APPENDIX E
TERRESTRIAL FLORA ASSESSMENT

Wilpinjong Coal Mine Modification

Terrestrial Flora Assessment

By Hunter Eco

July 2013

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1 Introduction

1.1 Background

The Wilpinjong Coal Mine is an existing open cut coal mining operation situated approximately 40 kilometres (km) north-east of Mudgee, near the Village of Wollar, within the Mid-Western Regional Council (MWRC) Local Government Area, in central New South Wales (NSW) (**Figure 1**).

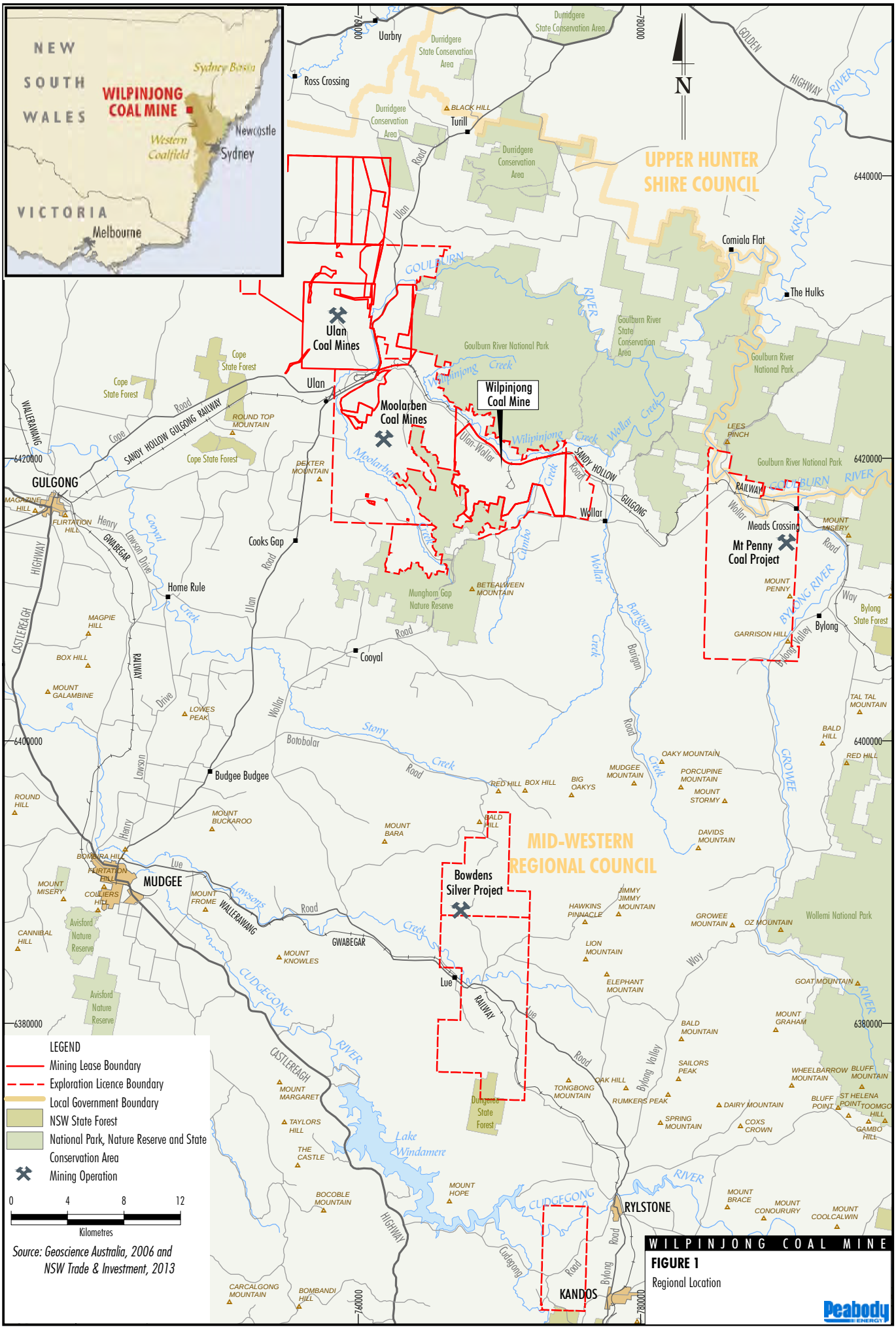
The Wilpinjong Coal Mine is owned and operated by Wilpinjong Coal Pty Limited (WCPL), a wholly owned subsidiary of Peabody Energy Australia Pty Limited. Mining is undertaken within Mining Lease (ML) 1573 and the approved open cut and contained infrastructure area at the Wilpinjong Coal Mine comprises approximately 1,920 hectares (ha) (**Figure 2**).

The Wilpinjong Coal Mine was approved under Part 3A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) by the NSW Minister for Planning in February 2006 (Project Approval 05-0021). The mine has been operating since 2006, and is approved to produce up to 15 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal from six open cut pits (**Figure 2**).

The Wilpinjong Coal Mine produces both washed and unwashed coal products. The coal handling and processing infrastructure has been designed to accommodate the processing of raw coal and the handling of raw (bypass) and washed product coal. The Project Approval currently allows for the beneficiation of up to 8.5 million tonnes (Mt) of ROM coal in the Coal Handling and Preparation Plant (CHPP) per year and up to 12.5 Mtpa of thermal coal products from the Wilpinjong Coal Mine are transported by rail to domestic customers for use in electricity generation and to port for export.

Following a review of mine planning, CHPP capacity, waste rock bulking factors, planned building and demolition works and light vehicle servicing requirements, WCPL has determined that a number of minor alterations to the approved Wilpinjong Coal Mine are required, including:

- development of incremental extensions to the existing open cut pits (**Figure 3**) that would extend the open cuts by approximately 70 ha and would result in the recovery of approximately 3 Mt of additional ROM coal;
- higher rates of annual waste rock production (from 28 million bank cubic metres [Mbcm] up to approximately 33.3 Mbcm) in order to maintain approved ROM coal production;
- minor CHPP upgrades to improve fine coal reject management (installation of a belt press filter) and an increase in the rate of ROM coal beneficiation in the CHPP to approximately 9 Mtpa;



WILPINJONG COAL MINE

FIGURE 1

Regional Location

Peabody ENERGY

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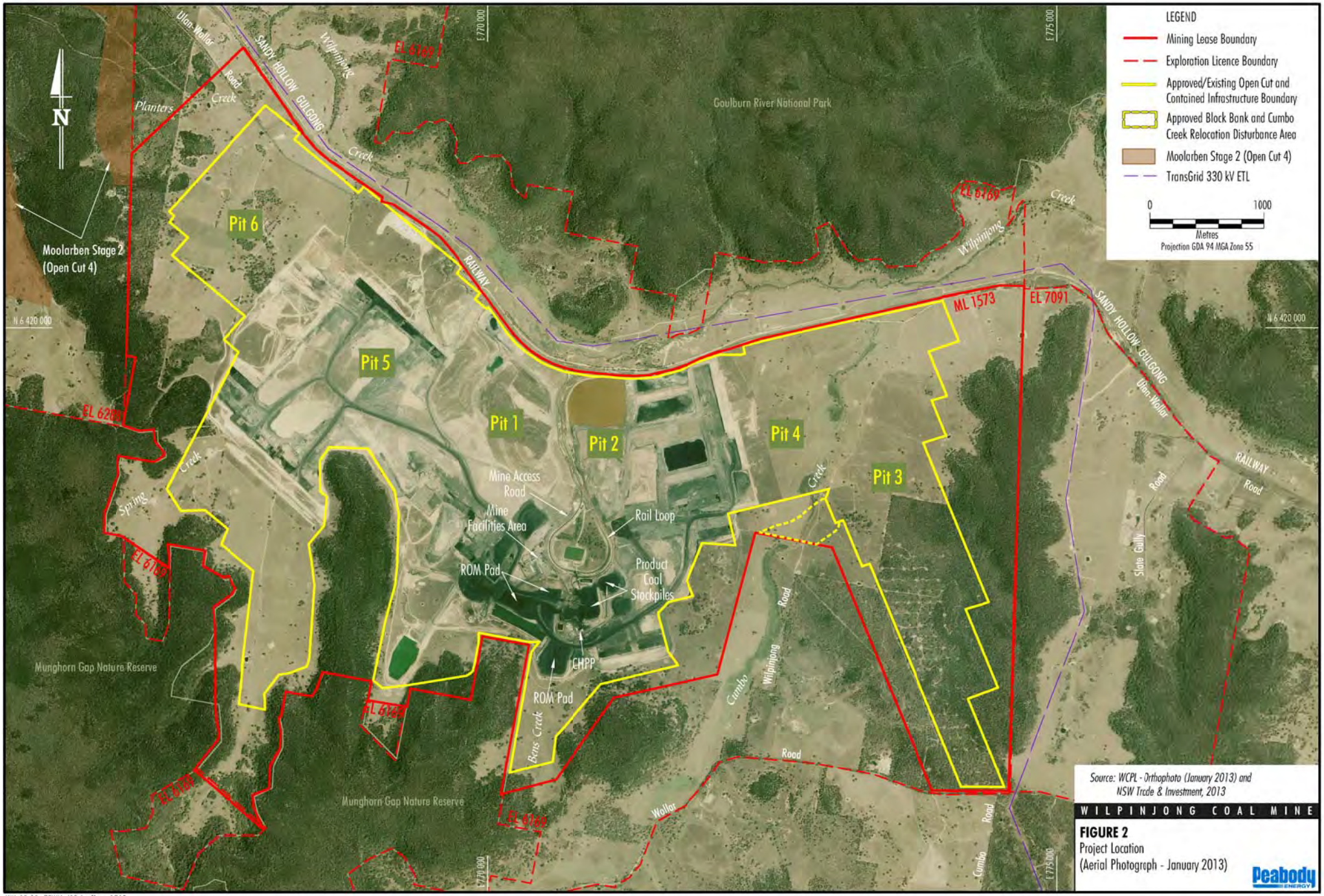

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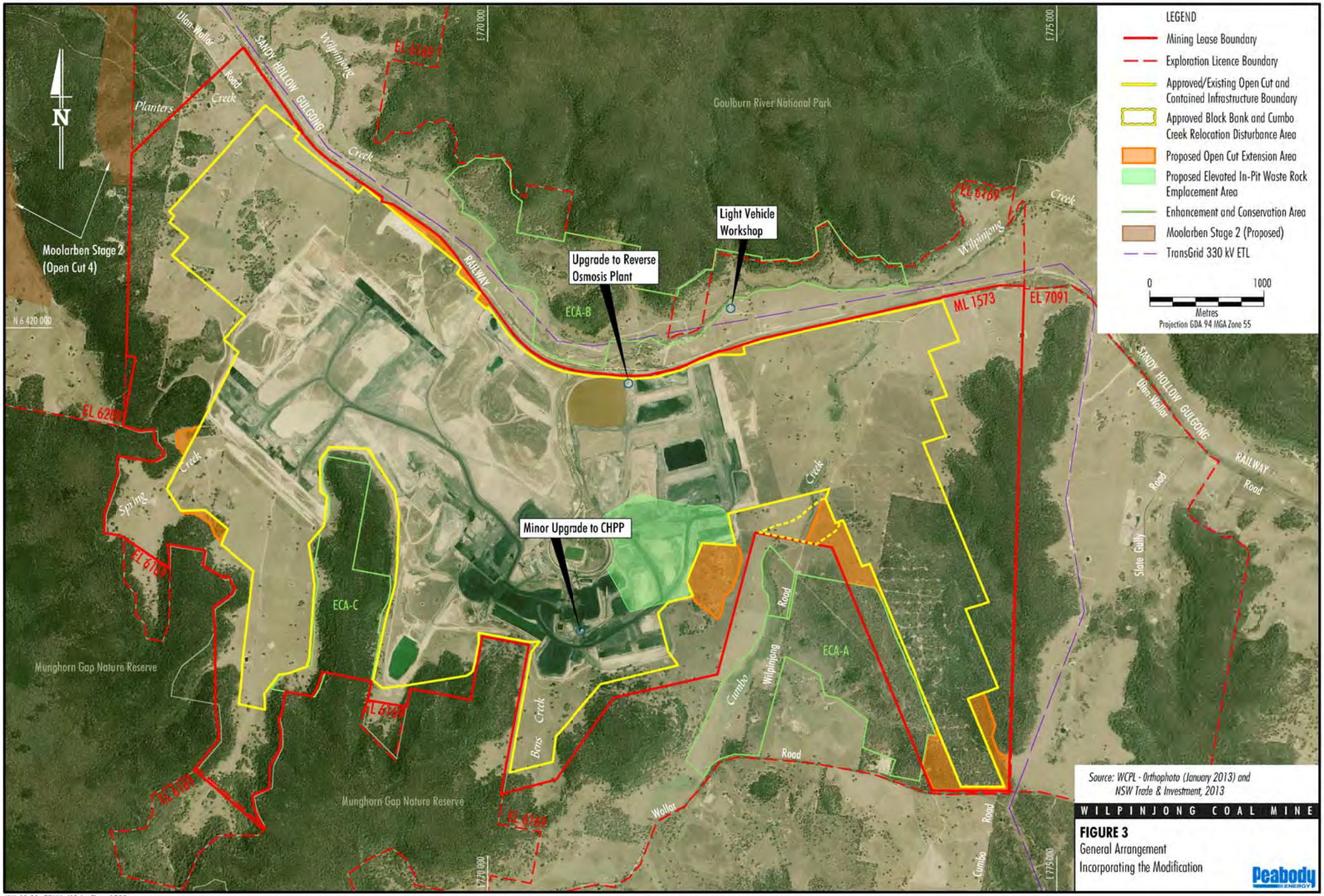

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- upgrade of the existing Reverse Osmosis Plant to a Water Treatment Facility with the addition of pre-filtration and flocculation/dosing facilities to improve plant efficiency;
- amendment of the waste emplacement strategy to include:
    - development of an elevated waste rock emplacement landform (up to approximately 450 metres [m] Australian Height Datum) within the footprint of Pit 2 (**Figure 3**);
    - disposal of some inert building and demolition waste that is produced from off-site building demolition in the approved mine waste rock emplacements;
    - co-disposal of fine coal reject material produced by the belt press filter with coarse rejects; and
- operation of a light vehicle servicing workshop at an existing farm shed that is located in the north of the Project Area (**Figure 3**).

Construction of the belt press filter and augmentation of the existing Reverse Osmosis Plant may require a temporary construction workforce of up to 20 people for periods in 2014.

These variations to the Wilpinjong Coal Mine are being sought via a Modification under Section 75W of the EP&A Act (the Modification).

It should be noted that no changes are proposed to the approved rates of production of ROM coal (15 Mtpa) or product coal (12.5 Mtpa) and the current owner-operator mobile fleet would not require augmentation. In addition, the Modification would not require any significant alteration to the existing approved Wilpinjong Coal Mine mining operations and general supporting infrastructure, or current operational workforce of approximately 550 staff and contractors.

1.2 Scope of this Report

This report describes the methods and results of an investigation into the impact of the Modification on flora and vegetation communities in the Modification open cut extension areas. The primary focus of the investigation was on occurring and potentially occurring species, populations and communities listed as threatened under the NSW *Threatened Species Conservation Act, 1995* (TSC Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

As the Modification is to be assessed under section 75W Part 3A of the EP&A Act, the investigation and impact assessment was conducted in accordance with the *Draft Guidelines for Threatened Species Assessment* (NSW Department of Environment and Conservation [DEC] and NSW Department of Primary Industries [DPI], 2005).

The aim of this investigation was to conduct a thorough assessment of the environment in and around the Modification open cut extension areas to maximise the opportunity for detecting threatened species, populations and communities. The assessment did not rely only on survey field results, but also took historical and regional data into account. Where survey timing was not optimal for a particular threatened species, but suitable habitat was present or previous surveys had observed the species, that species was considered to be present for the purposes of the impact assessment.

2 Existing Environment

2.1 Regional Location

The Modification open cut extension areas are located approximately 40 km north-east of Mudgee (**Figure 1**). Two other coal mining operations are present in the locality; Moolarben Coal Mine is immediately to the west, and Ulan Coal Mine is approximately 8 km north-west of Wilpinjong Coal Mine.

Wilpinjong Coal Mine is located at or in:

- the western extent of the Hunter Central Rivers Catchment Management Authority area, Kerrabee sub-region;
- the north western extent of the Sydney Basin Bioregion, Kerrabee sub-region;
- the Central Western Slopes Botanical Division.

2.2 Climate

Australian Bureau of Meteorology (BOM) data from Wollar (BOM, 2013) shows the local area to have an overall low rainfall with the long-term monthly mean ranging from about 38 millimetres (mm) to 67 mm. The months of April to September are the driest with a consistent monthly mean of around 40 mm, with rain then increasing from October to January, then decreasing to April (**Figure 4**). Rainfall for 2012 was exceptional, being much wetter than average from January to March and July, and much drier than average April to June and August to November. **Figure 4** also compares long term average (LTA) rainfall with 2012 records from the Wilpinjong Coal Mine weather station. These data show that by the end of December there had been 112 mm less rain than average over the preceding five months; >40% less than average for that period.

The nearest available long-term temperature data were from Mudgee and Gulgong, (BOM, 2013). Examination of these data showed that Mudgee was marginally cooler than Gulgong. **Figure 5** is a plot of the average variation in temperature of the two towns.

2.3 Geology and Soils

Geological information for the Wilpinjong Coal Mine area was sourced from the *Gulgong 1:100 000 Geological Map* (Division of Resources and Energy, 2013).

Geology across the low lying areas of the Wilpinjong Mine Mining Lease (ML 1573) is Permian, Sydney Basin, Illawarra Coal Measures expressed on the surface as quartz-lithic sandstone. This takes up the majority of the lease area and includes most of the Modification.

An exception is a narrow band of Quaternary sediments along the course of Cumbo Creek in the eastern part of the lease and Wilpinjong Creek to the north. A portion of Modification Areas A and B is contained within this Quaternary geology.

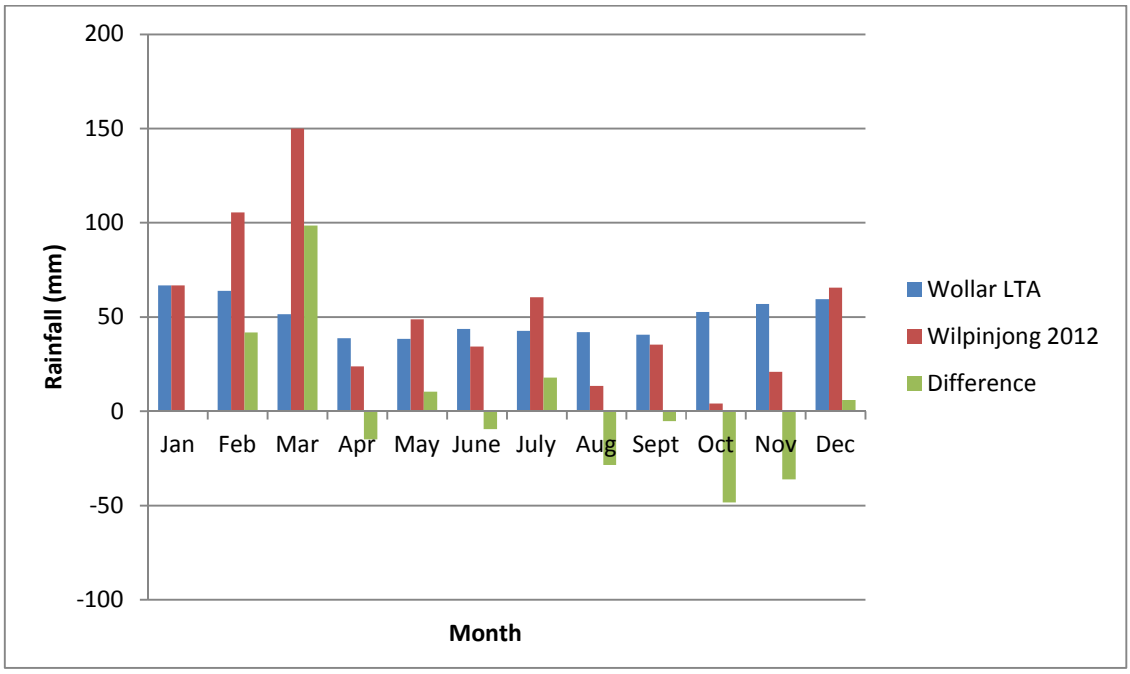


Figure 4 Monthly Average Rainfall Records From Wollar, Wilpinjong Coal Mine 2012 Monthly Figures and the Difference Between the Two

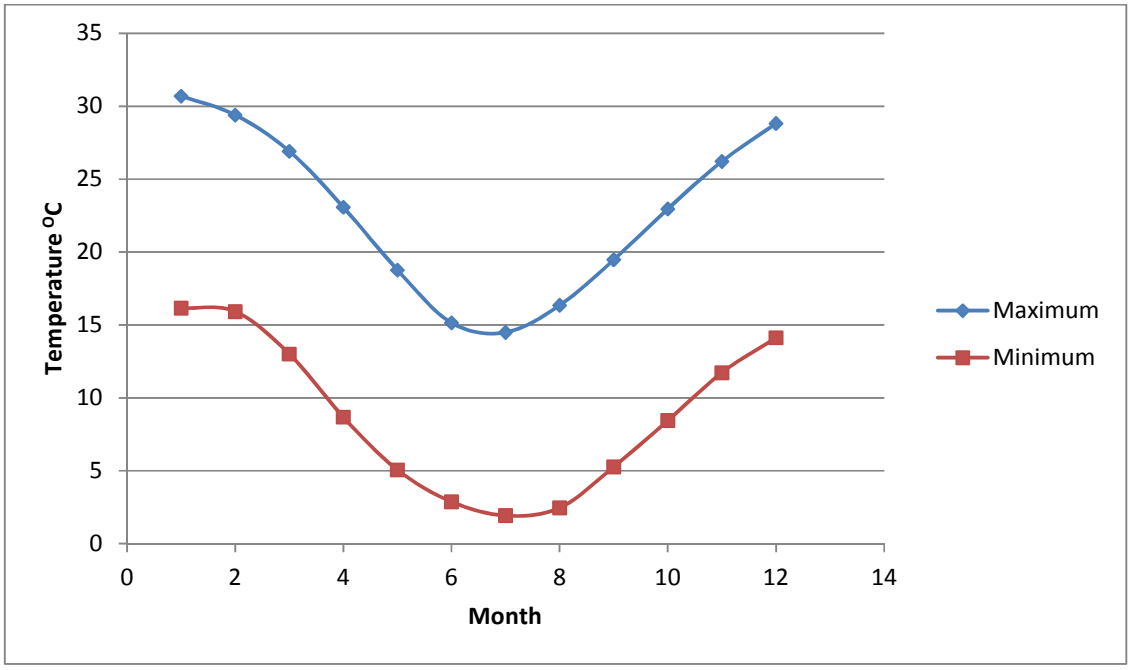


Figure 5 The Average Of Monthly LTA Temperatures for Mudgee and Gulgong

The elevated ridges within and outside of the lease are Triassic, Sydney Basin, Narrabeen group. At the south-east is a small area of Permian, Sydney Basin Shoalhaven group and this includes the western third of Modification Area G.

