisterus scapularis</i>	Australian King-parrot
Bird	<i>Anas superciliosa</i>	Pacific Black Duck
Bird	<i>Anthochaera carunculata</i>	Red Wattlebird
Bird	<i>Anthus novaeseelandiae</i>	Australasian Pipit
Bird	<i>Aquila audax</i>	Wedge-tailed Eagle
Bird	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
Bird	<i>Caligavis chrysops</i>	Yellow-faced Honeyeater
Bird	<i>Callocephalon fimbriatum</i> [^]	Gang-gang Cockatoo
Bird	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoo
Bird	<i>Chenonetta jubata</i>	Australian Wood Duck
Bird	<i>Cincloramphus mathewsi</i>	Rufous Songlark
Bird	<i>Cisticola exilis</i>	Golden-headed Cisticola
Bird	<i>Climacteris picumnus victoriae</i> [^]	Brown Treecreeper (eastern subspecies)
Bird	<i>Colluricincla harmonica</i>	Grey Shrike-thrush
Bird	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-Shrike
Bird	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike
Bird	<i>Corcorax melanorhamphos</i>	White-winged Chough
Bird	<i>Cormobates leucophaeus</i>	White-throated Treecreeper
Bird	<i>Corvus coronoides</i>	Australian Raven
Bird	<i>Corvus mellori</i>	Little Raven
Bird	<i>Cracticus nigrogularis</i>	Pied Butcher Bird
Bird	<i>Cuculus pallidus</i>	Pallid Cuckoo
Bird	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
Bird	<i>Dicaeum hirundinaceum</i>	Mistletoebird
Bird	<i>Dromaius novaehollandiae</i>	Emu
Bird	<i>Egretta novaehollandiae</i>	White-faced Heron
Bird	<i>Elanus axillaris</i>	Black-shouldered Kite
Bird	<i>Eolophus roseicapilla</i>	Galah
Bird	<i>Eopsaltria australis</i>	Eastern Yellow Robin

Group	Scientific Name	Common Name
Bird	<i>Eudynamys orientalis</i>	Common Koel
Bird	<i>Falco berigora</i>	Brown Falcon
Bird	<i>Falco cenchroides</i>	Nankeen Kestrel
Bird	<i>Grallina cyanoleuca</i>	Magpie-lark
Bird	<i>Gymnorhina tibicen</i>	Australian Magpie
Bird	<i>Hirundo neoxena</i>	Welcome Swallow
Bird	<i>Hylacola pyrrhopygia</i>	Chestnut-rumped Heathwren
Bird	<i>Lalage sueurii</i>	White-winged Triller
Bird	<i>Lichenostomus leucotis</i>	White-eared Honeyeater
Bird	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater
Bird	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater
Bird	<i>Malurus cyaneus</i>	Superb Fairy-wren
Bird	<i>Manorina melanocephala</i>	Noisy Miner
Bird	<i>Menura novaehollandiae</i>	Superb Lyrebird
Bird	<i>Merops ornatus</i> *	Rainbow Bee-eater
Bird	<i>Microeca fascinans</i>	Jacky Winter
Bird	<i>Myiagra inquieta</i>	Restless Flycatcher
Bird	<i>Neochmia modesta</i>	Plum-headed Finch
Bird	<i>Ocyphaps lophotes</i>	Crested Pigeon
Bird	<i>Oriolus sagittatus</i>	Olive-backed Oriole
Bird	<i>Pachycephala pectoralis</i>	Golden Whistler
Bird	<i>Pachycephala rufiventris</i>	Rufous Whistler
Bird	<i>Pardalotus striatus</i>	Striated Pardalote
Bird	<i>Phaps chalcoptera</i>	Common Bronzewing
Bird	<i>Philemon corniculatus</i>	Noisy Friarbird
Bird	<i>Platycercus eximius</i>	Eastern Rosella
Bird	<i>Pomatostomus temporalis</i> ^	Grey-crowned Babbler
Bird	<i>Psophodes olivaceus</i>	Eastern Whipbird
Bird	<i>Rhipidura fuliginosa</i>	Grey Fantail
Bird	<i>Rhipidura leucophrys</i>	Willie Wagtail
Bird	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo
Bird	<i>Smicrornis brevirostris</i>	Weebill
Bird	<i>Stagonopleura guttata</i> ^	Diamond Firetail
Bird	<i>Strepera graculina</i>	Pied Currawong
Bird	<i>Sturnus vulgaris</i>	Common Starling
Bird	<i>Taeniopygia bichenovii</i>	Double-barred Finch
Bird	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet
Bird	<i>Vanellus miles</i>	Masked Lapwing
Bird	<i>Zosterops lateralis</i>	Silvereye
Mammal	<i>Dama dama</i>	Fallow Deer
Mammal	<i>Felis catus</i>	Cat
Mammal	<i>Lepus capensis</i>	Brown Hare
Mammal	<i>Macropus giganteus</i>	Eastern Grey Kangaroo