Soil information was obtained from the *Soil Landscapes of the Dubbo 1:250,000 Sheet* (NSW Office of Environment and Heritage [OEH], 2013a). Most areas of ML1573 consist of yellow, brown and red podzolic soils, primarily of the Barigan Creek Soil Landscape Unit and include Modification Areas A, C, E and G. Part of Modification Area H is within the Lees Pinch soil landscape. Modification Area D is primarily lithosol soil type and Area F is primarily brown soils. There is a section of the Barigan Creek soil landscape in the east which includes all of Modification Area E. It is noted that contemporary soils information is also now available for the Modification open cut extension areas from recent soil investigations (McKenzie Soil Management, 2013). These investigations indicate that the Australia Soil Classification of soil pits in the Modification open cut extension areas comprised a range of Brown and Red Dermosols and Kurosols and were primarily aligned with the Barigan Creek soil landscape (McKenzie Soil Management, 2013). As described in Appendix I of the Environmental Assessment, the soils within the Modification open cut expansion areas have limitations such acidic soils, lack of waterholding capacity, dispersive subsoil, high soil salinity and nutrient deficiencies, particularly phosphorus (McKenzie Soil Management, 2013).

2.4 Landform and Hydrology

The majority of the lease is situated in a wide valley floor between hills and escarpments of the Goulburn River National Park to the north and Munghorn Gap Nature Reserve to the south (**Figure 6**).

The lease is located at the south western extent of the Hunter Catchment. Water from across ML 1573 flows into Cumbo and Wilpinjong Creeks. Wilpinjong Creek connects to Wollar Creek that flows north into the upper reaches of Goulburn River.

Figure 6 shows the distribution of elevation and slope across ML 1573 and surrounds. Elevation across the ML 1573 is between 350 m to a few ridges immediately south of ML 1573 rising to 610 m.

The slope classes of McDonald *et al*. (1998) are shown in **Figure 7** with the majority of ML 1573 being Level to Gently Inclined. Slope on the ridges varies from Moderately Inclined to Steep. The Modification open cut extension areas lie in Level to Moderately Inclined land.

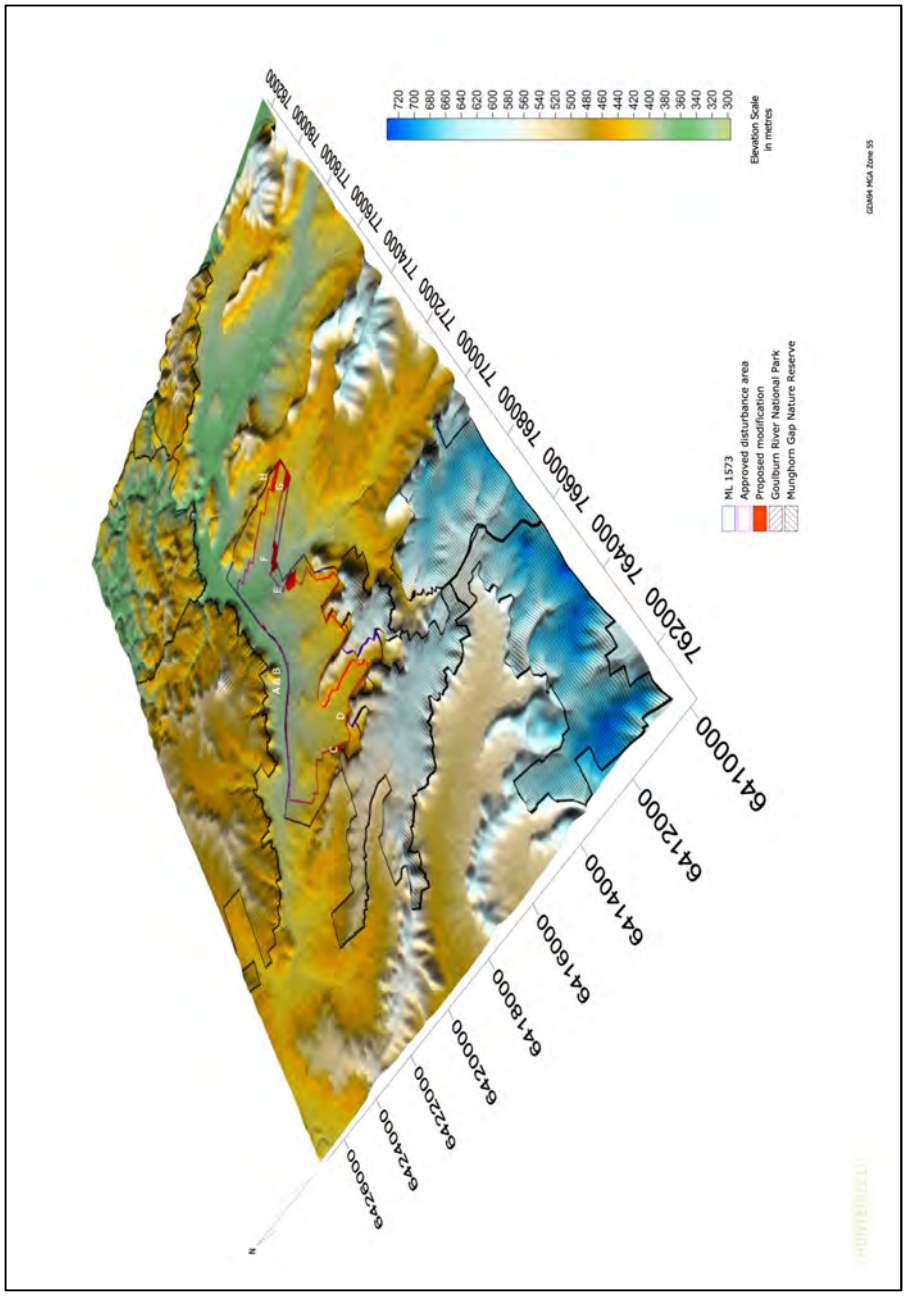


Figure 6 Topography of the Wilpinjong Coal Mine Mining Lease and Surrounding Area[1]

[1] Note: Figures 6 to 9 show an area labelled 'Approved disturbance boundary/area'. This boundary represents the disturbance associated with the approved open cut and contained infrastructure area. Approved ancillary infrastructure also occurs outside of this boundary.

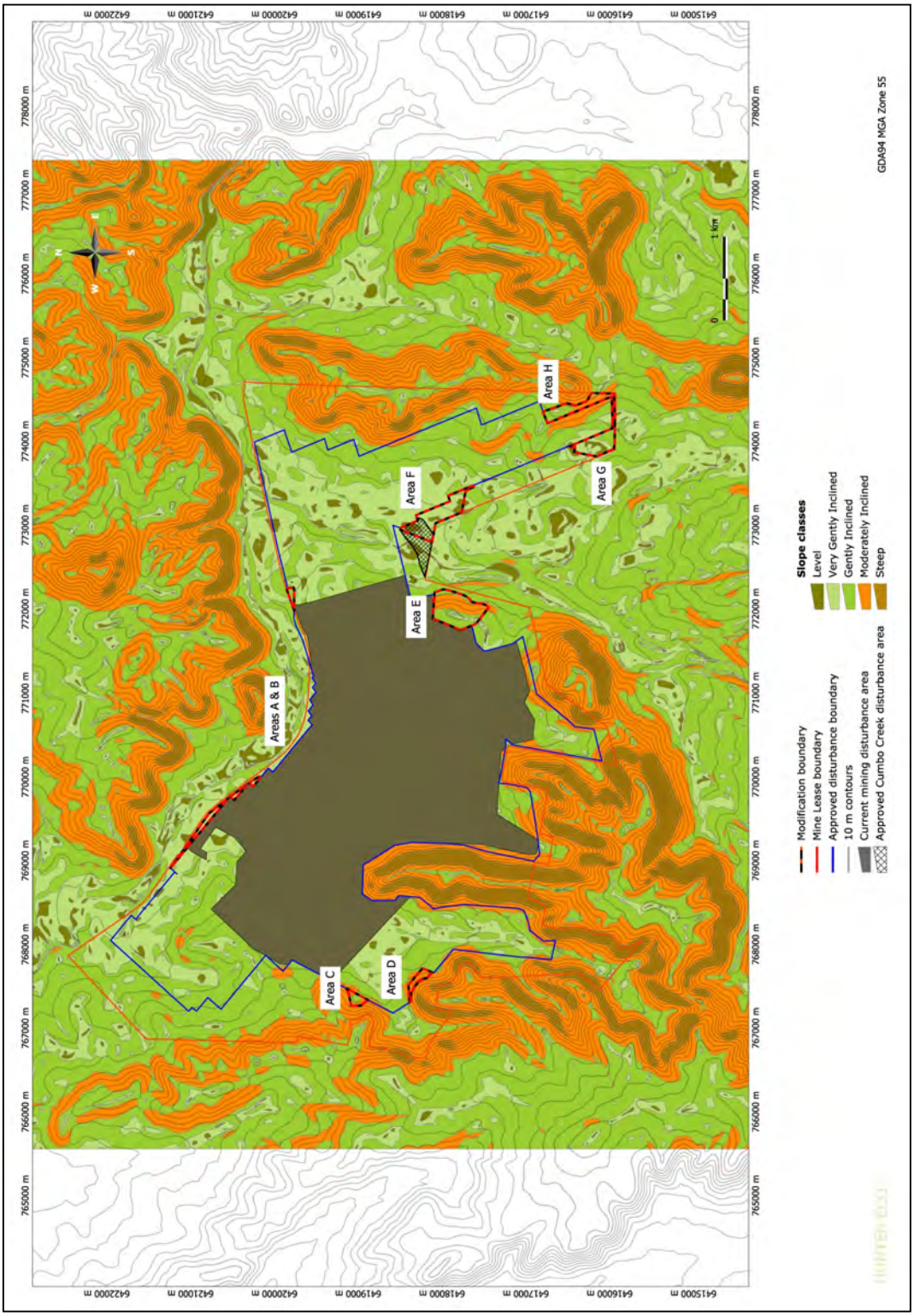


Figure 7 Elevation and Slope Across the Wilpinjong Coal Mine Mining Lease and Surrounds

Source: Slope classes from McDonald et al. (1998)

2.5 Land Use

Prior to the recent arrival of the Wilpinjong Coal Mine, the Wollar area was typical of early (around the 1800s) European settlement where lands deemed arable were cleared of most vegetation including the Modification open cut extension areas, primarily for grazing purposes.

2.6 Vegetation

The Wilpinjong Coal Mine lease (ML 1573) lies almost entirely in the Upper Goulburn Valleys and Escarpment Mitchell Landscape, designated as 57% cleared (OEH, 2007).

Areas of remnant forest are generally restricted to sandstone hills and escarpments that were historically difficult to clear. With low annual rainfall dry sclerophyll eucalypt forest is the dominant form. A lot of the cleared grazing lands retain a high native flora content and are generally referred to as derived native grasslands. Some areas with access to irrigation water have been subject to some cropping.

2.6.1 Vegetation Communities Mapped in the Modification Open Cut Extension Areas

Table 1 shows the communities mapped by FloraSearch (2005) (for the original Wilpinjong Coal Mine environmental application) as being present within the Modification open cut extension areas. Each of the proposed development areas within the Modification open cut extension areas also contain a substantial amount of grassland cleared of canopy trees. These grasslands were not mapped as a vegetation type by FloraSearch (2005), being only designated as cleared agricultural land.

2.7 Habitat Connectivity

Establishment of Wilpinjong Coal Mine has made little difference to pre-existing habitat connectivity (**Figure 8**) with the valley floor in which the mine is now located being mostly cleared with scattered paddock trees. The major corridor connecting Munghorn Gap Nature Reserve and Goulburn River National Park remains to the west, mostly within the Moolarben Coal Mines mining lease.

Table 1 FloraSearch (2005) Vegetation Communities Mapped in the Modification Open Cut Extension Areas[2]

Unmapped areas are patches of vegetation not included in the FloraSearch mapping. It is probable that they have regenerated in the seven years since that mapping.

Code	Community	Species	Area (ha)
	Area A and B		
7	Cleared Agricultural Land	**Total Area A and B**	**5.8**
	Area C		
7	Cleared Agricultural Land		1.8
5a	Grassy White Box Woodlands	*E. albens* ± *E. moluccana* ± *C. endlicheri*	0.7
		Total Area C	**2.5**
	Area D		
5b	Shrubby White Box Woodlands	*E. albens*/*C. endlicheri* ± *A. floribunda* ± *E. moluccana* ± *E. crebra*	1.9
7	Cleared Agricultural Land		1.1
		Total Area D	**3.0**
	Area E		
10	Unmapped		0.72
5a	Grassy White Box Woodlands	*E. albens* ± *E. moluccana* ± *C. endlicheri*	1.9
7	Cleared Agricultural Land		18.4
		Total Area E	**21.0**
	Area F		
10	Unmapped		0.05
4	Narrow-leaved Ironbark Forest	*E. crebra*/*C. endlicheri* ± *E. macrorhyncha* ± *A. floribunda* ± *E. caleyi*	0.05
7	Cleared Agricultural Land		16.6
1	Yellow Box and Blakely's Red Gum Woodlands	*Eucalyptus melliodora*/*E. blakelyi*/*Angophora floribunda* ± *E. moluccana*	0.4
		Total Area F	**17.1**
	Area G		
2	Coast Grey Box Woodlands	*E. moluccana* ± *E. crebra* ± *A. floribunda*	2.0
4	Narrow-leaved Ironbark Forest	*E. crebra*/C. endlicheri ± *E. macrorhyncha* ± *A. floribunda* ± *E. caleyi*	8.4
		Total Area G	**10.4**
	Area H		
2	Coast Grey Box Woodlands	*E. moluccana* ± *E. crebra* ± *A. floribunda*	1.0
5b	Shrubby White Box Woodlands	*E. albens*/C. endlicheri ± *A. floribunda* ± *E. moluccana* ± *E. crebra*	6.9
7	Cleared Agricultural Land		1.8
		Total Area H	**9.7**
GRAND TOTAL			**69.5**

[2] The vegetation community titles and codes within these tables are according to FloraSearch (2005) and will differ from those mapped for this assessment.

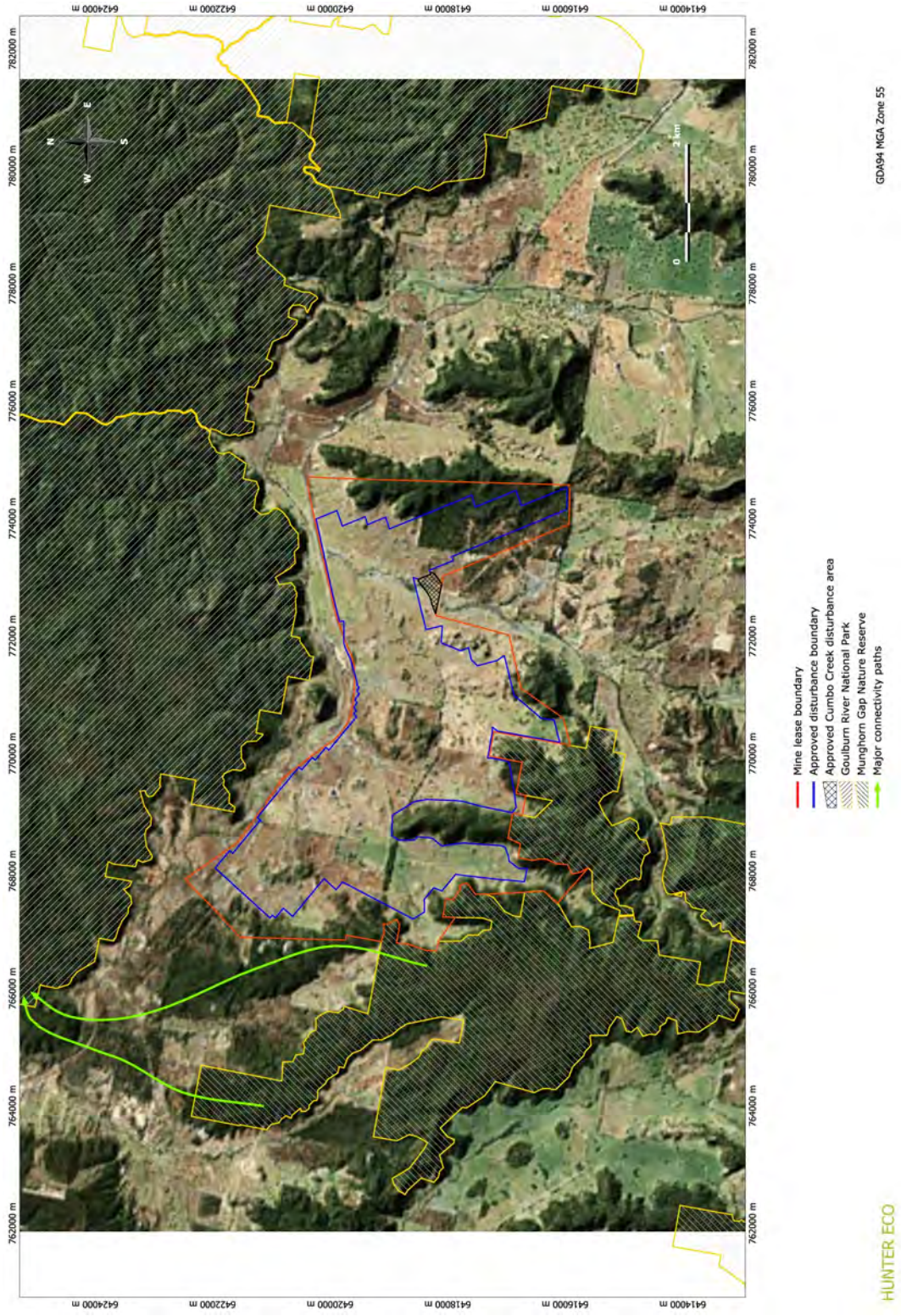


Figure 8 Habitat Connectivity Prior to Wilpinjong Coal Mine

3 Background Information

Past and current reports relevant to consideration of the impacts of the proposed Modification open cut extension areas with respect to flora and vegetation were examined. The primary information sought was records of threatened flora species and ecological communities as well as overall vegetation community classification. **Table 2** provides a summary of these resources.

The primary source used was FloraSearch (2005) (herein referred to as FloraSearch) which provides floristic lists, vegetation community classification and mapping from within and near the Wilpinjong Coal Mine ML 1573 and mine disturbance area, including areas covered by the Modification open cut extension areas.

Recently a draft regional vegetation classification and mapping project has been completed, referred to as the Greater Hunter Native Vegetation Mapping version 4.0 (GHV) (Sivertsen *et al.* 2011), an OEH project. This vegetation map included the Wilpinjong Coal Mine ML 1573.

It is intended that the GHV vegetation classification be integrated into the NSW Plant Community Type Classification for use in NSW assessment and regulatory tools. For this reason, particular attention was given to a comparison of the GHV vegetation map and the map produced by FloraSearch.

3.1 Flora Species

FloraSearch (2005) recorded 401 species from 80 families (including 104 weed species) with the full list provided in **Appendix 1**. The two most represented families were Asteraceae (daisies), 57 species including 25 weed species, and Poaceae (grasses), 73 species including 23 weed species. Ten plants were only identifiable to the level of genus. A taxonomic review was conducted resulting in two family names and 25 species names being updated; names changed are bracketed under the current name in **Appendix 1**. One native species (*Scutellaria humilis*) had been labelled as a weed.

3.2 Vegetation Communities

FloraSearch mapped vegetation communities across about 2,300 ha that included Wilpinjong Coal Mine ML 1573 and immediate surrounds. This mapping was supported by 88 ground-truthed data points that included 20 floristic sample plots of 20 x 20 m in size. Seven remnant vegetation communities were described along with two derived communities. Community classification by FloraSearch appears to have been arrived at intuitively rather than by data analysis, meaning that communities were classified based on subjective assessment of floristic content differences. **Table 3** lists the FloraSearch communities.

Of the two other vegetation classification and mapping projects listed in **Table 2** two of them take in all or part of the area of the FloraSearch map (albeit at a different scale), these are Hill (1999) and the Sivertsen *et al.* (2011) GHV map.

A comparison between the FloraSearch and GHV mapping was undertaken to determine the utility of the GHV product given that the FloraSearch map was primarily ground-truthed and the GHV mapping was at a very broad scale. The FloraSearch communities were compared with the GHV community at the same location. **Table 4** provides the comparison and it can be seen that the GHV map bears little resemblance to the FloraSearch map. In fact only 6% of the area covered by the FloraSearch map was given a similar classification in the GHV map. Thus the FloraSearch community types provided the best description of the local vegetation.

3.3 Threatened Flora Species

Eucalyptus cannonii was the only threatened flora species recorded by FloraSearch (2005) in surveys for the Wilpinjong Coal Project Environmental Impact Statement (EIS). The species was recorded within ML 1573 but outside of the Modification open cut extension areas and the approved/existing open cut and contained infrastructure boundary.

Table 2 Summary of Documents Providing Background Information

Source	Reference	Summary	Relevance
Moolarben Coal Project Stage 2 Environmental Assessment Report. Appendix 7 Ecological Impact Assessment.	Ecovision Consulting (2008)	An assessment of the ecological impacts of the Moolarben Coal Project Stage 2.	Vegetation mapping and floristic lists for an area immediately west of and abutting the Wilpinjong Coal Mine mining lease.
Wilpinjong Coal Project EIS. Appendix HA Flora Assessment.	FloraSearch (2005)	Classification and mapping of vegetation communities across the Wilpinjong Coal Mine mining lease and associated areas.	A ground-truthed vegetation map and comprehensive floristic list for areas including the proposed Modification open cut extension areas.
Vegetation Survey of Goulburn River National Park and Munghorn Gap Nature Reserve for Fire Management Purposes.	Hill (1999)	A comprehensive vegetation survey of Goulburn River National Park and Munghorn Gap Nature Reserve.	Vegetation mapping in areas abutting parts of the Wilpinjong Coal Mine mining lease.
Moolarben Coal Project Stage 1 EIS Appendix 11 Flora, Fauna and Aquatic Ecology Assessment.	Moolarben Biota (2006)	An assessment of the ecological impacts of the Moolarben Coal Project Stage 1.	Vegetation mapping and floristic lists for an area immediately west of the Wilpinjong Coal Mine mining lease.
Draft Greater Hunter Native Vegetation Mapping (Version 4) - VIS Map ID 3855.	Sivertsen *et al.*, (2011)	Classification and mapping of native vegetation communities across the greater Hunter region, including Hawkesbury Nepean CMA. The classification is intended to be integrated into the NSW Plant Community Type Classification for use in NSW assessment and regulatory tools. Version 4 of the map and classification should be regarded as draft, and may undergo minor changes as it is integrated into the NSW Plant Community Type and subsequent tools.	The mapping takes in the Wilpinjong Coal Mine mining lease and surrounds
Ulan Coal Continued Operations Environmental Assessment. Volume 3 Appendix 8 Ecological Assessment.	Umwelt (2009)	An assessment of the ecological impacts of the Ulan West underground mine and open cut extension	Vegetation mapping and floristic lists for an area approximately 15 km north west of the Wilpinjong Coal Mine

Table 3 Communities Classified and Mapped by FloraSearch

Code	Community	Species
1	Yellow Box and Blakely's Red Gum Woodlands	*Eucalyptus melliodora/E. blakelyi/Angophora floribunda ± E. moluccana*
2	Coast Grey Box Woodlands	*E. moluccana ± E. crebra ± A. floribunda*
3	Rough-barked Apple Woodlands	*A. floribunda ± E. crebra ± C. endlicheri*
4	Narrow-leaved Ironbark Forest	*E. crebra/C. endlicheri ± E. macrorhyncha ± A. floribunda ± E. caleyi*
5a	Grassy White Box Woodlands	*E. albens ± E. moluccana ± C. endlicheri*
5b	Shrubby White Box Woodlands	*E. albens/C. endlicheri ± A. floribunda ± E. moluccana ± E. crebra*
6	Sandstone Range Shrubby Woodlands	*E. punctata/E. sparsifolia/C. endlicheri*
7	Cleared Agricultural Land	
8	Secondary Shrubland	*Acacia ixiophylla/Bursaria spinosa/Cassinia quinquefaria/Acacia implexa/Acacia linearifolia*

Table 4 Comparison Between FloraSearch and Greater Hunter Vegetation Communities

FloraSearch communities are in bold followed by the GHV communities mapped over the same area. The percentage of the total area of each FloraSearch unit is shown. GHV communities that are equivalent to each FloraSearch community are highlighted in grey. Percentages for each total just under 100% because of slight differences in vegetated/cleared boundary detection from aerial photography.