Group	Scientific Name	Common Name
Mammal	<i>Macropus robustus</i>	Common Wallaroo
Mammal	<i>Macropus rufogriseus</i>	Red-necked Wallaby
Mammal	<i>Mus musculus</i>	Common House Mouse
Mammal	<i>Oryctolagus cuniculus</i>	Rabbit
Mammal	<i>Sus scrofa</i>	Pig
Mammal	<i>Vombatus ursinus</i>	Common Wombat
Mammal	<i>Vulpes vulpes</i>	Fox
Mammal	<i>Wallabia bicolor</i>	Swamp Wallaby
Mammal	<i>Austronomus australis</i>	White-striped Freetail Bat
Mammal	<i>Chalinolobus dwyeri</i> [^]	Large-eared Pied Bat
Mammal	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
Mammal	<i>Chalinolobus morio</i>	Chocolate Wattled bat
Mammal	<i>Miniopterus schreibersii oceanensis</i> [^]	Eastern Bentwing Bat
Mammal	<i>Mormopterus (Ozimops) ridei</i>	Eastern Freetail Bat
Mammal	<i>Mormopterus (Ozimops) planiceps</i>	South-eastern Freetail Bat
Mammal	<i>Nyctophilus sp.</i>	Long-eared Bat
Mammal	<i>Saccolaimus flaviventris</i> [^]	Yellow-bellied Sheathtail Bat
Mammal	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
Mammal	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat
Mammal	<i>Vespadelus darlingtoni</i>	Large Forest Bat
Mammal	<i>Vespadelus regulus</i>	Southern Forest Bat
Mammal	<i>Vespadelus vulturnus</i>	Little Forest Bat
Reptile	<i>Anomalopus leuckartii</i>	Two-clawed Worm Skink
Reptile	<i>Carlia tetradactyla</i>	Southern Rainbow Skink
Reptile	<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle
Reptile	<i>Cryptophis nigrescens</i>	Small-eyed Snake
Reptile	<i>Delma plebeia</i>	Leaden Delma
Reptile	<i>Demansia psammophis</i>	Yellow-faced Whip Snake
Reptile	<i>Diplodactylus vittatus</i>	Wood Gecko
Reptile	<i>Diporiphora nobbi</i>	Nobbi Dragon
Reptile	<i>Furina diadema</i>	Red-naped Snake
Reptile	<i>Liopholis whitii</i>	White's Skink
Reptile	<i>Lygisaurus foliorum</i>	Tree-base Litter Skink
Reptile	<i>Menetia greyii</i>	Common Dwarf Skink
Reptile	<i>Morethia boulengeri</i>	Boulenger's Skink
Reptile	<i>Phyllurus platurus</i>	Broad-tailed Gecko
Reptile	<i>Pogona barbata</i>	Eastern Bearded Dragon
Reptile	<i>Tiliqua scincoides</i>	Eastern Blue-tongue
Reptile	<i>Varanus varius</i>	Lace Monitor

[^] threatened species; * migratory species

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Translocation of Tiger Orchid *Cymbidium canaliculatum*