FloraSearch and Greater Hunter Vegetation Communities	% total area
1. Yellow Box and Blakely's Red Gum Woodlands	
MU092 White Box/ Black Cypress Pine shrubby woodland of the Western Slopes	22%
MU141 Rough-barked Apple grass/ forb riparian open forest in sandstone gullies of the upper Hunter and Sydney Basin	14%
MU142 Narrow-leaved Ironbark heathy woodland on sandstone ranges of the Sydney Basin and Brigalow Belt South	6%
MU155 Black Pine/ Red Ironbark/ Brown Bloodwood shrubby woodland on sandstone ranges of the Sydney Basin	26%
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	9%
MU157 Scribbly Gum/ Narrow-leaved Ironbark/ Bossiaea rhombifolia heathy open forest on sandstone ranges of the Sydney Basin	10%
MU158 Grey Gum/ Scribbly Gum/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	7%
MU175 Yellow Box/ Rough-barked Apple grassy woodland of the upper Hunter and Liverpool Plains	3%
MU180 Plainsgrass/ Purple wiregrass/ Wallaby Grass grassland on basalt soils of the Merriwa plateau	3%
2. Coast Grey Box Woodlands	
MU092 White Box/ Black Cypress Pine shrubby woodland of the Western Slopes	33%
MU141 Rough-barked Apple grass/ forb riparian open forest in sandstone gullies of the upper Hunter and Sydney Basin	8%
MU155 Black Pine/ Red Ironbark/ Brown Bloodwood shrubby woodland on sandstone ranges of the Sydney Basin	1%

Table 4 Comparison Between FloraSearch and Greater Hunter Vegetation Communities (Continued)

FloraSearch and Greater Hunter Vegetation Communities	% total area
2. Coast Grey Box Woodlands (Continued)	
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	41%
MU157 Scribbly Gum/ Narrow-leaved Ironbark/ Bossiaea rhombifolia heathy open forest on sandstone ranges of the Sydney Basin	2%
MU158 Grey Gum/ Scribbly Gum/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	12%
MU180 Plainsgrass/ Purple wiregrass/ Wallaby Grass grassland on basalt soils of the Merriwa plateau	2%
3. Rough-barked Apple Woodlands	
MU092 White Box/ Black Cypress Pine shrubby woodland of the Western Slopes	46%
MU141 Rough-barked Apple grass/ forb riparian open forest in sandstone gullies of the upper Hunter and Sydney Basin	5%
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	10%
MU157 Scribbly Gum/ Narrow-leaved Ironbark/ Bossiaea rhombifolia heathy open forest on sandstone ranges of the Sydney Basin	29%
MU158 Grey Gum/ Scribbly Gum/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	3%
MU180 Plainsgrass/ Purple wiregrass/ Wallaby Grass grassland on basalt soils of the Merriwa plateau	7%
4. Narrow-leaved Ironbark Forest	
MU141 Rough-barked Apple grass/ forb riparian open forest in sandstone gullies of the upper Hunter and Sydney Basin	10%
MU142 Narrow-leaved Ironbark heathy woodland on sandstone ranges of the Sydney Basin and Brigalow Belt South	6%
MU155 Black Pine/ Red Ironbark/ Brown Bloodwood shrubby woodland on sandstone ranges of the Sydney Basin	26%
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	12%
MU157 Scribbly Gum/ Narrow-leaved Ironbark/ Bossiaea rhombifolia heathy open forest on sandstone ranges of the Sydney Basin	44%
5a. Grassy White Box Woodlands	
MU092 White Box/ Black Cypress Pine shrubby woodland of the Western Slopes	20%
MU142 Narrow-leaved Ironbark heathy woodland on sandstone ranges of the Sydney Basin and Brigalow Belt South	8%
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	30%
MU173 Narrow-leaved Ironbark/ Grey Box grassy woodland of the central and upper Hunter	13%
MU175 Yellow Box/ Rough-barked Apple grassy woodland of the upper Hunter and Liverpool Plains	20%
MU180 Plainsgrass/ Purple wiregrass/ Wallaby Grass grassland on basalt soils of the Merriwa plateau	8%
5b. Shrubby White Box Woodlands	
MU092 White Box/ Black Cypress Pine shrubby woodland of the Western Slopes	38%

Table 4 Comparison Between FloraSearch and Greater Hunter Vegetation Communities (Continued)

FloraSearch and Greater Hunter Vegetation Communities	% total area
5b. Shrubby White Box Woodlands (Continued)	
MU141 Rough-barked Apple grass/ forb riparian open forest in sandstone gullies of the upper Hunter and Sydney Basin	2%
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	48%
MU158 Grey Gum/ Scribbly Gum/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	6%
MU180 Plainsgrass/ Purple wiregrass/ Wallaby Grass grassland on basalt soils of the Merriwa plateau	5%
6. Sandstone Range Shrubby Woodlands	
MU092 White Box/ Black Cypress Pine shrubby woodland of the Western Slopes	13%
MU141 Rough-barked Apple grass/ forb riparian open forest in sandstone gullies of the upper Hunter and Sydney Basin	4%
MU156 Red Ironbark/ Brown Bloodwood/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	54%
MU158 Grey Gum/ Scribbly Gum/ Black Pine heathy open forest on sandstone ranges of the Sydney Basin	26%

4 Supplementary Field Survey Methods

The Modification open cut extension areas were surveyed to determine floristic content and vegetation community types. A particular aim was to locate any flora species or ecological communities that were listed as threatened in TSC Act or EPBC Act.

The survey methodology utilised generally conformed with the *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities Working Draft* (DEC, 2004). Flora surveys were conducted on 9, 10, 11 and 25 January 2013, and 9 May 2013.

4.1 Flora

Floristic content in the Modification open cut extension areas was determined through the use of standard 20 x 20 m sample plots and random meanders. All species present within the bounds of each sample plot were recorded, along with a score for abundance. Abundance was scored using the modified Braun-Blanquet 1-6 scale (**Table 5**).

Table 5 Braun-Blanquet Cover-Abundance Scores

Cover range	Score
<5% few individuals	1
<5% many individuals	2
5% - <25%	3
25% - <50%	4
50% - <75%	5
75% - 100%	6

Random meanders were used to search for species that had not been recorded in the sample plots.

4.1.1 Threatened Flora

One of the primary targets of the field survey was to detect any threatened flora species in the Modification open cut extension areas. To facilitate this, all records were compiled from other studies in the immediate region (**Table 2**) along with database searches of NSW BioNet (OEH, 2013b) and the Commonwealth EPBC Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Communities, 2013). Records were drawn from within 20 km of the Wilpinjong Coal Mine. **Table 6** shows the resulting 20 threatened species along with two possible endangered populations.

Table 6 Threatened Flora Species and Populations Potentially Occurring in the Modification Open Cut Extension Areas

Threatened Species		**Status**[1]	
Family	**Scientific Name**	**TSC Act**	**EPBC Act**
Apocynaceae	*Tylophora linearis*	V	E
Asteraceae	*Leucochrysum albicans* var. *tricolor*	-	[E]
Asteraceae	*Ozothamnus tesselatus*	V	(V)
Fabaceae (Faboideae)	*Kennedia retrorsa*	V	(V)
Fabaceae (Faboideae)	*Swainsona recta*	E	(E)
Fabaceae (Mimosoideae)	*Acacia ausfeldii*	V	-
Geraniaceae	*Pelargonium* sp. *striatellum* (G.W.Carr 10345)	(E)	E
Lamiaceae	*Prostanthera cryptandroides* subsp. *cryptandroides*	V	(V)
Lamiaceae	*Prostanthera discolor*	V	(V)
Lamiaceae	*Prostanthera stricta*	V	(V)
Malvaceae	*Lasiopetalum longistamineum*	V	(V)
Myrtaceae	*Eucalyptus macrorhyncha subsp. cannonii*	-	V
Myrtaceae	*Eucalyptus cannonii*	V	-
Myrtaceae	*Homoranthus darwinioides*	V	(V)
Orchidaceae	*Prasophyllum* sp. *Wybong (C.Phelps ORG 5269)*	-	CE
Orchidaceae	*Diuris tricolor*[2]	V	-
Rhamnaceae	*Pomaderris queenslandica*	E	-
Rutaceae	*Philotheca ericifolia*	-	V
Santalaceae	*Thesium australe*	(V)	V
Scrophulariaceae	*Euphrasia arguta*	(CE)	CE
Endangered Populations			
Myrtaceae	*Eucalyptus camaldulensis* Dehnh. in the Hunter Catchment	EP	-
Orchidaceae	*Cymbidium canaliculatum* R. Br. in the Hunter Catchment	EP	-

Status: V=vulnerable, E=endangered, CE=critically endangered, EP=endangered population.
(V) bracketed status codes indicate listed species not included in the respective data extracts. [V] bracketed status codes indicate local records of species not included in data extracts.
[1] Conservation status under the TSC Act and EPBC Act current as of 17 June 2013.
[2] Listed as *Diuris sheaffiana* prior to name change to *D. tricolor.*

4.2 Vegetation Communities

In principle there are two separate components involved in preparing a vegetation map: community classification, and spatially mapping the distribution of the classified communities.

Classification involves decisions about species content that define communities as different. At its simplest, broad classification can be intuitive, based on perceived differences in floristic content as observed in the field. Detailed classification is arrived at through similarity analysis of floristic data collected from plots (commonly 20 x 20 m) that sample the observed (or theoretical) variation. Similarity analysis of plot data is generally conducted by way of hierarchical agglomerative clustering, often supported with multi-dimensional scaling (MDS); Primer 6 (Clarke and Gorley, 2006) was used for plot analysis in this report.

Initially rapid data points (RDP) were collected where the dominant species in the canopy, shrub and ground layers, were recorded against their geographic coordinates. The RDP were given a tentative community classification based on that of FloraSearch and these were used to approximately delineate community boundaries. Floristic plot data were then analysed for similarity. Because of the small size of the Modification open cut extension areas, a full classification was not determined. The similarity analysis results were used to provide insight into the robustness of the original FloraSearch intuitive classification. However, for the purposes of continuity, the FloraSearch classification was retained.

In one instance the distinct boundary between two communities was walked with a hand-held GPS to provide an accurate boundary line for the final vegetation map.

4.3 SEPP 44 Koala Habitat

In accordance with *State Environmental Planning Policy 44 – Koala Habitat Protection* (SEPP 44), the impact of the Modification open cut extension areas on core and potential Koala habitat was assessed. SEPP 44 aims to encourage the conservation and proper management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range, and to reverse a long trend of population decline. Core and potential Koala habitat are defined by SEPP 44 as:

- core Koala habitat means an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population); and
- potential Koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Eucalyptus albens (White Box) was the only Schedule 2 Koala feed tree present with both Shrubby White Box Woodland and Grassy White Box Woodland providing potential habitat. Koalas were targeted during the Modification fauna surveys (Biodiversity Monitoring Services, 2013). Despite this, there was no evidence that Koalas utilise the Modification open cut extension areas.

5 Supplementary Field Survey Results

5.1 Flora

Appendix 2 lists the 154 flora species from 52 families that were recorded across the Modification open cut extension areas, 26 species of which were weeds. The prominent families were Poaceae 35 species and Asteraceae 14 species. Also, 34 of these species had not been recorded in the FloraSearch (2005) survey (bold and italisiced in **Appendix 2**). No listed threatened flora species were recorded.

5.1.1 Threatened Flora Species and Populations

An evaluation of database records of threatened flora species occurring within or surrounding the Modification open cut extension areas, against the known habitat requirements of those species provides an assessment of likelihood of occurrence in the Modification open cut extension areas (**Table 7**). Habitat preference information was drawn from The Royal Botanic Gardens and Domain Trust (2013) and OEH (2013b). Flora species that were determined to be potentially impacted by the Modification open cut extension areas are assessed in **Section 7**.

Table 7 Threatened Flora Species and Populations Likelihood of Occurrence in the Modification Open Cut Extension Areas

Threatened Species/Population	Status[1]		Likelihood of Occurring
	TSC Act	EPBC Act	
Acacia ausfeldii	V	-	Potential. Suitable woodland habitat. Not recorded by past or current surveys.
Cymbidium canaliculatum R. Br. in the Hunter Catchment	EP	-	Potential. Suitable host species present for this arboreal orchid. Not recorded by past or current surveys.
Diuris tricolor[2]	V	-	Potential. Suitable grassland habitat. Not recorded by past or current surveys.
Eucalyptus camaldulensis Dehnh. in the Hunter Catchment	EP	-	Unlikely. No suitable riverine habitat. Not recorded by past or current surveys.
Eucalyptus cannonii	V	-	Potential. Suitable forest habitat. Not recorded by past or current surveys.
Eucalyptus macrorhyncha subsp. *cannonii*[1]	-	V	Potential. Suitable forest habitat. Not recorded by past or current surveys.
Euphrasia arguta	CE	CE	Unlikely Not recorded by past or current surveys.
Homoranthus darwinioides	V	V	Unlikely. No suitable habitat. Grows on sandstone outcrops or ridges. Not recorded by past or current surveys.
Kennedia retrorsa	V	V	Potential. Suitable woodland habitat

Table 7 Threatened Flora Species and Populations Likelihood of Occurrence in the Modification Open Cut Extension Areas (Continued)

Threatened Species/Population	Status[1]		Likelihood of Occurring
	TSC Act	EPBC Act	
Lasiopetalum longistamineum	V	V	Unlikely. No suitable habitat. Grows in rich alluvial deposits. Not recorded by past or current surveys.
Leucochrysum albicans var. *tricolor*	-	E	Potential. Suitable grassland habitat. Not recorded by past or current surveys.
Ozothamnus tesselatus	V	V	Potential. Suitable woodland habitat. Not recorded by past or current surveys.
Pelargonium sp. striatellum (G.W. Carr 10345)	E	E	Unlikely. Grows above the high water level of irregularly inundated or ephemeral lakes. Not recorded by past or current surveys.
Philotheca ericifolia	-	V	Unlikely. Grows in sclerophyll open forest/woodland on sandstone and in heath on gullies. Not recorded by past or current surveys.
Pomaderris queenslandica	E	-	Unlikely. No suitable habitat. Grows in moist eucalypt forest. Not recorded by past or current surveys.
Prasophyllum sp. *Wybong (C. Phelps ORG 5269)*	-	CE	Potential. Suitable grassland habitat. Not recorded by past or current surveys.
Prostanthera cryptandroides subsp. cryptandroides	V	V	Potential. Suitable woodland habitat. Not recorded by past or current surveys.
Prostanthera discolor	V	V	Unlikely. No suitable habitat. Grows in rocky gullies. Not recorded by past or current surveys.
Prostanthera stricta	V	V	Unlikely. No suitable habitat. Grows on sandy alluvium near watercourses. Not recorded by past or current surveys.
Swainsona recta	E	E	Potential. Suitable woodland habitat. Not recorded by past or current surveys.
Thesium australe	V	V	Potential. Suitable grassland habitat. Not recorded by past or current surveys.
Tylophora linearis	V	E	Potential. Suitable woodland habitat. Not recorded by past or current surveys.

Status: V=vulnerable, E=endangered, CE=critically endangered, EP=endangered population.
[1] Conservation status under the TSC Act and EPBC Act current as of 17 June 2013.
[2] Listed as *Diuris sheaffiana* prior to name change to *D. tricolor.*

5.1.2 Vegetation Communities

As was described in **Section 4.2**, vegetation communities in the Modification open cut extension areas were initially assessed intuitively for their resemblance to those described by FloraSearch (2005).

Figure 9 shows the communities mapped across ML 1573 by FloraSearch along with those mapped across the Modification open cut extension areas during the current investigation. Also included in **Figure 9** (insets) are the locations and codes for the 22 floristic sample plots, details of which can be found in **Appendix 3**. **Table 8** provides details of the communities occurring within each Modification open cut extension area. The only listed threatened ecological communities (TEC) were recorded in Area E.

Six woodland communities, classified according to FloraSearch (2005), were mapped across the Modification open cut extension areas. The only variation to the FloraSearch classification was for Area G where a Community 4a *Caley's Ironbark Woodland* was split out of Community 4 *Narrow-leaved Ironbark Forest* because of its distinctly different appearance. The boundary of this community was plotted by hand-held GPS.

Table 8 Vegetation Communities Mapped Across the Modification Open Cut Extension Areas

Veg Code	Community	Species	Status[1]	Area (ha)
Areas A and B				
0	Disturbance – non-native	-	-	**5.8**
Total				**5.8**
Area C				
7a	Derived Grassland – weedy	**Verbascum thapsus, *Plantago lanceolata*	-	1.8
7d	Derived Grassland – other native	*Bothriochloa macra, Sporobolus creber*	-	0.03
5b	Shrubby White Box Woodland	*E. albens ± E. moluccana ± C. endlicheri*	-	0.7
Total				**2.53**
Area D				
5b	Shrubby White Box Woodland	*E. albens/C. endlicheri ± A. floribunda ± E. moluccana ± E. crebra*	-	1.9
7c	Derived Grassland – box-gum shrubby	*Calotis lappulacea, Austrostipa scabra* subsp. *scabra, Sporobolus creber*	-	1.1
Total				**3.0**
Area E				
5a	Grassy White Box Woodland (ECC/CEEC)	*E. albens ± E. moluccana ± C. endlicheri*	EEC/CEEC[2]	2.2
5b	Shrubby White Box Woodland	*E. albens/C. endlicheri ± A. floribunda ± E. moluccana ± E. crebra*	-	5.0
7a	Derived Grassland – weedy	**Carthamus lanatus, *Verbena bonariensis, *Conyza* sp.	-	4.7

Table 8 Vegetation Communities Mapped Across the Modification Open Cut Extension Areas

Veg Code	Community	Species	Status[1]	Area (ha)
Area E (Continued)				
7b	Derived Grassland – box-gum grassy	*Convolvulus erubescens, Calotis lappulacea, Elymus scaber*, *Austrostipa scabra* subsp. *scabra*	EEC/CEEC[2]	8.4
7d	Derived Grassland – other native	*Austrostipa scabra* subsp. *scabra, *Verbena bonariensis, *Chondrilla juncea*	-	0.7
Total				**21.0**
Area F				
2	Coast Grey Box Woodland	*E. moluccana* ± *E. crebra* ± *A. floribunda*	-	0.3
7d	Derived Grassland – other native	*Rytidosperma duttoniana, Elymus scaber, Aristida vagans, Cryptandra spinescens*	-	16.8*
Total				**17.1**
Area G				
2	Coast Grey Box Woodland	*E. moluccana* ± *E. crebra* ± *A. floribunda*	-	2.1
4	Narrow-leaved Ironbark Forest	*E. crebra*/C. endlicheri ± *E. macrorhyncha* ± *A. floribunda* ± *E. caleyi*	-	5.3
4a	Caley's Ironbark Woodland	*E. caleyi/C. endlicheri*	-	3.0
Total				**10.4**
Area H				
2	Coast Grey Box Woodland	*E. moluccana* ± *E. crebra* ± *A. floribunda*	-	1.1
5b	Shrubby White Box Woodland	*E. albens*/C. endlicheri ± *A. floribunda* ± *E. moluccana* ± *E. crebra*	-	6.9
6	Sandstone Range Shrubby Woodland	*E. punctata/E. sparsifolia/ C. endlicheri*	-	1.3
7d	Derived Grassland – other native		-	0.4
Total				**9.7**
GRAND TOTAL				**69.5**
Total excluding disturbed land, Approved Mine Disturbance and Derived Grassland - Weedy				**51.7**

Note: EEC – Endangered Ecological Community, CEEC – Critically Endangered Ecological Community.

[1] Conservation status under the EPBC Act and/or TSC Act current as of 7 May 2013.

[2] NSW EEC *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland*; Commonwealth CEEC *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*

* Approximately 5.5 ha of Vegetation Community 7d Derived Grassland – other native within Modification Area F is already approved for disturbance and not included in vegetation calculations throughout this report.

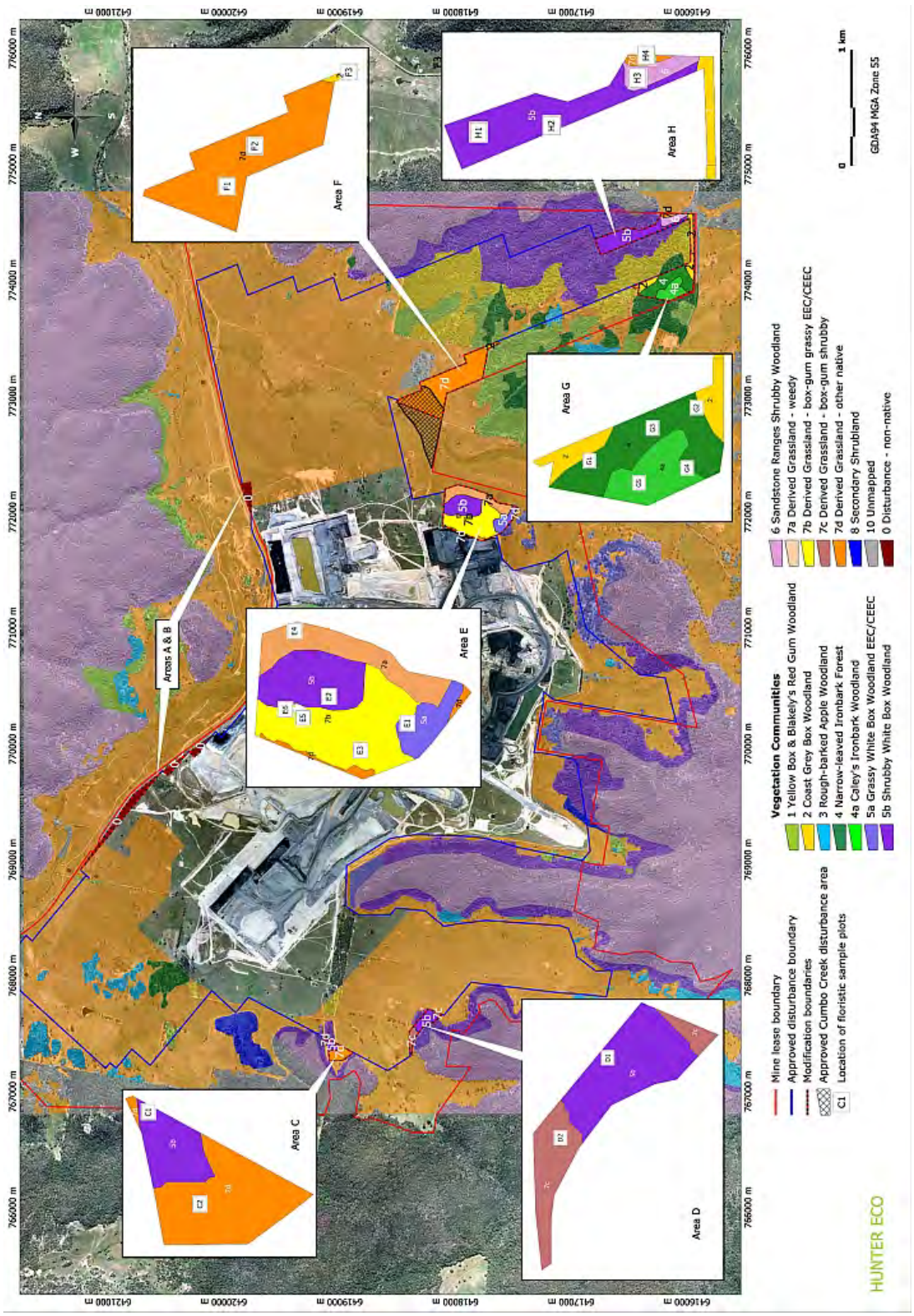


Figure 9 Vegetation Communities Mapped by FloraSearch (2005) Over Wilpinjong Coal Mine Mining Lease and Hunter Eco Over the Modification Open Cut Extension Areas

Vegetation community profiles are provided in **Appendix 4**.

Similarity analysis in the form of non-metric MDS showed that some of the FloraSearch communities were not clearly different, **(Figure 10)**. The floristic plots are positioned according to their relative similarity. The ellipses show grouping from a cluster analysis using the SIMPROF option that identifies significantly different groupings.

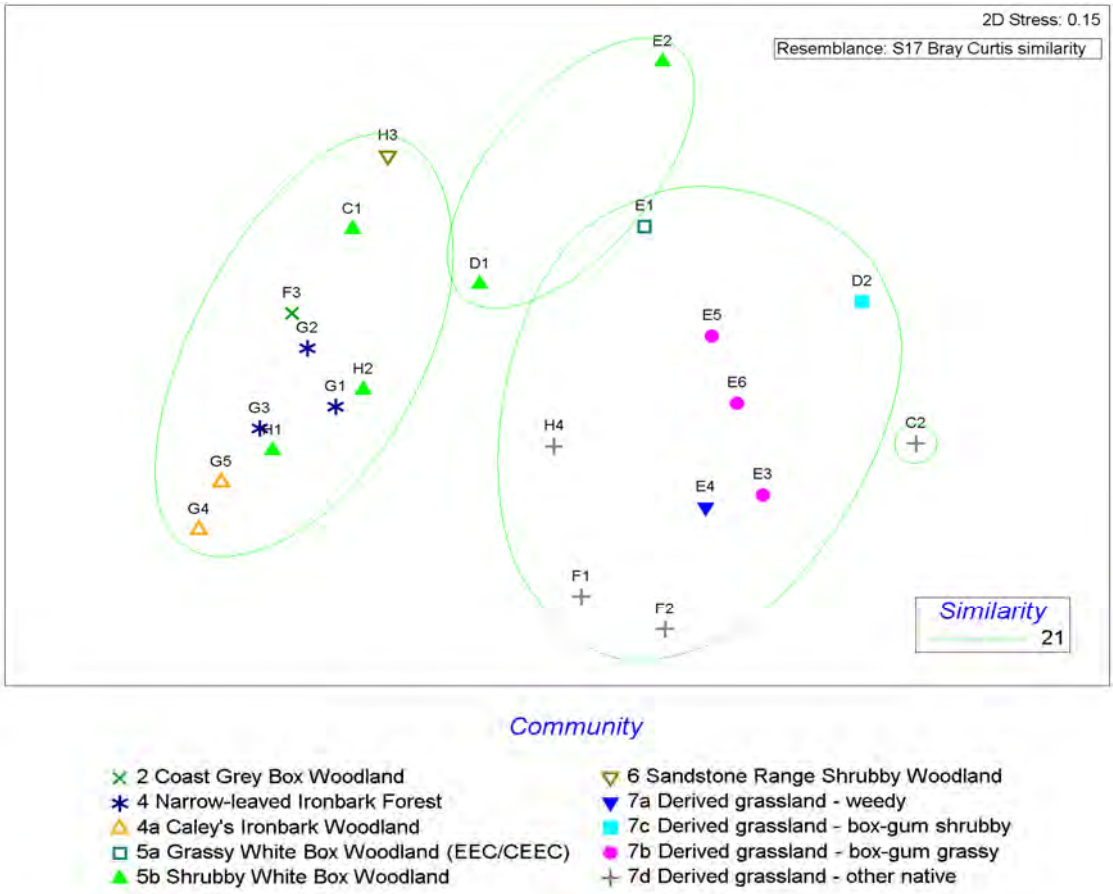


Figure 10 MDS Showing Relative Similarity Between Woodland Sample Plots

This analysis shows that despite differences in canopy species dominance, five communities identified by FloraSearch at Areas G and H are floristically similar and could well represent one community. Plot F3 is also included in this group which is consistent with it being in a small projection of Area F into the same woodland.

The Grassy White Box Woodland (EEC/CEEC) community is distinctly different from the Shrubby White Box Woodland communities that are themselves different from each other. It was clear from the floristic content that the community represented by plot E2 was different from any others. Plots C1 and D1 were from foot slope vegetation and further sampling from the adjoining woodland vegetation would be needed to provide a better understanding of their relationships.

Other than grasslands specifically identified as weedy, all vegetation in the Modification open cut extension areas was in good condition.

Modification Areas A and B
No floristic data were collected from this area as it was predominantly disturbed mine-worked land. This has been mapped as Disturbance – non-native.

Modification Area C
Approximately one third of this area was woodland with the remainder being grassland. A closer examination of the similarity analysis reveals that woodland plot C1 is most similar to plot H3.

This is not unexpected because plot C1 is located close to the same vegetation community in which plot H3 is located, Sandstone Range Shrubby Woodland. The canopy in the Area C woodland was dominated by Coast Grey Box (*Eucalyptus moluccana*), White Box (*Eucalyptus albens*) and Narrow-leaved Ironbark (*Eucalyptus crebra*).

The grassland contained a number of native species but was dominated by the large weed Green Mullein (*Verbascum virgatum*).

Modification Area D
This area is wrapped around the foot of a ridge and about half is woodland that is continuous with that on the ridge. The woodland canopy was dominated by *Eucalyptus albens* and *Callitris endlicheri* and there was a dense shrub layer of *Bursaria spinosa*. The grassland was predominantly native in content and derived from the adjoining Shrubby White Box Woodland.

Modification Area E
Area E lies over a minor ridge that extends into ML 1537. The highest point of the ridge contains Shrubby White Box Woodland with the canopy dominated by White Box (*Eucalyptus albens*). This area has a predominantly shale lithology and a very different suite of shrubs are present compared to the other shrubby white box sites. In particular there was *Santalum lanceolatum, Myoporum montanum, Halgania brachyrhyncha* and *Pimelea linifolia*.

Lower on the ridge the lithology became dominated by sandstone and there was a patch of *Eucalyptus albens* with a grassy ground cover that formed a Grassy White Box Woodland (EEC/CEEC) community. The surrounding cleared and predominantly native grassland was conservatively presumed to have been derived from the woodland community. Together this area was representative of the box-gum and derived grassland threatened communities:

- NSW EEC *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland*; and

- Commonwealth CEEC *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*.

At the base of the ridge on the eastern side was an area that was clearly dominated by weeds, with weeds being just under half the total species recorded. The dominant weed was Saffron Thistle (*Carthamus lanatus*) and while there was little new growth of this species abundant dead remnants were present.

Modification Area F

This area was almost entirely native grassland with some low shrubs, herbs and forbs along with scattered paddock trees. The paddock trees were mostly *Eucalyptus crebra* Ironbarks along with some White Box (*Eucalyptus albens*). The grassland was conservatively most likely derived from shrubby woodland consistent with the surrounding shrubby woodland. A small south eastern part of the area projected into the adjoining shrubby woodland.

Modification Area G

Based on canopy species dominance this area has been divided into three communities: Coast Grey Box Woodland dominated by Coastal Grey Box (*Eucalyptus moluccana*), Narrow-leaved Ironbark Forest dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*), and Caley's Ironbark Woodland dominated by Caley's Ironbark (*Eucalyptus caleyi*). Sifton Bush (*Cassinia arcuata*) was the main shrub present through the Coastal Grey Box Woodland and Narrow-leaved Ironbark Forest communities. Caley's' Ironbark Woodland had a generally dense midstorey of Cypress Pine (*Callitris endlicheri*).

Modification Area H

While this area has been mapped as Shrubby White Box Woodland, its canopy was a mixture of Coastal Grey Box (*Eucalyptus moluccana*), White Box (*Eucalyptus albens*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). As **Figure 10** shows, the composition was most similar to that of the adjoining Area G. There was also a small area of Sandstone Range Shrubby Woodland in the south east of Area H, dominated by Grey Gum (*Eucalyptus punctata*).

5.1.3 Threatened Flora Populations

No listed threatened flora populations were found in the Modification open cut extension areas.

6 Impact Evaluation

The Modification open cut extension areas would result in the same types of potential impacts on biodiversity as the existing approved mine (e.g. land clearance and indirect impacts). This section describes the magnitude, extent and significance of potential impacts from the Modification open cut extension areas in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005). Ancillary infrastructure associated with the Modification would be designed and constructed in accordance with existing management plans and protocols developed to minimise impacts on flora and fauna values. These existing measures are described in Section 9.1.

Section 7 provides an assessment of the potential impacts on threatened species.

6.1 Potential Direct Impacts

Clearing of native vegetation is listed as a key threatening process on Schedule 3 of the TSC Act. This is relevant to the Modification open cut extension areas as land clearance would cause impacts to a TEC that is known to occur in the Modification open cut extension areas, and potentially to threatened flora species that may occur (although none have been recorded). The Modification open cut extension areas would remove approximately 51.7 ha of native vegetation (29.8 ha of woodland and 21.9 ha of grassland).

Land clearance may also result in impacts to habitat connectivity; changes to hydrology and impacts to groundwater dependent ecosystems. These potential direct and indirect impacts are described in **Sections 6.1.1 to 6.2.4**.

6.1.1 Loss of Native Vegetation

The Modification open cut extension areas would require the removal of 51.7 ha of native vegetation as outlined in **Table 9**. This excludes Areas A and B (Disturbance – non-native), Derived Grassland – weedy, a dam and 5.5 ha of vegetation community 7d within Area F which is previously approved mine disturbance.

Table 9 Summary of Vegetation Classes to Be Cleared in the Modification Open Cut Extension Areas

Vegetation Class	Area (ha)
Box-gum woodland (EEC/CEEC)	2.2
Box-gum grassland (EEC/CEEC)	8.4
Woodland other	27.6
Grassland other	13.5
TOTAL	51.7

6.1.2 Impacts on Habitat Connectivity

Each component of the Modification open cut extension areas are situated at the edge of the approved mine disturbance area and therefore would not create habitat fragmentation (**Figure 3**).

6.1.3 Changes to Hydrology

The key drainage feature relevant to the Modification open cut extension areas is Cumbo Creek, an ephemeral drainage line that flows past Area F. The currently approved mine includes relocating this drainage line during mining and reinstating it post-mining.

All water management including upstream diversions for clean water, etc. is controlled by the *Wilpinjong Coal Project Site Water Management Plan* (WCPL 2006) and this document would be expanded to incorporate the Modification open cut extension areas. Therefore there would be no significant impact to hydrology as a result of the Modification open cut extension areas.

6.1.4 Groundwater Dependent Ecosystems

No vegetation was identified as having the potential to be groundwater dependent. Cumbo Creek passes through open grassland adjacent to Area F. All other areas of the Modification open cut extension areas were elevated and away from drainage lines. Therefore the Modification open cut extension areas would not impact any groundwater dependent ecosystems.

6.2 Potential Indirect Impacts

6.2.1 Introduced Flora

The Modification flora survey recorded 25 weed species in the Modification open cut extension areas (**Appendix 2**). Clearly, weeds were predominantly located in open grassland where 51% of the species recorded were weeds. This compared with 5% of the species recorded being weeds in woodland habitat. The *Wilpinjong Coal Mine Rehabilitation Management Plan* (WCPL, 2011) stipulates measures for weed control in the currently approved operations. This plan would be altered to include the Modification open cut extension areas.

6.2.2 Hydrology

Groundwater Dependent Vegetation

As noted in **Sections 6.1.3 and 6.1.4**, the Modification open cut extension areas would not substantially increase impacts on drainage lines and no groundwater dependent vegetation was present in the Modification open cut extension areas.

6.2.3 Dust

The atmospheric dust emissions produced by the approved Wilpinjong Coal Mine would increase slightly as a result of the Modification open cut extension areas (Todoroski Air Sciences 2013). This increase is primarily associated with ongoing construction activities, mining activities and waste rock handling and stockpiling activities.

The approved Wilpinjong Coal Mine currently operates with a dust monitoring programme. This programme would continue for the Modification open cut extension areas. It is unlikely that any flora species would be adversely impacted either directly or indirectly by any dust increase generated as a result of the Modification open cut extension areas.

6.2.4 *Phytophthora cinnamomi*

Infection of native plants by *Phytophthora cinnamomi* is listed as a key threatening process under Schedule 3 of the TSC Act and dieback caused by the *root-rot fungus (*Phytophthora cinnamomi*)* is listed under the EPBC Act. *Phytophthora cinnamomi* is a soil borne pathogen that is associated with plant deaths in native vegetation in NSW.

The Modification open cut extension areas would not increase the susceptibility of plants to *Phytophthora cinnamomi*. *Phytophthora cinnamomi* spreads in water, soil or plant material, generally in moist, wet conditions (NSW Department of Environment and Heritage 2006). The Modification open cut extension areas would not increase the spread of soils or plant material at the Wilpinjong Coal Mine. In addition, there are currently implemented control measures to stop and reduce the spread of weeds which would be continued for the Modification open cut extension areas as discussed in **Section 6.2.1** above.

6.3 Cumulative Impacts on Biodiversity

Cumulative impacts on biodiversity consist of the net effect of all activities that have occurred across a landscape since European settlement. Clearing of habitat in the Mudgee/Wollar area commenced in the early 1800s, primarily for agricultural purposes. The Wilpinjong Coal Mine was originally established in a widely cleared landscape (see **Figure 8**), and cumulative impacts by the Wilpinjong Coal Mine on biodiversity cannot be considered in isolation from earlier impacts (including those by neighbouring mines and agricultural enterprises).

The Modification open cut extension areas would result in the loss of 51.7 ha of mixed native woodland and grassland habitat. The overall proposal includes a strategy to offset these losses by a factor of four meaning that the cumulative effect of the Modification would be a net gain in biodiversity.

In addition, land disturbed by the Modification open cut extension areas would be rehabilitated post-mining with endemic species. Further detail on post-mining rehabilitation is provided in Sections 2.11 and 3.4 of the Main Text.

7 Threatened Species Assessment

The flora investigation and impact assessment was conducted according to the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005).

Section 8 provides a formal assessment of impacts by the Modification open cut extension areas on threatened flora and ecological communities.

7.1 Threatened Species

No threatened flora species were recorded in the Modification open cut extension areas by either the current surveys or those by FloraSearch for the original EIS. However, this does not mean that under suitable conditions one or more threatened species could be not found. **Table 10** shows those threatened species/populations with potential to occur in the Modification open cut extension areas, based on reported habitat preferences and knowledge of the habitat in the Modification open cut extension areas (**Table 7**).

Table 10 Assessment of the Likelihood of Threatened Flora Occurring in the Modification Open Cut Extension Areas

Threatened Species/Population	Status[1]	
	TSC Act	EPBC Act
Acacia ausfeldii	V	-
Diuris tricolor[2]	V	-
Eucalyptus cannonii	V	-
Eucalyptus macrorhyncha subsp. *cannonii*	-	V
Kennedia retrorsa	V	V
Leucochrysum albicans var. *tricolor*	-	E
Ozothamnus tesselatus	V	V
Prasophyllum sp. *Wybong (C. Phelps ORG 5269)*	-	CE
Prostanthera cryptandroides subsp. *cryptandroides*	V	V
Swainsona recta	E	E
Tylophora linearis	V	E
Thesium australe	V	V
Cymbidium canaliculatum R. Br. in the Hunter Catchment	EP	-

[1] Conservation status under the TSC Act and EPBC Act current as of 17 June 2013.
[2] Listed as Diuris sheaffiana prior to name change to *D. tricolor*.
V = Vulnerable, E – Endangered, CE – Critically

7.2 Endangered Populations

No listed endangered populations were recorded in the Modification open cut extension areas and none are considered likely enough to warrant individual assessment.

8 Impact Assessment

8.1 Threatened Flora Species

Because no threatened flora species or populations were recorded does not mean that they can be considered to be absent. For the purposes of this impact assessment it is assumed that any of those species or populations listed in **Table 10** may be present under favourable circumstances. For example, the terrestrial orchid *Diuris tricolor* has a brief flowering in late September to early October which is the only time it can be seen. Notwithstanding this conservative approach, considering the nature and scale of the impacts associated with the Modification open cut extension areas, individual assessments are not considered warranted for threatened flora species. The assessment presented below addresses all potential threatened species and populations (**Table 10**). Considering the nature and scale of the potential impacts, these assessments are considered adequate to address NSW and Federal assessment requirements.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Clearing of the Modification open cut extension areas would result in the loss of any threatened species in those areas and in the worst case, could destroy the only occurrence of the species in the immediate locality (should they occur at all). However the overall proposal includes a Biodiversity Offset strategy whereby habitat equivalent in type and quality to that in the Modification open cut extension areas would be set aside as reserve. Overall the proposal would result in a net gain in habitat that is potentially suitable for the threatened species that are the subject of this assessment.

No listed threatened populations were recorded. *Cymbidium canaliculatum* R. Br. in the Hunter Catchment is the only endangered population likely to occur in the Modification open cut extension areas. The nearest records for this arboreal orchid are from Bylong Valley approximately 20 km south-east of the Modification open cut extension areas.

Survey by FloraSearch (2005) and the current survey did not record *Cymbidium canaliculatum* and it has not been recorded in any surveys for Moolarben and Ulan Coal Mines. However, the Biodiversity Offset strategy includes habitat containing suitable host trees for the species.

Therefore it is considered that the Modification open cut extension areas are unlikely to affect the lifecycle of a threatened flora species or population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The response to the previous question is also applicable here. Despite loss of potential habitat in the Modification open cut extension areas (noting that no threatened species or populations have been recorded), the Biodiversity Offset strategy would result in a net gain in habitat.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Tylophora linearis would be at the south-eastern limits of its known distribution if it were present. None of the other threatened flora species are the limit of their known distribution.

How is the proposal likely to affect habitat connectivity?

The proposal would not affect habitat connectivity. Refer to detail in **Section 6.1.2**.

How is the proposal likely to affect critical habitat?

No critical habitat has been listed for the Modification open cut extension areas or surrounds.

8.2 Threatened Ecological Communities

One listed EEC was recorded in the Modification open cut extension areas and an impact assessment follows.

NSW EEC White Box, Yellow Box, Blakely's Red Gum Grassy Woodland

This EEC only occurred in Area E where there was 2.2 ha of the woodland type (5a Grassy White Box Woodland [EEC/CEEC]) and 8.4 ha of the derived grassland type (7b Derived Grassland – box-gum grassy). Because the derived grassland type is of value for its potential to recover to the woodland type from which it was derived, impact is assessed on the combined area of approximately 10.6 ha.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not relevant in consideration of an EEC.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Part of the proposal would result in the loss of approximately 10.6 ha this EEC in Modification Area E. However, in keeping with 'improve or maintain' principles, the proposal also includes a Biodiversity Offset strategy. Suitable habitat is proposed to be set aside as reserve (**Section 9**) so that the final outcome of the proposal would be a net gain for this EEC.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

This EEC extends from the Victorian border in the south to the Queensland border in the north. It occurs in both tablelands and western slopes.

At the Modification open cut extension areas, in the Central Western Slopes, the community is at about the centre of its range.

How is the proposal likely to affect habitat connectivity?

The proposal would not affect habitat connectivity. Refer to detail in **Section 6.1.2** above.

How is the proposal likely to affect critical habitat?

No critical habitat has been listed for the Wilpinjong area.

8.3 Conclusion

No threatened flora species were recorded within the Modification open cut extension areas. Further, the Modification open cut extension areas would only involve a small area of clearance (51.7 ha of native vegetation). The overall proposal includes a Biodiversity Offset strategy that would not only negate any losses incurred by the Modification open cut extension areas, but would result in a net gain. It is concluded that the Modification open cut extension areas would not have a significant impact on threatened flora, endangered populations or endangered communities.

9 Impact Avoidance, Mitigation and Offset Measures

The management and mitigation measures for the Modification open cut extension areas would be an extension of existing measures created for the Wilpinjong Coal Mine, with Project Approval 05-0021, granted by the NSW Minister for Planning in February 2006. **Section 9.1** details these existing management measures which would apply to the Modification open cut extension areas.

9.1 Existing Impact Avoidance and Mitigation Measures at the Wilpinjong Coal Mine

The *Wilpinjong Coal Mine Rehabilitation Management Plan* (WCPL, 2011) and *Bushfire Management Plan* (EcoLogical, 2011) have been developed to facilitate the management of biodiversity at the existing approved Wilpinjong Coal Mine. Details of these management measures relating to flora are provided below:

- Progressive site rehabilitation.
- Revegetation and regeneration within the Enhancement and Conservation Areas (ECA).
- Protecting and enhancing the ECAs.
- Creek rehabilitation.
- A Vegetation Clearance Protocol, including pre-clearance surveys and managing impacts on fauna.
- A Threatened Species Management Protocol (TSMP).
- Landscaping within the Wilpinjong Coal Mine area to minimise visual impacts.
- Conservation and re-use of topsoil.
- Collection and propagation of seed for rehabilitation works.
- Salvage and re-use of material from the Wilpinjong Coal Mine area for habitat enhancement.
- Weed and animal pest control.
- Restrictions on site access.
- Bushfire management.

Table 11 details the existing impact avoidance and mitigation measures that are currently implemented.

Table 11 Existing Impact Avoidance and Mitigation Measures at the Wilpinjong Coal Mine – Rehabilitation Management Plan

Measure	Description
Progressive site rehabilitation	Revegetation of Wilpinjong Coal Mine disturbance areas (rehabilitation areas) would be conducted progressively as mining proceeds with consideration of tailings dams and areas required for stockpiling pre-strip material. The strategy aim of progressive site rehabilitation is to establish floristic diversity. Surface development areas are progressively rehabilitated and revegetated with species characteristic of native species endemic to the local area. Progressive rehabilitation would include the placement of topsoil to act as germination medium for vegetation and as a seed source. Species to be planted in the rehabilitated landforms would be a mixture of native and introduced locally successful tree, grass and legume species. Locally collected tree and shrub seed would be used where practical.
Revegetation and regeneration within the ECAs	Management measures to be implemented within the ECAs include enhancement strategies such as fencing, selective planting of native vegetation if required, weed and animal pest control, bushfire management, salvaging of important habitat features (e.g. large hollows) and the use of artificial roosting/nesting boxes for fauna, particularly threatened fauna. The selective planting would aim to enlarge remnant vegetation and to link existing remnant vegetation. Native vegetation would be selectively placed along creeks where required. Regeneration areas would be established on WCPL-owned land to create a corridor between the surrounding protected areas of Goulburn River National Park and Munghorn Gap Nature Reserve, the ECAs and rehabilitated woodlands. Key objectives of the regeneration areas include: • To establish woodland vegetation on predominantly cleared agricultural land. • To be established through natural regeneration and selective planting where necessary. Stock would be excluded from regeneration areas for an initial 10 year period to allow trees to establish. *Monitoring* A number of techniques would be utilised to monitor the performance of the rehabilitation areas, ECAs and regeneration areas including visual monitoring and flora surveys. These would determine if there is a need of any maintenance and/or contingency measures. A series of monitoring locations have been set up in the ECAs to monitor vegetation in September 2007. A similar program was established in the first rehabilitation areas on the Wilpinjong Coal Mine site in September 2009. Regeneration areas would be monitored to determine natural regeneration processes and identify areas that may need assistance with the regeneration process. Regeneration areas would be monitored with the aim of achieving a 30% canopy cover for the long term. Regeneration areas would also be zoned for the purpose of protecting lands for conservation.
Protecting the ECAs	WCPL would implement a range of management measures in order to protect the ECAs, including those listed below: • conserve and manage the land in the ECAs in accordance with the Rehabilitation Management Plan (WCPL 2011); • exclude all stock grazing; • rezone the land in the ECAs for the purpose of protecting the land for conservation; and • exclude future open cut mining in the ECAs, unless, in the opinion of the Minister for Planning and Infrastructure, WCPL has demonstrated that there is a clear justification for this on social, economic and/or environmental grounds.