PIT 7 EXTENSION, JULY 2015

WILPINJONG COAL PROJECT



REPORT TO

PEABODY ENERGY

16 January 2016

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Translocation of Tiger Orchid *Cymbidium canaliculatum*

Pit 7 Extension, July 2015

Wilpinjong Coal Project

Report prepared for

Peabody Energy

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1.0 INTRODUCTION

This report details the translocation of the threatened Tiger Orchid *Cymbidium canaliculatum* which was located during pre-clearing surveys for the Pit 7 East extension area of Wilpinjong Coal Project. The Tiger Orchid is listed as Vulnerable under the NSW *Threatened Species Conservation Act, 1995*. An endangered population of the species is listed for the Hunter Valley catchment, which includes the locality of Wilpinjong. The species is not listed on the Federal *Environment Protection & Biodiversity Conservation Act 1999*. This species has not previously been located in previous environmental assessments of the Wilpinjong project, suggesting it is locally uncommon in the region.

The Tiger Orchid is a large epiphytic orchid has a scattered distribution across northern and eastern Australia, extending from Hunter River in NSW to Cape York and across northern NT and Queensland to the Kimberley region in WA. In NSW the species is restricted to the north-eastern quarter of the State, occurring chiefly in inland districts west to New England and Walgett on the north western plains and north of the Hunter River, through the north western slopes, northern tablelands and north coast into south-eastern Queensland.

A disjunct population of fewer than 500 individuals though estimated to be as low as 90, which occurs in the Hunter Valley at the south-eastern distributional limit of the species' range. The Hunter population is known to occur naturally as far south as Weston and Pokolbin in the Lower Hunter, which represents its south-eastern geographic limit, but appears to be more centred in the Upper Hunter, predominantly north of Singleton. In this area it is chiefly known from an area bounded by Ravensworth, Muswellbrook, Denman and Sandy Hollow, but extends northwards to the Aberdeen – Scone – Wingen districts. Isolated occurrences are also known from the Merriwa plateau, Bylong valley and the Gungah area near Goulburn River (including the Goulburn River National Park).

Nevertheless, the population is defined as occurring in the Hunter Catchment, and as such may be present in any of the local government areas of Cessnock, Maitland, Dungog, Singleton, Muswellbrook, Newcastle, Port Stephens, part of Mid-western Regional, and part of Upper Hunter. The vast majority of individuals (>90%) occur on private property, scattered across 30-40 sites, predominantly in the Muswellbrook and Upper Hunter LGAs

The Tiger Orchid typically grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. It usually occurs singly or as a single clump, which can form large colonies on trees, between two and six metres from the ground. Recruitment, germination and persistence is reliant on rotting wood and mycorrhizal fungal associations.

Within the Hunter Catchment, *Cymbidium canaliculatum* is most commonly found in *Eucalyptus albens* (White Box) dominated woodlands (including those dominated by the intergrade *E. albens-moluccana*), much of which may constitute the endangered ecological community (EEC) 'White Box Yellow Box Blakely's Red Gum Woodland'. It has been found, less commonly, to grow on *E. dawsonii* (Slaty Box), *E. crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box), *Angophora floribunda* (Rough-barked Apple), *Acacia salicina* (Cooba) and on some other species, including dead stags. It is also known to use man-made structures, such as fence posts and wooden bridges as its host.

A map illustrating the regional distribution of the Tiger Orchid in the Hunter Valley catchment is presented below in **Figure 1**.