Table 11 Existing Impact Avoidance and Mitigation Measures at the Wilpinjong Coal Mine – Rehabilitation Management Plan (Continued)

Measure	Description
Creek rehabilitation	The riparian zone of the permanent creek features formed within the rehabilitation areas would be revegetated where required. Native vegetation would be selectively placed along creeks where required. The banks of Wilpinjong and Cumbo Creeks in the rehabilitation areas and regeneration areas would be revegetated to increase the quality of riparian vegetation along these creeks.
Vegetation Clearance Protocol	Including the following measures to minimise impacts on threatened flora: • delineation of areas to be cleared of remnant vegetation; and • pre-clearance surveys. Areas of remnant vegetation to be cleared would be delineated. Vegetation adjoining the proposed clearance areas would be clearly marked to prevent accidental damage during vegetation clearance activities or Wilpinjong Coal Mine works. Weed infestation would be noted during pre-clearance surveys and appropriate weed management would be implemented. During vegetation clearance procedures, viable seed would be collected from felled trees. Topsoil resources would be identified, stripped and stockpiled.
Threatened Species Management Protocol	In the event a threatened species under the TSC Act or the EPBC Act is identified in the Wilpinjong Coal Mine, the Modification open cut extension areas or immediate surrounds, the TSMP would be initiated. TSMP strategies in relation to flora would involve threat abatement. Threat abatement would aim to alleviate threatening processes, dependant on the flexibility of mine planning.
Landscaping within the Wilpinjong Coal Mine area to minimise visual impacts	Revegetation would be progressive, commencing soon after the completion of landform shaping. Visual impacts associated with unvegetated mine landforms is expected to progressively reduce once the vegetative cover begins to establish. Revegetation in woodland areas would utilise native tree/shrub species, as well as grasses, characteristic of the area for consistency of colour and visual texture.
Conservation and reuse of topsoil	Topsoil and subsoil resources would be identified, stripped and spread directly onto areas prepared for rehabilitation to make use of the potential seed bank. Prior to soil stripping, soil resources would be quantified. Where a deficit of topsoil is identified, investigations would be undertaken to determine the viability of the use of subsoils and to identify the need for treatment measures (e.g. use of fertilisers) applied where there is a deficit of topsoil. Where direct spreading is not practicable, the stripped soil would be stockpiled and seeded with grasses to maintain soil viability prior to being re-spread.
Collection and propagation of seed for rehabilitation works	Seed present during land clearance activities would be collected for use in plant propagation programmes to provide tube stock for revegetation activities. Seed collection and propagation activities would include: • Examination of trees for their provision of seed prior to vegetation clearance. • Collation of relevant information on target species (e.g. from past ecological studies, nurseries, local landholders, Landcare groups and/or members of the Aboriginal community). • Progressive collection of native seed from the local area to augment revegetation resources. • The use of collection methods such as the manual removal of plant cuttings and stripping of seed pods, fruiting cones or berries directly off the plant into collection bags for transfer to drying rooms. • Seed extraction methods such as sun drying, oven-baking, light firing, high heat drying rooms and/or water soaking.

Table 11 Existing Impact Avoidance and Mitigation Measures at the Wilpinjong Coal Mine – Rehabilitation Management Plan (Continued)

Measure	Description
Collection and propagation of seed for rehabilitation works (Continued)	• The storage of seed in paper and/or calico bags in temperature controlled rooms. • The labelling of seed collection bags with the species collected, collection location, harvest date and dry weight details. • The maintenance of a seed inventory which would record the amount of seed collected, species type and treatment and propagation specifications.
Salvage and re-use of material from the Wilpinjong Coal Mine area for habitat enhancement	Clearing operations would be managed to maximise the re-use of cleared vegetative material. Cleared vegetation would be re-used for a number of purposes including habitat for fauna and fence posts where practical. Habitat features such as logs, fallen limbs and hollows would be collected/salvaged where practicable to provide habitat features for fauna in rehabilitation areas, regeneration areas and ECAs.
Weed and animal pest control	The MWRC is the primary authority with responsibility for weed control in the Mid-Western Regional Shire. A weed control program implemented on WCPL-owned land would include: • regular inspections of WCPL-owned lands to identify areas requiring the implementation of weed management measures; • implementation of weed management measures including mechanical removal and application of approved herbicides in authorised areas when conditions are favourable; • control of noxious weeds identified on WCPL-owned land in accordance with the relevant NSW Department of Trade and Investment, Regional Infrastructure and Services control category and the relevant regional weed management plan; • follow-up inspections to determine effectiveness of weed management measures and requirement for further measures; • minimising transportation of weeds; and • on-going consultation with relevant agencies regarding weed occurrence and management technologies. Measures to control exotic animals are implemented by an appropriately qualified person(s) and include: • pest control measures (e.g. the destruction of rabbit burrows, feral cat trapping and baiting of foxes and wild dogs); • maintenance of a clean, rubbish-free environment, particularly around administration and contractor areas in order to discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (e.g. rodents); • mandatory pest control for any declared pests (i.e. rabbits, pigs and wild dogs) known to occur on WCPL-owned land; and • no domestic pets such as cats or dogs would be permitted to be brought onto the site; and pest control in accordance with any Pest Control Orders issued under the *Rural Lands Protection Act, 1998*.
Restrictions on site access	Damage by vehicles can result in the compaction of soil (which can reduce the infiltration of water into the soil and restrict root growth, and consequently reduce natural regeneration), the spread of weeds and disturbance to vegetation. In order to reduce the degree of disturbance to the rehabilitation areas and ECAs, these areas would be fenced and signposted to limit access to authorised personnel only. Authorisation for vehicular entry into the ECAs would be determined by the Environmental Advisor at the time of request.

Table 11 Existing Impact Avoidance and Mitigation Measures at the Wilpinjong Coal Mine – Rehabilitation Management Plan (Continued)

Measure	Description
Bushfire management	Detailed in the *Bushfire Management Plan* (EcoLogical, 2011).

9.2 Proposed Biodiversity Offset Strategy

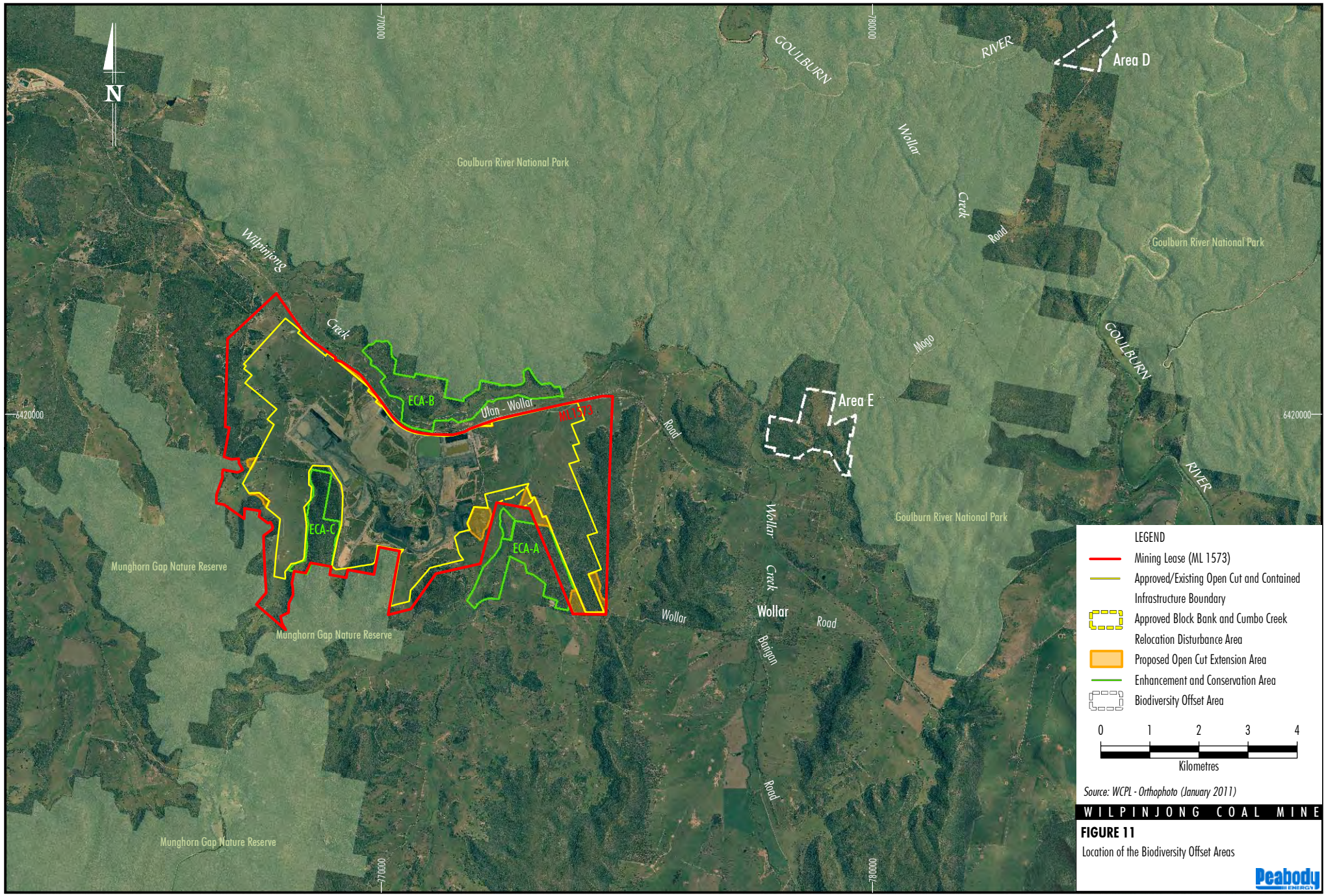
9.2.1 Offset Principles

Biodiversity offsets are measures for achieving a net gain in biodiversity values as a consequence of the implementation of a development. Most commonly, offsets involve land that has been assessed as having ecological values that are equivalent or superior to those in land being disturbed as a consequence of development. Furthermore, offsets are established as enduring through various planning instruments or incorporation into the existing reserve network. Management actions such as feral animal and weed control, removal of grazing, fire control, passive and active regeneration lead to improved biodiversity values in offsets over time. A net gain is achieved through offset land areas being (in the medium to long term) greater in area or quality (or a combination of both) than that being disturbed by development.

9.2.2 Wilpinjong Modification Proposed Biodiversity Offset

Two parcels of land are proposed to offset the residual losses that would be incurred through implementation of the Wilpinjong Modification, designated as Areas D and E (**Figures 11**, **12** and **13**). Both parcels share boundaries with Goulburn River National Park. Information summarising the biodiversity contained in the proposed biodiversity offset compared with that in the Modification is provided in this section while detail is provided in **Appendix 5** of this report (for flora) and in Biodiversity Monitoring Services (2013), Terrestrial Fauna Assessment for the Modification (for fauna).

Table 12 shows a comparison between vegetation communities in the Modification disturbance areas and the combined proposed Biodiversity Offset, with 51.7 ha disturbance being offset with 210.8 ha. Within those overall areas, **Table 13** shows that 10.6 ha of box-gum EEC is proposed to be offset with 47.8 ha. **Appendix 5** includes figures showing vegetation mapping across the Biodiversity Offset. **Figures 12** and **13** below show EEC mapping.



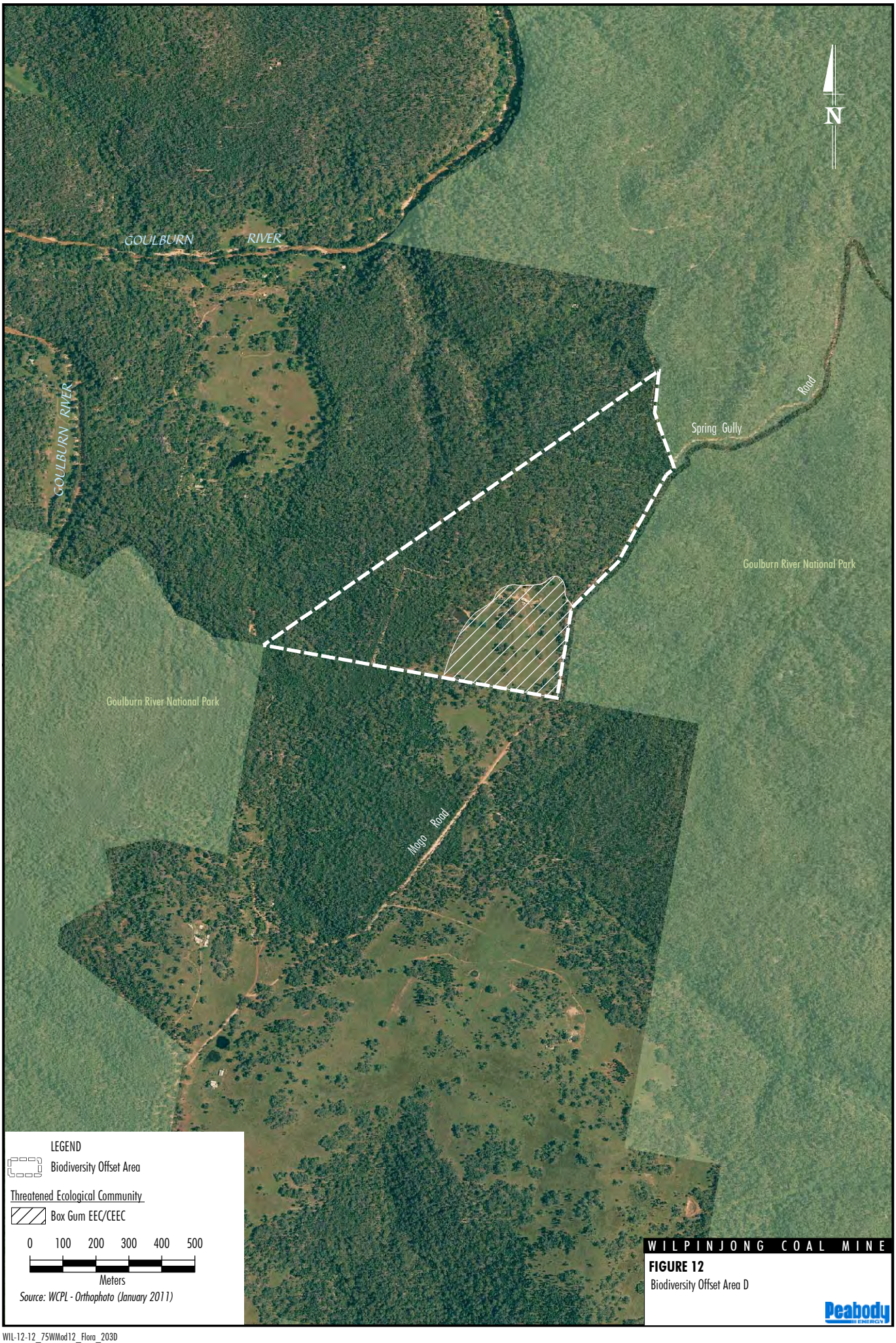
WILPINJONG COAL MINE

FIGURE 11

Location of the Biodiversity Offset Areas

Peabody ENERGY

WIL-12-12_75WMod12_Flora_202D



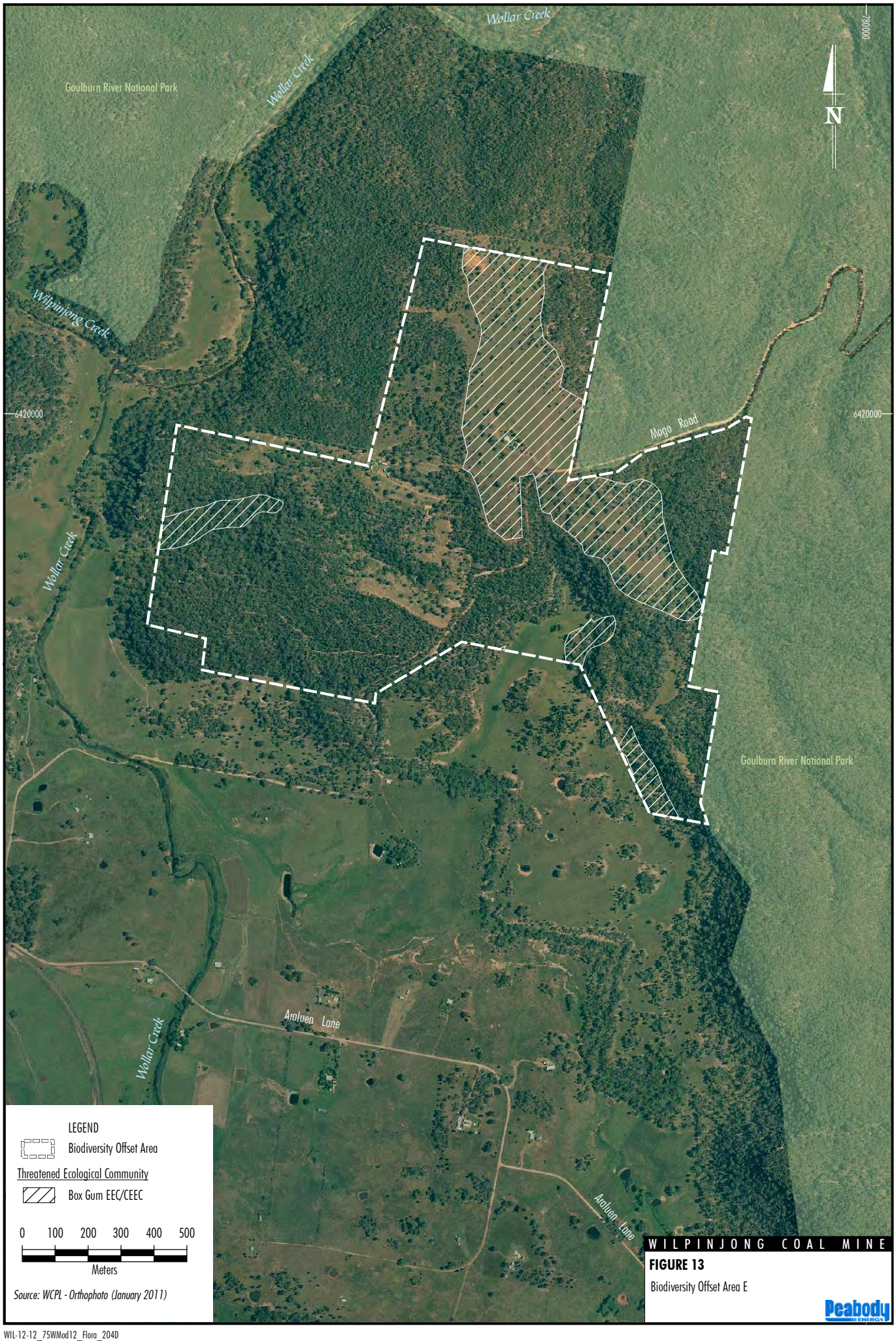
WILPINJONG COAL MINE

FIGURE 12

Biodiversity Offset Area D

Peabody ENERGY

WIL-12-12_75WMod12_Flora_203D



WILPINJONG COAL MINE

FIGURE 13

Biodiversity Offset Area E

Peabody ENERGY

WIL-12-12_75WMod12_Flora_204D

Table 12 Vegetation Disturbance and Biodiversity Offset

Code	Community		Class (Keith [2004])	Disturbance Area (ha)	Biodiversity Offset (ha)
2	Coast Grey Box Woodland		Coastal Valley Grassy Woodlands	3.5	35.2
15	Narrow-leaved Ironbark – Box Woodland				
16	Rough-barked Apple Woodland		North Coast Dry Sclerophyll Forests	-	1.6
9	Broombush Scrub		Pilliga Outwash Dry Sclerophyll Forests	-	3.3
4	Narrow-leaved Ironbark Forest		Western Slopes Dry Sclerophyll Forests	24.1	101.9
4a	Caley's Ironbark Woodland				
5b	Shrubby White Box Woodland				
6	Sandstone Range Shrubby Woodland				
12	Grey Gum - Narrow-leaved Stringybark Forest				
13	Ironbark-Bloodwood-Redgum Woodland				
5a	Grassy White Box Woodland (EEC/CEEC)		Western Slopes Grassy Woodlands	24.1	55.2
7b	Derived Grassland - box-gum grassy (EEC/CEEC)	Derived Native Grassland (Biodiversity Offset)			
7c	Derived Grassland - box-gum shrubby				
7d	Derived Grassland - other native				
8	Blakely's Red Gum Woodland (EEC/CEEC)				
14	Inland Grey Box Woodland				
17	Yellow Box Woodland (EEC/CEEC)				
18	Shrubby Regeneration		-	-	13.6
Total				**51.7[1]**	**210.8[2]**

[1] Excludes approximately 17.8 ha of Derived grassland – weedy, approved mine disturbance and a dam.

[2] Excludes a 0.2 ha dam.

Table 13 Box-gum Woodland EEC – Disturbance and Biodiversity Offset

Box-gum Woodland EEC	Disturbance Area (ha)	Biodiversity Offset (ha)
Woodland	2.2	47.8
Grassland[1]	8.4	0
Total	**10.6**	**47.8**

[1] The Biodiversity Offset very likely contains areas of derived grassland that equate to the *White Box Yellow Box Blakely's Red Gum Woodland* EEC and *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC, however these have been conservatively excluded from the EEC calculations. In contrast, within the disturbance area, derived grassland adjacent to the woodland form of the Box-gum Woodland EEC has been conservatively included in the EEC calculations.

Sections 8.1 and 8.3 conclude that the Modification would not have a significant impact on threatened flora species. No threatened flora species were recorded in the Modification open cut extension areas although several were conservatively assessed as having some potential to occur. No threatened flora species were recorded in the biodiversity offset however all threatened species assessed could also potentially occur in the biodiversity offset.

Floristic diversity was compared between the Modification disturbance areas and the Biodiversity Offset areas with significantly more (>55%) native species present in the biodiversity offset (**Table 14**).

Table 14 Floristic Diversity Comparison

Attribute	Habitat Type	Disturbance	Offset	T-test result	Significant
Native Species	Woodland/Forest	17.31	26.97	T-Value = -4.45 P-Value = 0.000 DF = 36	Yes
Native Species	Native Grassland	15.13	16.67	T-Value = -0.41 P-Value = 0.701 DF = 5	No
Weeds	Woodland/Forest	1.08	1.7	T-Value = -1.36 P-Value = 0.180 DF = 40	No
Weeds	Native Grassland	7.67	6.33	T-Value = 0.58 P-Value = 0.588 DF = 5	No

9.2.3 Reconciliation of the Proposed Biodiversity Offset Strategy against OEH Offset Principles

A substantial net gain in biodiversity would result from the Modification (including the Biodiversity Offset) considering the current habitat values of the proposed biodiversity offset and that they would increase through active management. The biodiversity offset would be established and a plan for their management developed, within 12 months of commencement of the Modification. It is recommended that management of the biodiversity offset be focussed on stock control, weed management and select plantings as necessary (following review of natural regeneration). Measures should be developed cognisant of the measures described in the *Goulburn River National Park and Munghorn Gap Nature Reserve Plan of Management* (National Parks and Wildlife Service, 2003).

A reconciliation of the proposed Biodiversity Offset proposal against the Offset Principles (OEH, 2011) is provided in Table 15.

Table 15 Reconciliation of the Proposed Biodiversity Offset Strategy against OEH Offset Principles

OEH Offset Principles (OEH, 2011)	How the Proposed Biodiversity Offset Addresses the OEH Offset Principles
Impacts must be avoided first by using prevention and mitigation measures.	The disturbance area has been defined by topographical and geological constraints. The disturbance areas are extensions to the existing disturbance footprint rather than new isolated areas.
All regulatory requirements must be met.	WCPL is required to meet all statutory requirements and the Modification would not commence until all regulatory requirements have been met. The proposed Biodiversity Offset is independent of other licence/approval requirements.
Offsets must never reward ongoing poor performance.	The proposed Biodiversity Offset addresses residual impacts associated with the Modification only.
Offsets will complement other government programmes.	The Biodiversity Offset would complement other government programmes and reserve systems. It is proposed that the Biodiversity Offset be added to the existing reserve network in NSW. The land that comprises the Biodiversity Offset shares a common boundary with Goulburn River National Park.
Offsets must be underpinned by sound ecological principles.	The proposed Biodiversity Offset was selected for its similarity to the habitat that would be lost as a result of the Modification proceeding.
Offsets should aim to result in a net improvement in biodiversity over time.	The proposed Biodiversity Offset contains four times the area that would be disturbed. The habitat value of the Biodiversity Offset would also improve as a result of the proposed incorporation into Goulburn River National Park, managed under the Goulburn River National Park and Munghorn Gap Nature Reserve Plan of Management (National Parks and Wildlife Service, 2003).

Table 15 Reconciliation of the Proposed Biodiversity Offset Strategy against OEH Offset Principles (Continued)

Offsets must be enduring. They must offset the impact of the development for the period that the impact occurs.	It is proposed that the Biodiversity Offset be added to the existing reserve network in NSW i.e. Goulburn River National Park. However other long term protection mechanisms would be considered by WCPL if considered more suitable by the DP&I.
Offsets should be agreed prior to the impact occurring.	The Biodiversity Offset is proposed as part of the Modification. The implementation of the Biodiversity Offset is expected to be a condition of Project Approval.
Offsets must be quantifiable. The impacts and benefits must be reliably estimated.	Refer to **Tables 8** and **9**.
Offsets must be targeted.	The proposed Biodiversity Offset was selected for its similarity to the habitat that would be lost as a result of the Modification proceeding.
Offsets must be located appropriately.	Both the Biodiversity Offset area and the Modification open cut extension areas are located in the Hunter-Central Rivers CMA (Hunter sub-catchment) and within the South Brigalow Interim Biogeographic Regionalisation for Australia region. The Biodiversity Offset is also strategically located to complement existing reserves. The biodiversity offset has similar ecological characteristics to Modification open cut extension areas and would maintain or improve biodiversity values of the region in the medium to long term.
Offsets must be supplementary.	The proposed Biodiversity Offset has not previously been used for offsetting other actions.
Offsets and their actions must be enforceable through Development Consent conditions, licence conditions, conservation agreements or a contract.	Measures to monitor and independently audit the Biodiversity Offset are provided. The implementation of the Biodiversity Offset is expected to be a condition of Project Approval. WCPL proposes that the Biodiversity Offset be secured in perpetuity for wildlife conservation (e.g. by transferring the land into the adjoining national park estate, a Voluntary Conservation Agreement, Voluntary Planning Agreement, Biobanking Agreement or other mechanisms to the satisfaction of DP&I). The flora assessment for the Biodiversity Offset is provided in Appendix 5. The fauna assessment for the Biodiversity Offset is provided in the fauna appendix of the EA (Biodiversity Monitoring Services, 2013).

9.2.4 Long-Term Protection of the Biodiversity Offset

The Biodiversity Offset contains two parcels of land that are both located adjoining the Goulburn River National Park. It is recommended that both areas are amalgamated into the existing NSW reserve system and become part of the Goulburn River National Park. Should this protection mechanism not be suitable, WCPL should consult with DP&I and OEH to determine an alternative long term conservation mechanism. Such alternative mechanisms may include a Voluntary Conservation Agreement, Voluntary Planning Agreement or Biobanking Agreement etc.

9.3 Summary of Ecological Gains of the Proposed Biodiversity Offset

In summary, the proposed Biodiversity Offset areas have the following values relating to flora:

- Located within the same CMA sub-region and Interim Biogeographic Regionalisation for Australia region as the Modification open cut extension areas and would provide an opportunity to increase biodiversity values in the region.
- Adjoins the Goulburn River National Park and compliments the existing reserve system.
- All habitat types present within the Modification open cut extension areas are represented in the Biodiversity Offset.
- The Biodiversity Offset is in good condition with low weed occurence.
- The Biodiversity Offset has the ability to improve through management measures such as restricting stock and select tubestock planting.
- A substantial area of higher quality Box-gum woodland EEC occurs within the Biodiversity Offset (approximately 47.8 ha compared with approximately 10.6 ha being disturbed).

10 Conclusion

The proposed modification to the Wilpinjong Coal Mine consists of eight areas, six of which contain a mix of cleared grassland and remnant woodland or forest. The remaining two have been disturbed by approved ancillary disturbance associated with the existing mine (Disturbance – non-native). Preliminary investigation of previous ecology surveys both for the Wilpinjong Coal Mine and neighbouring mines, along with records drawn from State and Commonwealth databases showed that several threatened flora species, an endangered population and threatened ecological community could possibly occur within the Modification open cut extension areas.

Detailed field investigation and subsequent analysis resulted in ten vegetation communities being identified, six woodland/forest communities and four open grassland communities. One threatened ecological community was identified as being representative of both the NSW EEC *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland* and the Commonwealth CEEC *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*. No threatened flora species or populations were recorded.

A formal impact assessment was conducted for the known EEC/CEEC and on the conservative assumption that, even though none were recorded, threatened flora species might be present given the right circumstances. The conclusion of the impact assessment was that the Modification open cut extension areas would not result in the loss of any known threatened flora species or populations while a small area of EEC/CEEC would be lost. The overall Modification open cut extension areas proposal includes provision of a biodiversity offset substantially greater in area and quality than would be lost due to clearing. Taken as a whole, the Modification would result in a substantial net gain in both general habitat and specific EEC/CEEC.

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Appendix 1 Flora species from FloraSearch (2005)

*Indicates weed species

Acanthaceae	**Asteraceae (cont.)**
Brunoniella pumilio	**Carthamus lanatus*
Adiantaceae (Sinopteridaceae)	**Centaurea calcitrapa*
Adiantum aethiopicum	**Centaurea melitensis*
Adiantum hispidulum	**Chondrilla juncea*
Cheilanthes distans	**Cirsium vulgare*
Cheilanthes sieberi	**Conyza albida*
Pellaea falcata	**Conyza bonariensis*
Amaranthaceae	**Conyza parva*
**Alternanthera pungens*	**Dittrichia graveolens*
**Amaranthus hybridus*	**Gamochaeta purpurea*
Alternanthera denticulata	**Hedypnois rhagadioloides* subsp. *cretica* (**Hedypnois rhagadioloides* var. *cretica*)
Anacardiaceae	**Hypochaeris glabra*
**Schinus areira*	**Hypochaeris radicata*
Anthericaceae	**Lactuca saligna*
Arthropodium minus	**Lactuca serriola*
Dichopogon strictus	**Schkuhria pinnata var. abrotanoides*
Laxmannia gracilis	**Sonchus oleraceus*
Tricoryne elatior	**Taraxacum officinale*
Apiaceae	**Tolpis barbata* (**Tolpis umbellata*)
**Ciclospermum leptophyllum*	**Tragopogon porrifolius*
Daucus glochidiatus forma C	**Xanthium spinosum*
Hydrocotyle laxiflora	*Cotula australis*
Platysace ericoides	*Cymbonotus sp.*
Araliaceae	*Calocephalus citreus*
Astrotricha longifolia	*Calotis cuneifolia*
Asclepiadaceae	*Calotis lappulacea*
**Gomphocarpus fruticosus*	*Cassinia arcuata*
Asphodelaceae	*Cassinia cunninghamii*
Bulbine bulbosa	*Cassinia laevis*
Aspleniaceae	*Cassinia quinquefaria*
Asplenium flabellifolium	*Chrysocephalum apiculatum*
Asteraceae	*Chrysocephalum semipapposum*
**Ambrosia tenuifolia*	*Chrysocephalum sp.*
**Aster subulatus*	*Euchiton gymnocephalus*
**Bidens pilosa*	*Euchiton sphaericus*
**Carduus pycnocephalus*	*Lagenifera gracilis*

Asteraceae (Cont.)	**Caryophyllaceae (Continued)**
Leiocarpa leptolepis (*Ixiolaena leptolepis*)	**Silene gallica var. gallica*
Olearia elliptica	**Silene nocturna*
Podolepis neglecta	**Stellaria media*
Senecio bathurstianus	*Arenaria leptoclados*
Senecio prenanthoides	*Stellaria pungens*
Senecio quadridentatus	**Chenopodiaceae**
Sigesbeckia orientalis subsp. orientalis	**Chenopodium album*
Solenogyne bellioides	*Chenopodium carinatum*
Triptilodiscus pygmaeus	*Dysphania pumilio* (*Chenopodium pumilio*)
Vittadinia cervicularis var. subcervicularis	*Einadia nutans subsp. linifolia*
Vittadinia cuneata var. cuneata	*Einadia nutans subsp. nutans*
Vittadinia cuneata var. hirsuta	*Einadia polygonoides*
Vittadinia dissecta var. dissecta	*Einadia trigonos subsp. leiocarpa*
Vittadinia muelleri	*Maireana enchylaenoides*
Vittadinia pustulata	*Salsola kali*
Vittadinia sulcata	**Clusiaceae**
Xerochrysum viscosum (*Bracteantha viscosa*)	**Hypericum perforatum*
Boraginaceae	*Hypericum gramineum*
Cynoglossum australe	**Convolvulaceae**
Brassicaceae	*Convolvulus erubescens*
**Hirschfeldia incana*	*Dichondra repens*
**Lepidium africanum*	**Crassulaceae**
**Lepidium bonariense*	*Crassula sieberiana*
Cactaceae	**Cucurbitaceae**
**Opuntia stricta*	*Citrullus lanatus*
Campanulaceae	**Cupressaceae**
Wahlenbergia communis	*Callitris endlicheri*
Wahlenbergia luteola	**Cyperaceae**
Wahlenbergia stricta subsp. *alterna* (*Wahlenbergia stricta* var. *alterna*)	*Carex appressa*
Wahlenbergia stricta subsp. *stricta* (*Wahlenbergia stricta* var. *stricta*)	*Carex inversa*
Caryophyllaceae	*Cyperus fulvus*
**Cerastium glomeratum*	*Cyperus gracilis*
**Paronychia brasiliana*	*Fimbristylis dichotoma*
**Petrorhagia nanteuilii*	*Gahnia aspera*
**Petrorhagia velutina*	*Lepidosperma laterale*
**Polycarpon tetraphyllum*	

Dennstaedtiaceae	**Fabaceae (Faboideae) (Continued)**
Pteridium esculentum	*Daviesia ulicifolia*
Casuarinaceae	*Desmodium brachypodum*
Allocasuarina gymnanthera	*Desmodium varians*
Allocasuarina luehmannii	*Glycine canescens*
Allocasuarina verticillata	*Glycine clandestina*
Dilleniaceae	*Glycine microphylla*
Hibbertia acicularis	*Glycine sp.*
Hibbertia obtusifolia	*Glycine tabacina*
Hibbertia pedunculata	*Hardenbergia violacea*
Ericaceae (Styphelioideae) (Epacridaceae)	*Hovea apiculata*
Acrotriche rigida	*Indigofera adesmiifolia*
Astroloma humifusum	*Indigofera australis*
Brachyloma daphnoides	*Podolobium ilicifolium*
Leucopogon muticus	*Pultenaea microphylla*
Lissanthe strigosa	*Swainsona galegifolia*
Melichrus erubescens	*Templetonia stenophylla*
Melichrus urceolatus	**Trifolium campestre*
Monotoca scoparia	**Fabaceae (Mimosoideae)**
Styphelia triflora	*Acacia decora*
Euphorbiaceae	*Acacia difformis*
Chamaesyce drummondii	*Acacia doratoxylon*
Phyllanthus hirtellus forma B	*Acacia implexa*
Phyllanthus virgatus	*Acacia ixiophylla*
Poranthera corymbosa	*Acacia lanigera*
Poranthera microphylla	*Acacia leucolobia*
Fabaceae (Faboideae)	*Acacia linearifolia*
**Lotus australis*	*Acacia longissima*
**Medicago lupulina*	*Acacia paradoxa*
**Medicago polymorpha*	*Acacia penninervis*
**Medicago sativa*	*Acacia sertiformis*
**Medicago truncatula*	*Acacia ulicifolia*
**Melilotus indicus*	*Acacia verniciflua*
**Trifolium angustifolium*	**Gentianaceae**
**Trifolium arvense*	**Centaurium erythraea*
**Trifolium cernuum*	**Geraniaceae**
**Trifolium glomeratum*	**Geranium molle*
**Trifolium subterraneum*	*Erodium crinitum*
Bossiaea rhombifolia subsp. *rhombifolia* *Bossiaea rhombifolia* var. *rhombifolia*	*Geranium potentilloides var. potentilloides*
Daviesia acicularis	*Geranium solanderi var. solanderi*

Geraniaceae (cont.)	**Lomandraceae (cont.)**
Geranium sp.	*Lomandra multiflora*
Goodeniaceae	**Loranthaceae**
Goodenia hederacea	*Amyema miquelii*
Goodenia ovata	*Amyema quandang*
Goodenia pinnatifida	**Luzuriagaceae**
Velleia paradoxa	*Eustrephus latifolius*
Haloragaceae	**Malaceae**
Gonocarpus longifolius	**Cotoneaster pannosus*
Gonocarpus tetragynus	**Malvaceae**
Juncaceae	**Malva parviflora*
Juncus filicaulis	*Sida corrugata*
Juncus homalocaulis	*Sida cunninghamii*
Juncus ochrocoleus	*Sida trichopoda*
Juncus remotiflorus	**Moraceae**
Juncus subsecundus	*Ficus rubiginosa*
Luzula flaccida (*Luzula meridionalis* var. *flaccida*)	**Myoporaceae**
Lamiaceae	*Eremophila debilis*
**Marrubium vulgare*	*Eremophila deserti*
**Prunella vulgaris*	**Myrtaceae**
**Salvia verbenaca*	*Angophora floribunda*
Scutellaria humilis	*Eucalyptus agglomerata*
Ajuga australis	*Eucalyptus albens*
Mentha satureioides	*Eucalyptus blakelyi*
Prostanthera prunelloides	*Eucalyptus caleyi*
Lauraceae	*Eucalyptus cannonii*
Cassytha melantha	*Eucalyptus cannonii x E. macrorhyncha*
Cassytha sp.	*Eucalyptus crebra*
Lobeliaceae	*Eucalyptus dawsonii*
Isotoma axillaris	*Eucalyptus fibrosa subsp. fibrosa*
Loganiaceae	*Eucalyptus goniocalyx*
Logania albiflora	*Eucalyptus macrorhyncha*
Lomandraceae	*Eucalyptus melliodora*
Lomandra confertifolia subsp. pallida	*Eucalyptus moluccana*
Lomandra filiformis subsp. coriacea	*Eucalyptus punctata*
Lomandra filiformis subsp. filiformis	*Eucalyptus sparsifolia*
Lomandra filiformis subsp. flavior	*Kunzea sp. Mt. Kaputar*
Lomandra leucocephala subsp. leucocephala	*Melaleuca erubescens*
Lomandra longifolia	*Melaleuca thymifolia*

Myrtaceae (cont.)	**Poaceae (cont.)**
Micromyrtus ciliata	**Lolium rigidum*
Nyctaginaceae	**Paspalum dilatatum*
Boerhavia dominii	**Pennisetum clandestinum*
Orchidaceae	**Phalaris aquatica*
Caladenia sp.	**Rostraria cristata*
Diuris sulphurea	**Setaria parviflora* (**Setaria gracilis*)
Microtis sp.	**Sorghum halepense*
Pterostylis bicolor (*Hymenochilus bicolor*)	**Sorghum leiocladum*
Pterostylis sp.	**Urochloa panicoides*
Oxalidaceae	**Vulpia bromoides*
Oxalis chnoodes	**Vulpia muralis*
Papaveraceae	**Vulpia myuros*
**Argemone ochroleuca subsp. ochroleuca*	*Aristida personata* (*Aristida ramosa var. speciosa*)
Phormiaceae	*Aristida vagans*
Dianella caerulea var. caerulea	*Austrostipa densiflora*
Dianella longifolia var. longifolia	*Austrostipa scabra subsp. falcata*
Dianella revoluta var. revoluta	*Austrostipa verticillata*
Pittosporaceae	*Bothriochloa macra*
Billardiera scandens var. scandens	*Chloris truncata*
Bursaria spinosa subsp. spinosa	*Chloris ventricosa*
Plantaginaceae	*Cymbopogon refractus*
**Plantago lanceolata*	*Dichelachne micrantha*
Plantago debilis	*Digitaria brownii*
Plantago hispida	*Digitaria ciliaris*
Plantago varia	*Digitaria diffusa*
Poaceae	*Digitaria divaricatissima*
**Aira cupaniana*	*Digitaria longiflora*
**Aira elegantissima*	*Digitaria ramularis*
**Briza minor*	*Echinochloa colona*
**Bromus cartharticus*	*Echinopogon caespitosus*
**Bromus diandrus*	*Echinopogon ovatus*
**Bromus hordeaceus subsp. molliformis*	*Elymus scaber*
**Cynodon dactylon*	*Enneapogon gracilis*
**Eleusine tristachya*	**Echinochloa esculenta*
**Eragrostis cilianensis*	*Eragrostis alveiformis*
**Eragrostis curvula*	*Eragrostis brownii*
**Hordeum leporinum*	*Eragrostis elongata*

Poaceae (cont.)	*Portulaca oleracea*
Eragrostis leptostachya	**Primulaceae**
Eriochloa pseudoacrotricha	**Anagallis arvensis*
Eulalia aurea	**Proteaceae**
Lachnagrostis filiformis	*Persoonia linearis*
Microlaena stipoides var. stipoides	**Ranunculaceae**
Panicum effusum	*Clematis glycinoides*
Panicum simile	**Rhamnaceae**
Paspalidium criniforme	*Cryptandra amara var. amara*
Paspalidium distans	*Cryptandra spinescens*
Paspalidium gracile	*Pomaderris ferruginea*
Poa labillardierei	*Pomaderris intermedia*
Poa sieberiana var. sieberiana	*Pomaderris lanigera*
Rytidosperma auriculatum (*Austrodanthonia auriculata*)	*Pomaderris ledifolia*
Rytidosperma bipartitum (*Austrodanthonia bipartita*)	**Rosaceae**
Rytidosperma caespitosum (*Austrodanthonia caespitosa*)	**Rosa rubiginosa*
Rytidosperma carphoides (*Austrodanthonia carphoides*)	**Rubus ulmifolius*
Rytidosperma erianthum (*Austrodanthonia eriantha*)	*Acaena echinata*
Rytidosperma laeve (*Austrodanthonia laevis*)	**Rubus fruticosus* (**Rubus discolor*)
Rytidosperma monticola (*Austrodanthonia monticola*)	*Rubus parvifolius*
Rytidosperma racemosum var. *racemosum* (*Austrodanthonia racemosa*)	**Rubiaceae**
Rytidosperma richardsonii (*Austrodanthonia richardsonii*)	**Richardia stellaris*
Rytidosperma setaceum (*Austrodanthonia setacea*)	*Asperula conferta*
Pseudoraphis sp.	*Galium divaricatum*
Sporobolus creber	*Galium gaudichaudii*
Themeda australis (*Themeda triandra*)	*Galium migrans*
Polygonaceae	*Galium murale*
**Acetosella vulgaris*	*Opercularia hispida*
**Polygonum sp.*	*Pomax umbellata*
**Rumex crispus*	**Rutaceae**
Rumex brownii	*Boronia angustisepala*
Portulacaceae	*Correa reflexa*

Rutaceae (cont.)
Geijera parviflora
Phebalium squamulosum
Santalaceae
Exocarpos cupressiformis
Exocarpos strictus
Santalum lanceolatum
Sapindaceae
Dodonaea triangularis
Dodonaea truncatiales
Scrophulariaceae
**Verbascum virgatum*
Veronica plebeia
Simaroubaceae
**Ailanthus altissima*
Solanaceae
**Lycium ferocissimum*
**Solanum nigrum*
Solanum brownii
Solanum campanulatum
Solanum cinereum
Stackhousiaceae
Stackhousia monogyna
Stackhousia muricata
Sterculiaceae
Brachychiton populneus
Stylidiaceae
Stylidium laricifolium
Thymelaeaceae
Pimelea curviflora var. sericea
Typhaceae
Typha domingensis
Urticaceae
Urtica incisa
Verbenaceae
**Verbena bonariensis*
**Verbena hispida*
Violaceae
Viola hederacea
Viscaceae
Notothixos cornifolius

Xanthorrhoeaceae
Xanthorrhoea acaulis
Zamiaceae
Macrozamia reducta
Zygophyllaceae
**Tribulus terrestris*

Appendix 2 Flora species recorded in the Modification Open Cut Extension Areas

Family names in bold are followed by species names. Species name in bold were not reported in FloraSearch (2005)

Adiantaceae	**Caryophyllaceae**
Cheilanthes sieberi	**Paronychia brasiliana*
Anthericaceae	**Petrorhagia nanteuilii*
Tricoryne elatior	***Petrorhagia velutina***
Apiaceae	**Casuarinaceae**
Hydrocotyle laxiflora	*Allocasuarina verticillata*
Asteraceae	**Chenopodiaceae**
**Carthamus lanatus*	*Atriplex spinibractea*
**Chondrilla juncea*	***Einadia hastata***
**Cirsium vulgare*	*Einadia nutans*
**Conyza sp.*	*Einadia nutans subsp. nutans*
**Sonchus oleraceus*	*Einadia trigonos subsp. leiocarpa*
**Taraxacum officinale*	*Atriplex sp.*
**Xanthium spinosum*	***Enchylaena tomentosa***
Calocephalus citreus	**Clusiaceae**
Calotis cuneifolia	**Hypericum perforatum*
Calotis lappulacea	**Commelinaceae**
Cassinia arcuata	***Commelina cyanea***
Cassinia cunninghamii	**Convolvulaceae**
Cassinia quinquefaria	*Convolvulus erubescens*
Chrysocephalum apiculatum	*Dichondra repens*
Hypochaeris radicata	**Cupressaceae**
Olearia elliptica	*Callitris endlicheri*
Ozothamnus diosmifolius	**Cyperaceae**
Senecio quadridentatus	*Carex inversa*
Vittadinia cervicularis var. subcervicularis	*Gahnia aspera*
Vittadinia gracilis	**Dilleniaceae**
Xerochrysum viscosum	*Hibbertia acicularis*
Chrysocephalum semipapposum	*Hibbertia obtusifolia*
Boraginaceae	**Epacridaceae**
Halgania brachyrhyncha	*Acrotriche rigida*
Brassicaceae	*Astroloma humifusum*
**Lepidium africanum*	*Lissanthe strigosa*
Lepidium pseudohyssopifolium	*Melichrus urceolatus*