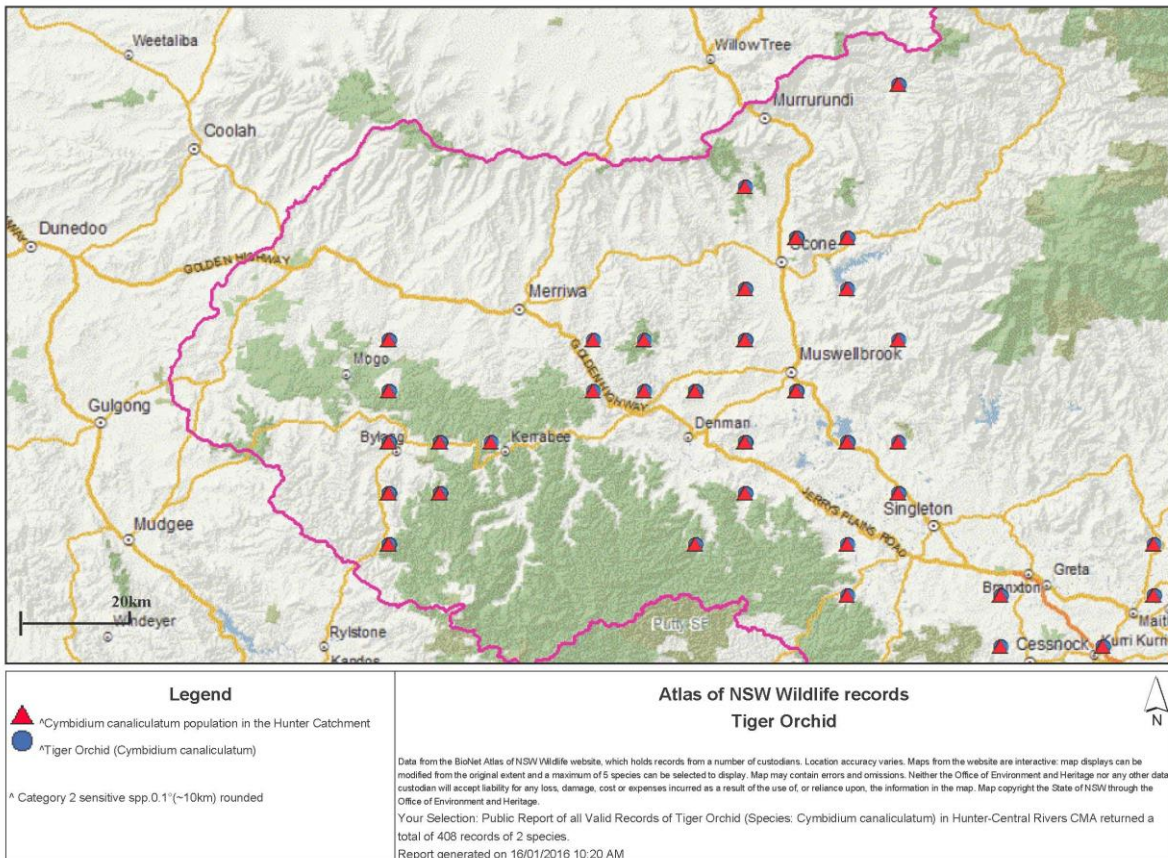


Figure 1. Tiger Orchid Locations, Hunter Valley Catchment (courtesy Office of Environment & Heritage, January 2016).

The Wilpinjong Tiger Orchid location represents the most western known location of the species in the Hunter Catchment, based on known published records.

1.1 Mine Project Area

The pre-clearance survey of the Pit 7 extension identified the location of one individual plant. Translocation of the individual plant was implemented to ensure its continued survival, as this procedure has been successfully undertaken at a number of coal mines in the Hunter Valley, with good success rates. A formal procedure has not been documented for translocation of the orchid, but Glencore (NSW) have developed an informal procedure based on previous trials. Consultation with Glencore (NSW) was undertaken to ensure success of the translocation procedure.

The location of the individual Tiger Orchid is presented below in **Figure 2**. The dotted line represents the search area conducted within Pit 3 and Pit 7.