Cactaceae	**Ericaceae (Styphelioideae)**
**Opuntia stricta*	*Leucopogon muticus*
Campanulaceae	**Euphorbiaceae**
Wahlenbergia communis	*Chamaesyce drummondii*
Euphorbiaceae	**Loranthaceae**
Phyllanthus hirtellus	***Amyema cambagei***
Fabaceae (Faboideae)	*Amyema miquelii*
Daviesia genistifolia	**Malvaceae**
Desmodium brachypodum	**Modiola caroliniana*
Desmodium varians	*Sida corrugata*
Glycine clandestina	*Sida cunninghamii*
Glycine tabacina	**Myrtaceae**
Hardenbergia violacea	*Angophora floribunda*
Podolobium ilicifolium	*Eucalyptus albens*
Zornia dyctiocarpa var. dyctiocarpa	*Eucalyptus blakelyi*
**Trifolium angustifolium*	*Eucalyptus caleyi*
Fabaceae (Mimosoideae)	*Eucalyptus crebra*
Acacia decora	*Eucalyptus goniocalyx*
Acacia implexa	*Eucalyptus moluccana*
Acacia ixiophylla	*Eucalyptus punctata*
Acacia paradoxa	**Nyctaginaceae**
Acacia uncinata	*Boerhavia dominii*
Geraniaceae	**Phormiaceae**
**Geranium molle*	***Dianella longifolia***
Goodeniaceae	**Pittosporaceae**
Goodenia hederacea subsp. hederacea	*Bursaria spinosa*
Juncaceae	**Plantaginaceae**
Juncus australis	**Plantago lanceolata*
Juncus remotiflorus	**Poaceae**
Juncus usitatus	****Bromus catharticus***
Lamiaceae	****Bromus hordeaceus***
**Marrubium vulgare*	****Bromus molliformis***
**Salvia verbenaca*	**Paspalum dilatatum*
Linaceae	***Aristida calycina var. calycina***
**Linum trigynum*	*Aristida personata*
Lomandraceae	***Aristida ramosa***
Lomandra bracteata	*Aristida vagans*
Lomandra confertifolia subsp. pallida	*Austrostipa scabra*
Lomandra filiformis subsp. filiformis	*Austrostipa scabra subsp. falcata*
Lomandra multiflora	***Austrostipa scabra subsp. scabra***
Lomandra patens	*Bothriochloa macra*

Poaceae (Cont.)	**Scrophulariaceae (Cont.)**
Chloris ventricosa	*Eremophila debilis*
Dichelachne micrantha	***Myoporum montanum***
Dichelachne rara	*Eremophila sp.*
Digitaria brownii	**Simaroubaceae**
Digitaria ramularis	**Ailanthus altissima*
Echinopogon ovatus	**Solanaceae**
Elymus scaber	*Solanum cinereum*
Enneapogon gracilis	*Solanum sp.*
Eragrostis alveiformis	**Sterculiaceae**
Eragrostis leptostachya	*Brachychiton populneus*
Microlaena stipoides	**Thymelaeaceae**
Panicum queenslandicum	***Pimelea linifolia***
Paspalidium distans	**Urticaceae**
Rytidosperma auriculatum	*Urtica incisa*
Rytidosperma caespitosa	**Verbenaceae**
Rytidosperma duttoniana	**Verbena bonariensis*
Rytidosperma eriantha	
Rytidosperma fulva	
Rytidosperma setacea	
Rytidosperma sp.	
Rytidosperma tenuior	
Sporobolus creber	
Themeda australis	
Polygonaceae	
Rumex brownii	
Ranunculaceae	
Clematis glycinoides	
Clematis microphylla	
Rhamnaceae	
Cryptandra spinescens	
Santalaceae	
Exocarpos strictus	
Santalum lanceolatum	
Sapindaceae	
Dodonaea truncatiales	
Scrophulariaceae	
**Verbascum thapsus*	

* Introduced species.

Appendix 3 Floristic sample plot data

CA = cover-abundance score (see **Table 5** in main report)
m = species added during meander outside of the plot

PLOT C1		
Family Name	**Scientific Name**	**CA**
Asteraceae	*Cassinia quinquefaria*	1
Asteraceae	*Olearia elliptica*	1
Asteraceae	*Calotis cuneifolia*	1
Asteraceae	*Cassinia arcuata*	1
Convolvulaceae	*Dichondra repens*	1
Cupressaceae	*Callitris endlicheri*	1
Euphorbiaceae	*Chamaesyce drummondii*	1
Fabaceae (Faboideae)	*Glycine clandestina*	1
Fabaceae (Mimosoideae)	*Acacia uncinata*	1
Lomandraceae	*Lomandra filiformis subsp. filiformis*	1
Myrtaceae	*Eucalyptus blakelyi*	1
Poaceae	*Panicum queenslandicum*	1
Poaceae	*Eragrostis leptostachya*	1
Ranunculaceae	*Clematis glycinoides*	1
Cyperaceae	*Gahnia aspera*	2
Fabaceae (Faboideae)	*Desmodium brachypodum*	2
Lomandraceae	*Lomandra multiflora*	2
Lomandraceae	*Lomandra patens*	2
Myoporaceae	*Eremophila debilis*	2
Pittosporaceae	*Bursaria spinosa*	2
Poaceae	*Aristida vagans*	2
Poaceae	*Microlaena stipoides*	2
Poaceae	*Austrostipa scabra subsp. falcata*	2
Myrtaceae	*Eucalyptus moluccana*	4
Asteraceae	*Calotis lappulacea*	m
Chenopodiaceae	*Einadia hastata*	m
Fabaceae (Mimosoideae)	*Acacia ixiophylla*	m
Myrtaceae	*Eucalyptus albens*	m
Myrtaceae	*Eucalyptus crebra*	m
PLOT C2		
Asteraceae	**Carthamus lanatus*	1
Asteraceae	**Chondrilla juncea*	1
Caryophyllaceae	**Petrorhagia nanteuilii*	1
Cyperaceae	*Gahnia aspera*	1
Malvaceae	*Sida corrugata*	1
Poaceae	*Rytidosperma caespitosa*	1

PLOT C2 (Continued)		
Family Name	**Scientific Name**	**CA**
Poaceae	*Sporobolus creber*	1
Asteraceae	**Taraxacum officinale*	2
Plantaginaceae	**Plantago lanceolata*	2
Poaceae	*Bothriochloa macra*	2
Scrophulariaceae	**Verbascum thapsus*	3
PLOT D1		
Adiantaceae	*Cheilanthes sieberi*	1
Asteraceae	**Carthamus lanatus*	1
Asteraceae	**Xanthium spinosum*	1
Asteraceae	*Cassinia arcuata*	1
Asteraceae	*Cassinia quinquefaria*	1
Asteraceae	*Vittadinia cervicularis var. subcervicularis*	1
Chenopodiaceae	*Einadia nutans subsp. nutans*	1
Cyperaceae	*Gahnia aspera*	1
Euphorbiaceae	*Chamaesyce drummondii*	1
Fabaceae (Faboideae)	*Desmodium brachypodum*	1
Fabaceae (Faboideae)	*Desmodium varians*	1
Malvaceae	*Sida corrugata*	1
Poaceae	*Aristida vagans*	1
Poaceae	*Paspalidium distans*	1
Poaceae	*Rytidosperma fulva*	1
Polygonaceae	*Rumex brownii*	1
Solanaceae	*Solanum sp.*	1
Asteraceae	*Calotis lappulacea*	2
Chenopodiaceae	*Einadia hastata*	2
Convolvulaceae	*Dichondra repens*	3
Myrtaceae	*Eucalyptus albens*	3
Poaceae	*Austrostipa scabra*	3
Cupressaceae	*Callitris endlicheri*	4
Pittosporaceae	*Bursaria spinosa*	4
Fabaceae (Mimosoideae)	*Acacia implexa*	m
Loranthaceae	*Amyema cambagei*	m
PLOT D2		
Campanulaceae	*Wahlenbergia communis*	1
Asteraceae	**Carthamus lanatus*	2
Malvaceae	*Sida corrugata*	2
Malvaceae	*Sida cunninghamii*	2
Plantaginaceae	**Plantago lanceolata*	2

PLOT D2 (Continued)		
Family Name	**Scientific Name**	**CA**
Poaceae	*Chloris ventricosa*	2
Poaceae	*Sporobolus creber*	2
Poaceae	*Austrostipa scabra subsp. scabra*	3
Asteraceae	*Calotis lappulacea*	4
Asteraceae	**Xanthium spinosum*	m
Asteraceae	*Cassinia quinquefaria*	m
Caryophyllaceae	**Paronychia brasiliana*	m
Casuarinaceae	*Allocasuarina verticillata*	m
Chenopodiaceae	*Atriplex spinibractea*	m
Fabaceae (Faboideae)	*Desmodium brachypodum*	m
Lamiaceae	**Marrubium vulgare*	m
Loranthaceae	*Amyema miquelii*	m
Myoporaceae	*Eremophila debilis*	m
PLOT E1		
Asteraceae	*Cassinia arcuata*	1
Chenopodiaceae	*Einadia hastata*	1
Chenopodiaceae	*Atriplex sp.*	1
Chenopodiaceae	*Enchylaena tomentosa*	1
Convolvulaceae	*Dichondra repens*	1
Myoporaceae	*Eremophila debilis*	1
Plantaginaceae	**Plantago lanceolata*	1
Poaceae	*Chloris ventricosa*	1
Lamiaceae	**Marrubium vulgare*	2
Lomandraceae	*Lomandra filiformis subsp. filiformis*	2
Malvaceae	*Sida corrugata*	2
Poaceae	*Rytidosperma sp.*	2
Asteraceae	*Calotis lappulacea*	4
Myrtaceae	*Eucalyptus albens*	4
Poaceae	*Austrostipa scabra subsp. falcata*	4
PLOT E2		
Asteraceae	*Calocephalus citreus*	1
Convolvulaceae	*Convolvulus erubescens*	1
Convolvulaceae	*Dichondra repens*	1
Cyperaceae	*Gahnia aspera*	1
Euphorbiaceae	*Chamaesyce drummondii*	1
Lomandraceae	*Lomandra multiflora*	1
Lomandraceae	*Lomandra patens*	1
Myoporaceae	*Eremophila debilis*	1

PLOT E2 (Continued)		
Family Name	**Scientific Name**	**CA**
Phormiaceae	*Dianella longifolia*	1
Plantaginaceae	**Plantago lanceolata*	1
Poaceae	*Chloris ventricosa*	1
Sterculiaceae	*Brachychiton populneus*	1
Thymelaeaceae	*Pimelea linifolia*	1
Boraginaceae	*Halgania brachyrhyncha*	2
Fabaceae (Mimosoideae)	*Acacia decora*	2
Santalaceae	*Santalum lanceolatum*	2
Pittosporaceae	*Bursaria spinosa*	3
Poaceae	*Austrostipa scabra subsp. scabra*	3
Ranunculaceae	*Clematis microphylla*	3
Sapindaceae	*Dodonaea truncatiales*	3
Myrtaceae	*Eucalyptus albens*	4
Adiantaceae	*Cheilanthes sieberi*	m
Asteraceae	*Calotis cuneifolia*	m
Asteraceae	*Calotis lappulacea*	m
Asteraceae	*Cassinia arcuata*	m
Asteraceae	*Xerochrysum viscosum*	m
Asteraceae	*Chrysocephalum semipapposum*	m
Cactaceae	**Opuntia stricta*	m
Clusiaceae	**Hypericum perforatum*	m
Fabaceae (Faboideae)	*Daviesia genistifolia*	m
Fabaceae (Faboideae)	*Desmodium brachypodum*	m
Fabaceae (Mimosoideae)	*Acacia implexa*	m
Malvaceae	*Sida corrugata*	m
Scrophulariaceae	*Myoporum montanum*	m
Scrophulariaceae	*Eremophila sp.*	m
PLOT E3		
Asteraceae	**Carthamus lanatus*	1
Asteraceae	**Xanthium spinosum*	1
Asteraceae	*Cassinia arcuata*	1
Chenopodiaceae	*Einadia trigonos subsp. leiocarpa*	1
Fabaceae (Faboideae)	*Desmodium varians*	1
Lamiaceae	**Marrubium vulgare*	1
Lomandraceae	*Lomandra bracteata*	1
Lomandraceae	*Lomandra multiflora*	1

PLOT E3 (Continued)		
Family Name	**Scientific Name**	**CA**
Malvaceae	**Modiola caroliniana*	1
Poaceae	**Bromus hordeaceus*	1
Poaceae	*Bothriochloa macra*	1
Poaceae	*Enneapogon gracilis*	1
Poaceae	*Eragrostis alveiformis*	1
Poaceae	*Themeda australis*	1
Polygonaceae	*Rumex brownii*	1
Solanaceae	*Solanum cinereum*	1
Chenopodiaceae	*Einadia nutans*	2
Malvaceae	*Sida corrugata*	2
Nyctaginaceae	*Boerhavia dominii*	2
Plantaginaceae	**Plantago lanceolata*	2
Poaceae	*Austrostipa scabra subsp. scabra*	2
Poaceae	*Elymus scaber*	2
Verbenaceae	**Verbena bonariensis*	2
Asteraceae	**Chondrilla juncea*	3
Asteraceae	*Calotis lappulacea*	3
Convolvulaceae	*Convolvulus erubescens*	3
Clusiaceae	**Hypericum perforatum*	4
Anthericaceae	*Tricoryne elatior*	m
Asteraceae	**Cirsium vulgare*	m
Asteraceae	*Calotis cuneifolia*	m
Asteraceae	*Senecio quadridentatus*	m
Campanulaceae	*Wahlenbergia communis*	m
Caryophyllaceae	**Paronychia brasiliana*	m
Caryophyllaceae	**Petrorhagia nanteuilii*	m
Commelinaceae	*Commelina cyanea*	m
Dilleniaceae	*Hibbertia obtusifolia*	m
Epacridaceae	*Melichrus urceolatus*	m
Geraniaceae	**Geranium molle*	m
Lamiaceae	**Salvia verbenaca*	m
Linaceae	**Linum trigynum*	m
Poaceae	*Aristida personata*	m
Poaceae	*Aristida ramosa*	m
Poaceae	*Rytidosperma auriculatum*	m
Poaceae	*Rytidosperma fulva*	m
PLOT E4		
Asteraceae	**Carthamus lanatus*	1
Asteraceae	**Chondrilla juncea*	1
Asteraceae	**Cirsium vulgare*	1
Asteraceae	**Sonchus oleraceus*	1
Asteraceae	*Cassinia arcuata*	1
Brassicaceae	**Lepidium africanum*	1
Campanulaceae	*Wahlenbergia communis*	1
Chenopodiaceae	*Einadia nutans*	1
Convolvulaceae	*Dichondra repens*	1

PLOT E4 (Continued)		
Family Name	**Scientific Name**	**CA**
Poaceae	**Bromus hordeaceus*	1
Poaceae	**Bromus molliformis*	1
Poaceae	**Paspalum dilatatum*	1
Poaceae	*Aristida ramosa*	1
Poaceae	*Austrostipa scabra subsp. falcata*	1
Poaceae	*Eragrostis alveiformis*	1
Asteraceae	*Calotis lappulacea*	2
Clusiaceae	**Hypericum perforatum*	2
Convolvulaceae	*Convolvulus erubescens*	2
Malvaceae	*Sida corrugata*	2
Poaceae	*Bothriochloa macra*	2
Poaceae	*Digitaria brownii*	2
Poaceae	*Rytidosperma fulva*	2
Verbenaceae	**Verbena bonariensis*	2
Asteraceae	**Conyza sp.*	3
Poaceae	*Elymus scaber*	3
Fabaceae (Faboideae)	*Glycine tabacina*	4
Asteraceae	*Vittadinia gracilis*	m
Caryophyllaceae	*Petrorhagia velutina*	m
Lamiaceae	**Salvia verbenaca*	m
Linaceae	**Linum trigynum*	m
Malvaceae	**Modiola caroliniana*	m
Pittosporaceae	*Bursaria spinosa*	m
Poaceae	**Bromus catharticus*	m
Poaceae	*Dichelachne micrantha*	m
PLOT E5		
Poaceae	*Digitaria brownii*	1
Asteraceae	*Cassinia arcuata*	1
Asteraceae	*Chrysocephalum apiculatum*	1
Asteraceae	*Chrysocephalum semipapposum*	1
Campanulaceae	*Wahlenbergia communis*	1
Dilleniaceae	*Hibbertia aff monogyna*	1
Fabaceae (Faboideae)	*Hardenbergia violacea*	1
Fabaceae (Mimosoideae)	*Acacia decora*	1
Lomandraceae	*Lomandra filiformis subsp. filiformis*	1
Lomandraceae	*Lomandra filiformis subsp. coriacea*	1
Malvaceae	*Sida corrugata*	1
Myrtaceae	*Angophora floribunda*	1
Poaceae	*Chloris ventricosa*	1
Poaceae	*Panicum queenslandicum*	1

PLOT E5 (Continued)		
Family Name	**Scientific Name**	**CA**
Poaceae	*Aristida ramosa*	2
Poaceae	*Themeda australis*	2
Clusiaceae	**Hypericum perforatum*	3
Poaceae	*Austrostipa scabra subsp. falcata*	3
Poaceae	*Sporobolus creber*	3
Asteraceae	*Calotis lappulacea*	5
Asteraceae	*Chondrilla juncea*	1
Lomandraceae	*Lomandra filiformis subsp. coriacea*	1
Fabaceae (Faboideae)	*Glycine clandestina*	1
Asteraceae	*Calocephalus citreus*	1
Asteraceae	**Chondrilla juncea*	1
Brassicaceae	*Lepidium pseudohyssopifolium*	1
Poaceae	*Eragrostis alveiformis*	1
Epacridaceae	*Melichrus urceolatus*	2
Poaceae	*Rytidosperma bipartita*	2
Thymelaeaceae	*Pimelea curviflora var. sericea*	2
Poaceae	*Bothriochloa decipiens*	3
PLOT E6		
Asteraceae	*Cassinia arcuata*	1
Asteraceae	*Chrysocephalum semipapposum*	1
Malvaceae	*Sida corrugata*	1
Poaceae	*Chloris ventricosa*	1
Clusiaceae	**Hypericum perforatum*	1
Poaceae	*Austrostipa scabra subsp. falcata*	1
Myrtaceae	*Eucalyptus albens*	1
Asteraceae	**Cirsium vulgare*	1
Lomandraceae	*Lomandra patens*	1
Poaceae	**Setaria parviflora*	1
Poaceae	*Digitaria brownii*	2
Poaceae	*Aristida ramosa*	2
Poaceae	*Themeda australis*	2
Asteraceae	**Carthamus lanatus*	2
Convolvulaceae	*Convolvulus erubescens*	2
Lamiaceae	**Marrubium vulgare*	2
Plantaginaceae	**Plantago lanceolata*	2
Poaceae	*Sporobolus creber*	3
Asteraceae	*Calotis lappulacea*	4
Poaceae	*Eragrostis alveiformis*	1

PLOT E6 (Continued)		
Family Name	**Scientific Name**	**CA**
Asteraceae	**Conyza bonariensis*	1
Plantaginaceae	*Plantago debilis*	1
Poaceae	*Rytidosperma tenuior*	2
Chenopodiaceae	*Einadia trigonos*	2
Anthericaceae	*Thysanotus juncifolius*	1
PLOT F1		
Asteraceae	**Carthamus lanatus*	1
Asteraceae	*Calocephalus citreus*	1
Asteraceae	*Cassinia arcuata*	1
Fabaceae (Faboideae)	*Zornia dyctiocarpa var. dyctiocarpa*	1
Linaceae	**Linum trigynum*	1
Malvaceae	*Sida corrugata*	1
Poaceae	*Aristida calycina var. calycina*	1
Poaceae	*Aristida ramosa*	1
Poaceae	*Austrostipa scabra subsp. falcata*	1
Poaceae	*Themeda australis*	1
Verbenaceae	**Verbena bonariensis*	1
Asteraceae	*Chrysocephalum apiculatum*	2
Asteraceae	*Hypochaeris radicata*	2
Caryophyllaceae	**Petrorhagia nanteuilii*	2
Clusiaceae	**Hypericum perforatum*	2
Convolvulaceae	*Convolvulus erubescens*	2
Goodeniaceae	*Goodenia hederacea subsp. hederacea*	2
Poaceae	*Aristida vagans*	2
Poaceae	*Elymus scaber*	2
Poaceae	*Rytidosperma duttoniana*	2
Rhamnaceae	*Cryptandra spinescens*	2
Anthericaceae	*Tricoryne elatior*	m
Asteraceae	*Calotis cuneifolia*	m
Asteraceae	*Calotis lappulacea*	m
Brassicaceae	*Lepidium pseudohyssopifolium*	m
Caryophyllaceae	**Paronychia brasiliana*	m
Chenopodiaceae	*Einadia hastata*	m
Plantaginaceae	**Plantago lanceolata*	m
Poaceae	*Aristida personata*	m
Poaceae	*Bothriochloa macra*	m

PLOT F2		
Family Name	**Scientific Name**	**CA**
Anthericaceae	*Tricoryne elatior*	1
Asteraceae	**Carthamus lanatus*	1
Asteraceae	*Cassinia arcuata*	1
Cyperaceae	*Carex inversa*	1
Juncaceae	*Juncus australis*	1
Juncaceae	*Juncus remotiflorus*	1
Linaceae	**Linum trigynum*	1
Poaceae	*Aristida vagans*	1
Poaceae	*Bothriochloa macra*	1
Poaceae	*Elymus scaber*	1
Poaceae	*Eragrostis alveiformis*	1
Polygonaceae	*Rumex brownii*	1
Asteraceae	*Hypochaeris radicata*	2
Convolvulaceae	*Convolvulus erubescens*	2
Plantaginaceae	**Plantago lanceolata*	3
Clusiaceae	**Hypericum perforatum*	4
Verbenaceae	**Verbena bonariensis*	5
Asteraceae	**Cirsium vulgare*	m
Asteraceae	*Calotis lappulacea*	m
Fabaceae (Faboideae)	**Trifolium angustifolium*	m
Loranthaceae	*Amyema cambagei*	m
Malvaceae	*Sida corrugata*	m
Myrtaceae	*Eucalyptus moluccana*	m
Poaceae	*Rytidosperma fulva*	m
PLOT F3		
Asteraceae	**Taraxacum officinale*	1
Dilleniaceae	*Hibbertia acicularis*	1
Lomandraceae	*Lomandra confertifolia subsp. pallida*	1
Plantaginaceae	**Plantago lanceolata*	1
Poaceae	*Austrostipa scabra subsp. falcata*	1
Poaceae	*Dichelachne rara*	1
Poaceae	*Echinopogon ovatus*	1
Convolvulaceae	*Dichondra repens*	2
Cyperaceae	*Gahnia aspera*	2
Poaceae	*Aristida vagans*	2
Myrtaceae	*Eucalyptus moluccana*	3
Poaceae	*Rytidosperma setacea*	3
Asteraceae	*Cassinia arcuata*	4
Myrtaceae	*Eucalyptus blakelyi*	4
Poaceae	*Aristida ramosa*	m
Santalaceae	*Exocarpos strictus*	m