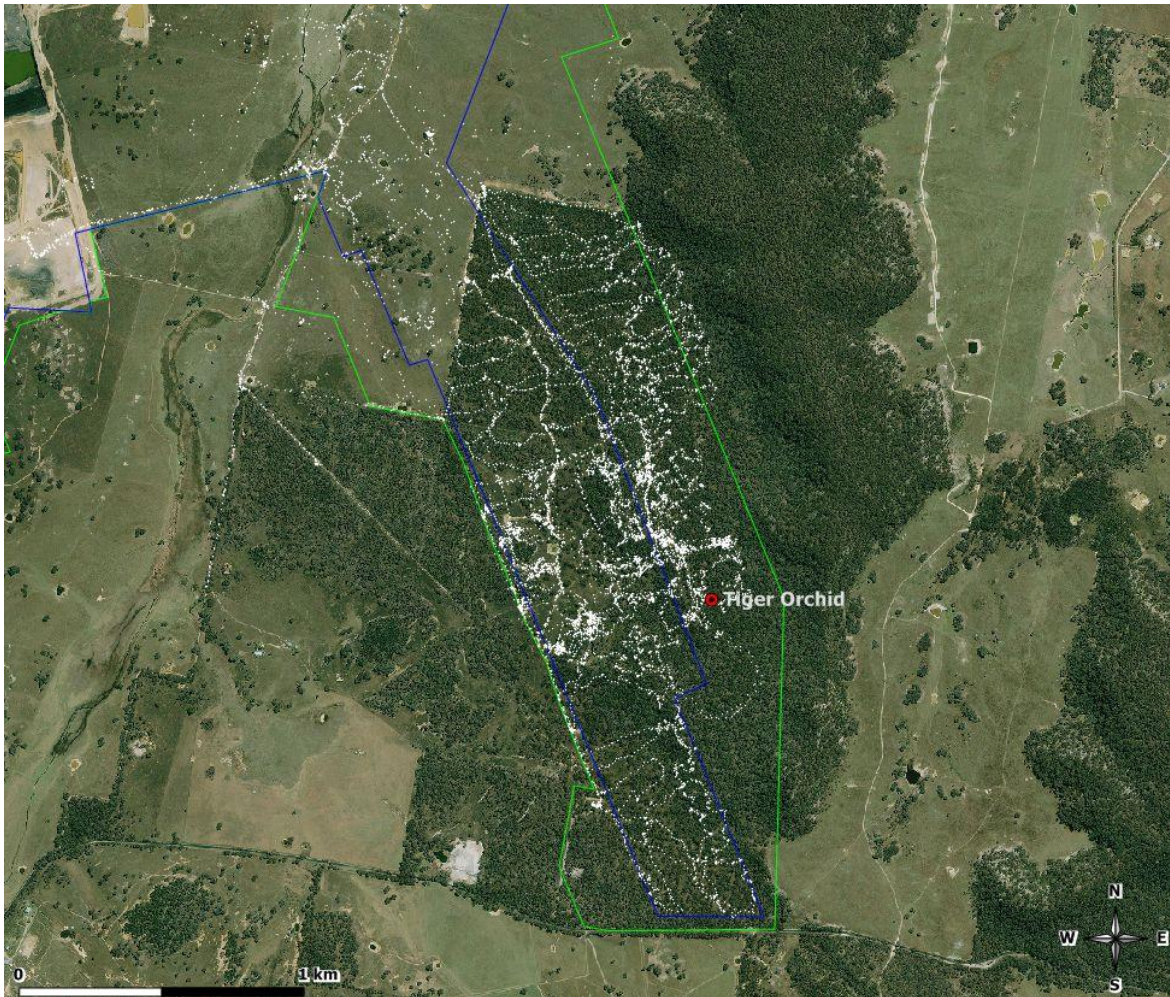


Figure 2. Tiger Orchid Location and Search Area, Pit 7, Wilpinjong Coal Project

Note: dotted line represents track log of search area recorded by gps.

2.0 METHODOLOGY

2.1 Pre-clearance Survey

Pre-clearance surveys were conducted to identify habitat trees and record their physical characteristics and location. Searches conducted by vehicle and foot traverses of each pre-clearance survey area. As part of the survey, any additional observations were recorded. Foot traverses were logged with a hand held Garmin 60Csx GPS with an apparent accuracy of +/- 5 metres, depending upon canopy cover. The entire search area was traversed on foot searching for habitat trees and any additional significant habitat features such as wombat holes.

3.0 RESULTS

In July 2015, a Grey Box *Eucalyptus moluccana* tree containing hollows was located in part of the Pit 7 extension area, which was found to also contain an individual Tiger Orchid *Cymbidium canaliculatum* growing out of the central trunk hollow. The orchid was approximately 2-3 metres above ground level (refer to **Figure 3** below).



Figure 3. Photographs of Tiger Orchid

During tree clearing of the Pit 7 extension area (29 July 2015), the individual orchid was removed, with the base and approximately 1.0 metre above the orchid cut from the tree. Once removed from the tree, the orchid was found to have extended its root system into a 45 degree hollow branch that extended approximately 1.0 metre above the orchid clump. The orchid clump plus tree base was lifted onto a light vehicle and transported to the translocation site, located within a Conservation area to the immediate west of Pit 7. The total distance from the removal site to the translocation site is about 1,400 metres. The translocation site was selected due to its close proximity, with similar forest structure (tree height, tree species composition and degree of shading) and tree species. The translocation site selected contained a Grey Box tree with similar aspect to the original location.

The entire orchid + tree base was affixed to the translocation tree with heavy duty strapping. A photograph of the translocation site is presented below in **Figure 4 and 5**.



Figure 4. Photographs of translocation site, Tiger Orchid, Wilpinjong Conservation Area.

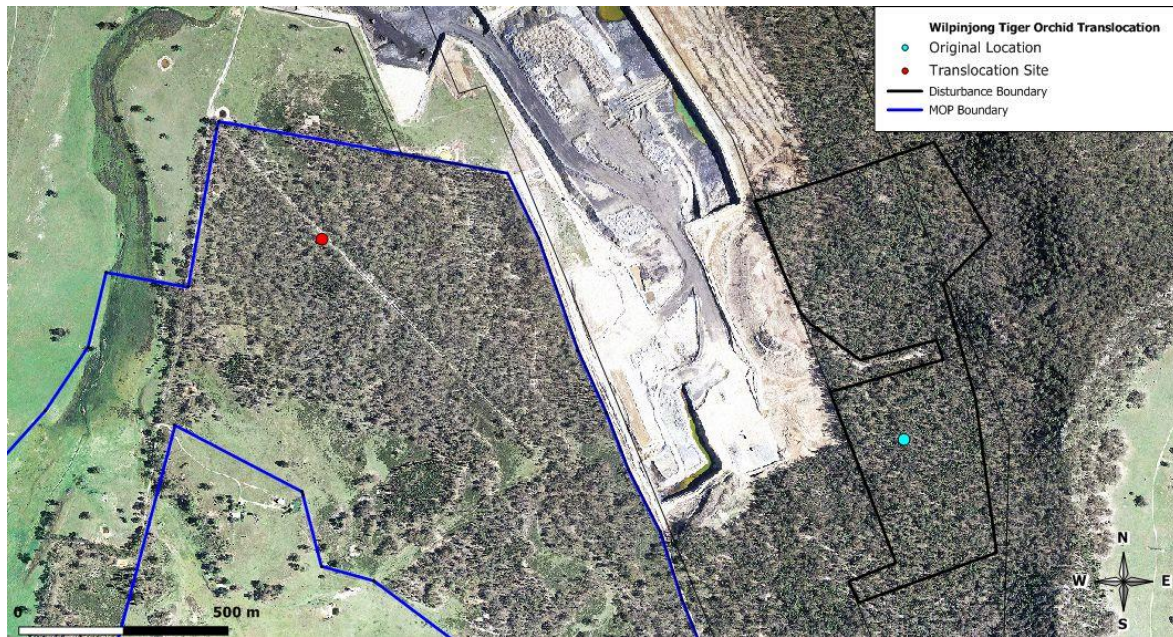


Figure 5. Translocation site, Tiger Orchid, Wilpinjong Conservation Area.

The orchid will be monitored annual for the following 3 years to ensure the success of the translocation trial.

4.0 REFERENCE

Resource Strategies (2005). Wilpinjong Coal Project Environmental Impact Statement. Prepared for Wilpinjong Coal Pty Limited.