PLOT G1		
Family Name	**Scientific Name**	**CA**
Adiantaceae	*Cheilanthes sieberi*	1
Anthericaceae	*Tricoryne elatior*	1
Asteraceae	*Calotis cuneifolia*	1
Cactaceae	**Opuntia stricta*	1
Convolvulaceae	*Dichondra repens*	1
Cyperaceae	*Gahnia aspera*	1
Epacridaceae	*Astroloma humifusum*	1
Fabaceae (Faboideae)	*Desmodium varians*	1
Fabaceae (Mimosoideae)	*Acacia ixiophylla*	1
Fabaceae (Mimosoideae)	*Acacia uncinata*	1
Malvaceae	*Sida corrugata*	1
Myrtaceae	*Eucalyptus blakelyi*	1
Myrtaceae	*Eucalyptus crebra*	1
Myrtaceae	*Eucalyptus goniocalyx*	1
Poaceae	*Aristida ramosa*	1
Poaceae	*Dichelachne micrantha*	1
Poaceae	*Austrostipa scabra subsp. falcata*	2
Asteraceae	*Cassinia arcuata*	3
Cupressaceae	*Callitris endlicheri*	3
Myrtaceae	*Eucalyptus moluccana*	3
Poaceae	*Aristida vagans*	3
Juncaceae	*Juncus australis*	m
Loranthaceae	*Amyema cambagei*	m
Poaceae	*Dichelachne rara*	m
Poaceae	*Rytidosperma fulva*	m
Simaroubaceae	**Ailanthus altissima*	m
PLOT G2		
Asteraceae	**Cirsium vulgare*	1
Asteraceae	*Calotis lappulacea*	1
Asteraceae	*Cassinia quinquefaria*	1
Convolvulaceae	*Dichondra repens*	1
Cyperaceae	*Gahnia aspera*	1
Epacridaceae	*Astroloma humifusum*	1
Fabaceae (Faboideae)	*Desmodium varians*	1
Fabaceae (Mimosoideae)	*Acacia implexa*	1
Juncaceae	*Juncus usitatus*	1
Poaceae	*Rytidosperma setacea*	1
Poaceae	*Rytidosperma tenuior*	1
Poaceae	*Aristida personata*	2
Poaceae	*Austrostipa scabra subsp. falcata*	2
Myrtaceae	*Eucalyptus moluccana*	3
Poaceae	*Aristida vagans*	3

PLOT G2 (Continued)		
Family Name	**Scientific Name**	**CA**
Myrtaceae	*Eucalyptus crebra*	4
Asteraceae	*Cassinia arcuata*	6
Anthericaceae	*Tricoryne elatior*	m
Cupressaceae	*Callitris endlicheri*	m
Epacridaceae	*Acrotriche rigida*	m
Fabaceae (Mimosoideae)	*Acacia decora*	m
PLOT G3		
Adiantaceae	*Cheilanthes sieberi*	1
Anthericaceae	*Tricoryne elatior*	1
Campanulaceae	*Wahlenbergia communis*	1
Dilleniaceae	*Hibbertia obtusifolia*	1
Epacridaceae	*Astroloma humifusum*	1
Fabaceae (Faboideae)	*Glycine clandestina*	1
Fabaceae (Mimosoideae)	*Acacia decora*	1
Fabaceae (Mimosoideae)	*Acacia implexa*	1
Poaceae	*Austrostipa scabra subsp. falcata*	1
Poaceae	*Echinopogon ovatus*	1
Cupressaceae	*Callitris endlicheri*	2
Poaceae	*Aristida vagans*	3
Myrtaceae	*Eucalyptus crebra*	4
Asteraceae	*Cassinia arcuata*	5
Myrtaceae	*Angophora floribunda*	m
PLOT G4		
Adiantaceae	*Cheilanthes sieberi*	1
Cactaceae	**Opuntia stricta*	1
Epacridaceae	*Acrotriche rigida*	1
Asteraceae	*Cassinia arcuata*	2
Poaceae	*Aristida vagans*	2
Myrtaceae	*Eucalyptus caleyi*	3
Cupressaceae	*Callitris endlicheri*	6
PLOT G5		
Adiantaceae	*Cheilanthes sieberi*	1
Cyperaceae	*Gahnia aspera*	1
Dilleniaceae	*Hibbertia obtusifolia*	1
Fabaceae (Mimosoideae)	*Acacia decora*	1
Lomandraceae	*Lomandra multiflora*	1
Epacridaceae	*Astroloma humifusum*	2
Fabaceae (Mimosoideae)	*Acacia paradoxa*	2
Poaceae	*Aristida vagans*	2

PLOT G5		
Family Name	**Scientific Name**	**CA**
Asteraceae	*Cassinia arcuata*	3
Myrtaceae	*Eucalyptus caleyi*	4
Cupressaceae	*Callitris endlicheri*	5
PLOT H1		
Adiantaceae	*Cheilanthes sieberi*	1
Anthericaceae	*Tricoryne elatior*	1
Cyperaceae	*Gahnia aspera*	1
Epacridaceae	*Melichrus urceolatus*	1
Fabaceae (Mimosoideae)	*Acacia decora*	1
Poaceae	*Austrostipa scabra subsp. falcata*	1
Poaceae	*Echinopogon ovatus*	1
Poaceae	*Rytidosperma duttoniana*	1
Rhamnaceae	*Cryptandra spinescens*	1
Fabaceae (Mimosoideae)	*Acacia ixiophylla*	2
Myrtaceae	*Eucalyptus crebra*	2
Myrtaceae	*Eucalyptus moluccana*	2
Poaceae	*Aristida calycina var. calycina*	2
Cupressaceae	*Callitris endlicheri*	3
Epacridaceae	*Astroloma humifusum*	3
Poaceae	*Aristida vagans*	3
Asteraceae	*Cassinia arcuata*	5
Asteraceae	*Ozothamnus diosmifolius*	m
Cactaceae	**Opuntia stricta*	m
Campanulaceae	*Wahlenbergia communis*	m
Epacridaceae	*Acrotriche rigida*	m
Ericaceae (Styphelioideae)	*Leucopogon muticus*	m
Fabaceae (Faboideae)	*Desmodium varians*	m
PLOT H2		
Anthericaceae	*Tricoryne elatior*	1
Asteraceae	*Olearia elliptica*	1
Asteraceae	*Ozothamnus diosmifolius*	1
Cyperaceae	*Gahnia aspera*	1
Epacridaceae	*Astroloma humifusum*	1
Poaceae	*Aristida ramosa*	1
Poaceae	*Aristida vagans*	1
Asteraceae	*Calotis lappulacea*	2
Asteraceae	*Cassinia cunninghamii*	2
Convolvulaceae	*Dichondra repens*	2
Poaceae	*Austrostipa scabra subsp. falcata*	2

PLOT H2 (Continued)		
Family Name	**Scientific Name**	**CA**
Asteraceae	*Cassinia arcuata*	3
Cupressaceae	*Callitris endlicheri*	3
Myrtaceae	*Eucalyptus crebra*	3
Myrtaceae	*Eucalyptus moluccana*	3
PLOT H3		
Apiaceae	*Hydrocotyle laxiflora*	1
Asteraceae	*Calotis cuneifolia*	1
Asteraceae	*Calotis lappulacea*	1
Caryophyllaceae	**Paronychia brasiliana*	1
Epacridaceae	*Lissanthe strigosa*	1
Euphorbiaceae	*Phyllanthus hirtellus*	1
Fabaceae (Faboideae)	*Glycine clandestina*	1
Fabaceae (Faboideae)	*Hardenbergia violacea*	1
Lomandraceae	*Lomandra filiformis subsp. filiformis*	1
Lomandraceae	*Lomandra multiflora*	1
Poaceae	*Aristida personata*	1
Poaceae	*Aristida vagans*	1
Poaceae	*Digitaria ramularis*	1
Poaceae	*Rytidosperma eriantha*	1
Asteraceae	*Cassinia arcuata*	2
Chenopodiaceae	*Einadia nutans*	2
Fabaceae (Faboideae)	*Podolobium ilicifolium*	2
Poaceae	*Austrostipa scabra subsp. falcata*	2
Poaceae	*Microlaena stipoides*	2
Urticaceae	*Urtica incisa*	2
Convolvulaceae	*Dichondra repens*	3
Myrtaceae	*Eucalyptus punctata*	6
Cupressaceae	*Callitris endlicheri*	m
Myrtaceae	*Eucalyptus albens*	m
PLOT H4		
Asteraceae	**Carthamus lanatus*	1
Asteraceae	*Calotis cuneifolia*	1
Clusiaceae	**Hypericum perforatum*	1
Malvaceae	**Modiola caroliniana*	1
Myrtaceae	*Eucalyptus albens*	1
Poaceae	*Digitaria brownii*	1
Poaceae	*Eragrostis brownii*	1
Verbenaceae	**Verbena bonariensis*	1
Asteraceae	*Cassinia arcuata*	2
Asteraceae	**Hypochaeris radicata*	2
Poaceae	*Aristida vagans*	2

PLOT H4 (Continued)		
Family Name	**Scientific Name**	**CA**
Poaceae	*Austrostipa scabra subsp. falcata*	2
Asteraceae	*Calotis lappulacea*	3
Poaceae	*Aristida ramosa*	3
Poaceae	*Sporobolus creber*	4
Brassicaceae	*Lepidium pseudohyssopifolium*	1
Poaceae	*Eragrostis alveiformis*	1
Poaceae	*Eragrostis leptostachya*	1
Poaceae	*Chloris truncata*	1
Poaceae	*Rytidosperma caespitosa*	1
Poaceae	*Eragrostis elongata*	1
Poaceae	*Panicum effusum*	2

Appendix 4 Vegetation Community Profiles

The following are summary descriptions and example images of the vegetation communities that were recorded within the proposed Modification open cut extension areas. Each community is also assigned the nearest match to GHV (Sivertsen 2011) and BioMetric (OEH 2012) types as well as the broader Keith Class (Keith 2004). It should be noted that these equivalent types often bear only passing resemblance to the local vegetation.

FloraSearch Code	2
NAME	Coast Grey Box Woodland
CONSERVATION STATUS	Not threatened
GHV equivalent	MU090 Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter
BioMetric equivalent	HU552 Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin
Keith Class	Hunter-Macleay Dry Sclerophyll Forests
RECORDED IN	Areas F, G and H
Plots 2	**Mean diversity** 20

Image: Area F

DESCRIPTION

Canopy	*Eucalyptus moluccana, Eucalyptus blakelyi, Eucalyptus goniocalyx*
Shrubs	*Cassinia arcuata*
Ground	*Gahnia aspera, Rytidosperma setaceum, Aristida sp.*
Climbers and creepers	-
Weeds – low abundance	*Plantago lanceolata, Taraxacum officinale*
Significant Species	-

FloraSearch Code	4
NAME	Narrow-leaved Ironbark Forest
CONSERVATION STATUS	Not threatened
GHV equivalent	MU093 Narrow-leaved Ironbark - Black Cypress Pine shrub - grass woodland upper Hunter and northern Wollemi
BioMetric equivalent	HU551 Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin
Keith Class	Western Slopes Dry Sclerophyll Forests
RECORDED IN	Area G
Plots 2	**Mean diversity** 21.5

Image: Area G

DESCRIPTION	
Canopy	*Eucalyptus crebra, Eucalyptus moluccana, Eucalyptus blakelyi, Callitris endlicheri*
Shrubs	*Cassinia arcuata*
Ground	*Aristida vagans*
Climbers and creepers	-
Weeds – low abundance	-
Significant Species	-

FloraSearch Code	None, Hunter Eco 4a
NAME	Caley's Ironbark Woodland
CONSERVATION STATUS	Not threatened
GHV equivalent	MU159 Caley's Ironbark - Red Ironbark - Currawang shrubby woodland on sandstone ranges of the Sydney Basin
BioMetric equivalent	HU527 Caley's Ironbark - Currawang shrubby woodland on sandstone ridges of the upper Hunter Valley, Sydney Basin
Keith Class	Western Slopes Dry Sclerophyll Forests
RECORDED IN	Area G
Plots 2	**Mean diversity** 11

Image: Area G

DESCRIPTION

Canopy	*Eucalyptus caleyi, Callitris endlicheri*
Shrubs	*Cassinia arcuata, Acacia paradoxa, Acacia decora*
Ground	*Aristida vagans, Cheilanthes sieberi, Hibbertia obtusifolia*
Climbers and creepers	-
Weeds – low abundance	*Opuntia stricta*
Significant Species	-

FloraSearch Code	5a
NAME	Grassy White Box Woodlands
CONSERVATION STATUS	EEC/CEEC
GHV equivalent	MU176 White Box grassy woodland on basalts of the upper Hunter and Liverpool Plains
BioMetric equivalent	HU654 White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South
Keith Class	Western Slopes Grassy Woodlands
RECORDED IN	Area E
Plots 1	**Mean diversity** 17

Image: Area E

DESCRIPTION	
Canopy	*Eucalyptus albens*
Shrubs	-
Ground	*Calotis lappulacea, Lomandra filiformis* subsp. *filiformis, Sida corrugata, Austrostipa scabra* subsp. *falcata*
Climbers and creepers	-
Weeds – low abundance	*Marrubium vulgare*
Significant Species	-

FloraSearch Code	5b
NAME	Shrubby White Box Woodland
CONSERVATION STATUS	Not threatened
GHV equivalent	MU069 White Box - Boxthorn shrubby woodland on sandstone ranges of the Sydney Basin
BioMetric equivalent	HU653 White Box - Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin
Keith Class	Western Slopes Dry Sclerophyll Forests
RECORDED IN	Areas C, D and H
Plots 3	**Mean diversity** 21

Image: Area D

DESCRIPTION	
Canopy	*Eucalyptus albens, Eucalyptus moluccana, Eucalyptus blakelyi, Eucalyptus crebra, Callitris endlicheri*
Shrubs	*Bursaria spinosa, Cassinia arcuata, Acacia decora, Ozothamnus diosmifolius, Cassinia cunninghamii, Acacia ixiophylla*
Ground	*Dichondra repens, Austrostipa scabra* subsp. *falcata, Calotis lappulacea, Aristida ramosa, Aristida vagans, Einadia hastata*
Climbers and creepers	*Desmodium varians, Desmodium brachypodum*
Weeds – low abundance	-
Significant Species	-

FloraSearch Code	5b
NAME	Shrubby White Box Woodland
CONSERVATION STATUS	Not threatened
GHV equivalent	MU069 White Box - Boxthorn shrubby woodland on sandstone ranges of the Sydney Basin
BioMetric equivalent	HU653 White Box - Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin
Keith Class	Western Slopes Dry Sclerophyll Forests
RECORDED IN	*Area E
Plots 4	**Mean diversity** 30

Image: Area E

DESCRIPTION	
Canopy	*Eucalyptus albens, Brachychiton populnea*
Shrubs	*Acacia decora, Dodonaea truncatiales, Bursaria spinosa, Santalum lanceolatum, Halgania brachyrhyncha, Cassinia arcuata*
Ground	*Austrostipa scabra* subsp*. scabra, Lomandra filiformis* subsp*. filiformis,*
Climbers and creepers	*Clematis microphylla, Convolvulus erubescens*
Weeds – low abundance	*Plantago lanceolata*
Significant Species	*?Eremophila sp.*

*Because this example of Shrubby White Box was distinctly different from the other Shrubby White Box sites it is given its own entry.

FloraSearch Code	6
NAME	Sandstone Range Shrubby Woodland
CONSERVATION STATUS	Not threatened
GHV equivalent	MU111 Narrow-leaved Stringybark - Grey Gum shrubby open forest on sandstone ranges of the Sydney Basin
BioMetric equivalent	HU553 Grey Gum - Narrow-leaved Stringybark - ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin
Keith Class	Western Slopes Dry Sclerophyll Forests
RECORDED IN	Area H
Plots 1	**Mean diversity** 24

Image: Area H

DESCRIPTION

Canopy	*Eucalyptus punctata*
Shrubs	*Cassinia arcuata, Podolobium ilicifolium, Lissanthe strigosa*
Ground	*Dichondra repens, Austrostipa scabra* subsp. *falcata, Microlaena stipoides*
Climbers and creepers	*Glycine clandestina, Hardenbergia violacea*
Weeds – low abundance	*Paronychia brasiliana*
Significant Species	-

FloraSearch Code	None, Hunter Eco 7a
NAME	Derived Grassland - weedy
CONSERVATION STATUS	Not threatened
GHV equivalent	No equivalent
BioMetric equivalent	No equivalent
Keith Class	No equivalent
RECORDED IN	Areas C and E
Plots 2	**Mean diversity** 22

Image: Area E

DESCRIPTION	
Canopy	-
Shrubs	-
Ground	*Bothriochloa macra, Elymus scaber, Sida corrugata, Calotis lappulacea*
Climbers and creepers	*Convolvulus erubescens, Glycine tabacina*
Weeds – high abundance	*Verbascum thapsus, Plantago lanceolata, Hypericum perforatum, Carthamus lanatus, Conyza sp., Bromus molliformis, Bromus catharticus, Verbena bonariensis*
Significant Species	-

FloraSearch Code	None, Hunter Eco 7b
NAME	Derived Grassland – box-gum grassy (EEC/CEEC)
CONSERVATION STATUS	EEC/CEEC
GHV equivalent	No equivalent
BioMetric equivalent	No equivalent
Keith Class	Western Slopes Grasslands
RECORDED IN	Area E
Plots 1	**Mean diversity** 31

Image: Area E

DESCRIPTION	
Canopy	-
Shrubs	-
Ground	*Calotis lappulacea, Elymus scaber, Sida corrugata, Austrostipa scabra* subsp. *scabra, Aristida sp., Lomandra bracteata, Eragrostis alveiformis*
Climbers and creepers	*Convolvulus erubescens, Boerhavia dominii*
Weeds – medium abundance	*Plantago lanceolata, Verbena bonariensis, Hypericum perforatum, Chondrilla juncea*
Significant Species	-

FloraSearch Code	None, Hunter Eco 7c
NAME	Derived Grassland – box-gum shrubby
CONSERVATION STATUS	Not threatened
GHV equivalent	No equivalent
BioMetric equivalent	No equivalent
Keith Class	Western Slopes Grasslands
RECORDED IN	Area D
Plots 1	**Mean diversity** 10

Image: Area D

DESCRIPTION	
Canopy	-
Shrubs	-
Ground	*Calotis lappulacea, Sida corrugata, Sida cunninghamii, Sporobolus creber, Austrostipa scabra* subsp. *scabra*
Climbers and creepers	-
Weeds – low abundance	*Plantago lanceolata, Carthamus lanatus*
Significant Species	-

FloraSearch Code	None, Hunter Eco 7d
NAME	Derived Grassland – other native
CONSERVATION STATUS	Not threatened
GHV equivalent	No equivalent
BioMetric equivalent	No equivalent
Keith Class	Western Slopes Grasslands
RECORDED IN	Areas C, E, F and H
Plots 2	**Mean diversity** 24.5

Image: Area F

DESCRIPTION	
Canopy	-
Shrubs	*Cryptandra spinescens, Chrysocephalum apiculatum, Cassinia arcuata*
Ground	*Aristida vagans, Aristida sp., Elymus scaber, Goodenia hederacea* subsp. *hederacea, Zornia dyctiocarpa, Rytidosperma duttonianum*
Climbers and creepers	*Convolvulus erubescens*
Weeds – low abundance	*Hypericum perforatum, Petrorhagia nanteuilii, Carthamus lanatus, Plantago lanceolata*
Significant Species	-

Appendix 5 Biodiversity Offset – Flora Report

Wilpinjong Coal Open Cut Modification

Appendix 5 – Flora Offset Assessment

By Hunter Eco

July 2013

CONTENTS

TABLES

FIGURES

1 Introduction

This is a report of the flora attributes of areas proposed as Biodiversity Offset for loss that would result from proceeding with the proposed Wilpinjong Coal Mine Modification. Two areas make up the Biodiversity Offset:

- Offset Area D; and
- Offset Area E.

A map showing these locations is provided in **Figure 1**.

2 Field Survey Methods

To inform field surveys, records of threatened flora species and populations were obtained from New South Wales (NSW) BioNet (NSW Office of Environment and Heritage [OEH], 2013) and the Commonwealth *Protected Matters Search Tool* (Department of Sustainability, Environment, Water, Population and Communities, 2013). Records were drawn from within 20 kilometre of the Biodiversity Offset. **Table 1** shows the resulting 20 threatened species along with two possible endangered populations.

Table 1 Threatened flora species and populations potentially occurring in the Biodiversity Offset

Threatened Species		**Status**[1]	
Family	**Scientific Name**	**TSC Act**	**EPBC Act**
Apocynaceae	*Tylophora linearis*	V	E
Asteraceae	*Leucochrysum albicans* var. *tricolor*	-	[E]
Asteraceae	*Ozothamnus tesselatus*	V	(V)
Fabaceae (Faboideae)	*Kennedia retrorsa*	V	(V)
Fabaceae (Faboideae)	*Swainsona recta*	E	(E)
Fabaceae (Mimosoideae)	*Acacia ausfeldii*	V	-
Geraniaceae	*Pelargonium* sp. *striatellum* (G.W.Carr 10345)	(E)	E
Lamiaceae	*Prostanthera cryptandroides* subsp. *cryptandroides*	V	(V)
Lamiaceae	*Prostanthera discolor*	V	(V)
Lamiaceae	*Prostanthera stricta*	V	(V)
Malvaceae	*Lasiopetalum longistamineum*	V	(V)
Myrtaceae	*Eucalyptus macrorhyncha subsp. cannonii*	-	V
Myrtaceae	*Eucalyptus cannonii*	V	-
Myrtaceae	*Homoranthus darwinioides*	V	(V)
Orchidaceae	*Prasophyllum sp. Wybong (C.Phelps ORG 5269)*	-	CE
Orchidaceae	*Diuris tricolor*[2]	V	-
Rhamnaceae	*Pomaderris queenslandica*	E	-

Table 1 Threatened flora species and populations potentially occurring in the Biodiversity Offset (Continued)

Threatened Species		**Status[1]**	
Family	**Scientific Name**	**TSC Act**	**EPBC Act**
Rutaceae	*Philotheca ericifolia*	-	V
Santalaceae	*Thesium australe*	(V)	V
Scrophulariaceae	*Euphrasia arguta*	(CE)	CE
Endangered Populations			
Myrtaceae	*Eucalyptus camaldulensis* Dehnh. in the Hunter Catchment	EP	-
Orchidaceae	*Cymbidium canaliculatum* R. Br. in the Hunter Catchment	EP	-

Status: V=vulnerable, E=endangered, CE=critically endangered, EP=endangered population. (V) bracketed status codes indicate listed species not included in the respective data extracts. [V] bracketed status codes indicate local records of species not included in data extracts.
[1]Conservation status under the *Threatened Species Conservation Act, 1995* (TSC Act) and *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) current as of 17 June 2013.
[2]Listed as *Diuris sheaffiana* prior to name change to *D. tricolor.*

2.1 Vegetation Communities and Flora

A vegetation map was prepared from ground-truthed point data, floristic plot data and ground-truthed community boundary determination. The applied methods were developed in part by the author, and published by the NSW Department of Environment and Climate Change (DECC) (DECC, 2008). Ground-truthed vegetation data were collected using a hand-held GPS during meanders by vehicle and on foot. The initial ground-truth data were used to map the floristic variation occurring across the target areas.

Vegetation community classification was supported by data collected from standard 20 metres (m) x 20 m (0.04 hectares [ha]) floristic plots in which all species were identified and their abundance given a score based on the modified Braun-Blanquet 1-6 scale (Braun-Blanquet, 1932/1951). Plots were placed in locations representative of the different habitat types resulting from the ground-truth data assessment.

Areas surveyed and mapped were larger than ultimately included in the Biodiversity Offset however all data is considered relevant to describing the values of the Biodiversity Offset proposed. Hence the plot data and vegetation mapping outside of the Biodiversity Offset is included in this report.

Data analysis was conducted using hierarchical agglomerative clustering (Primer 6) (Clarke and Gorley, 2006) and local vegetation community types were determined according to the similarity of the sample plots.

Field data was collected from the proposed Biodiversity Offset in January and May 2013 (**Table 2**).

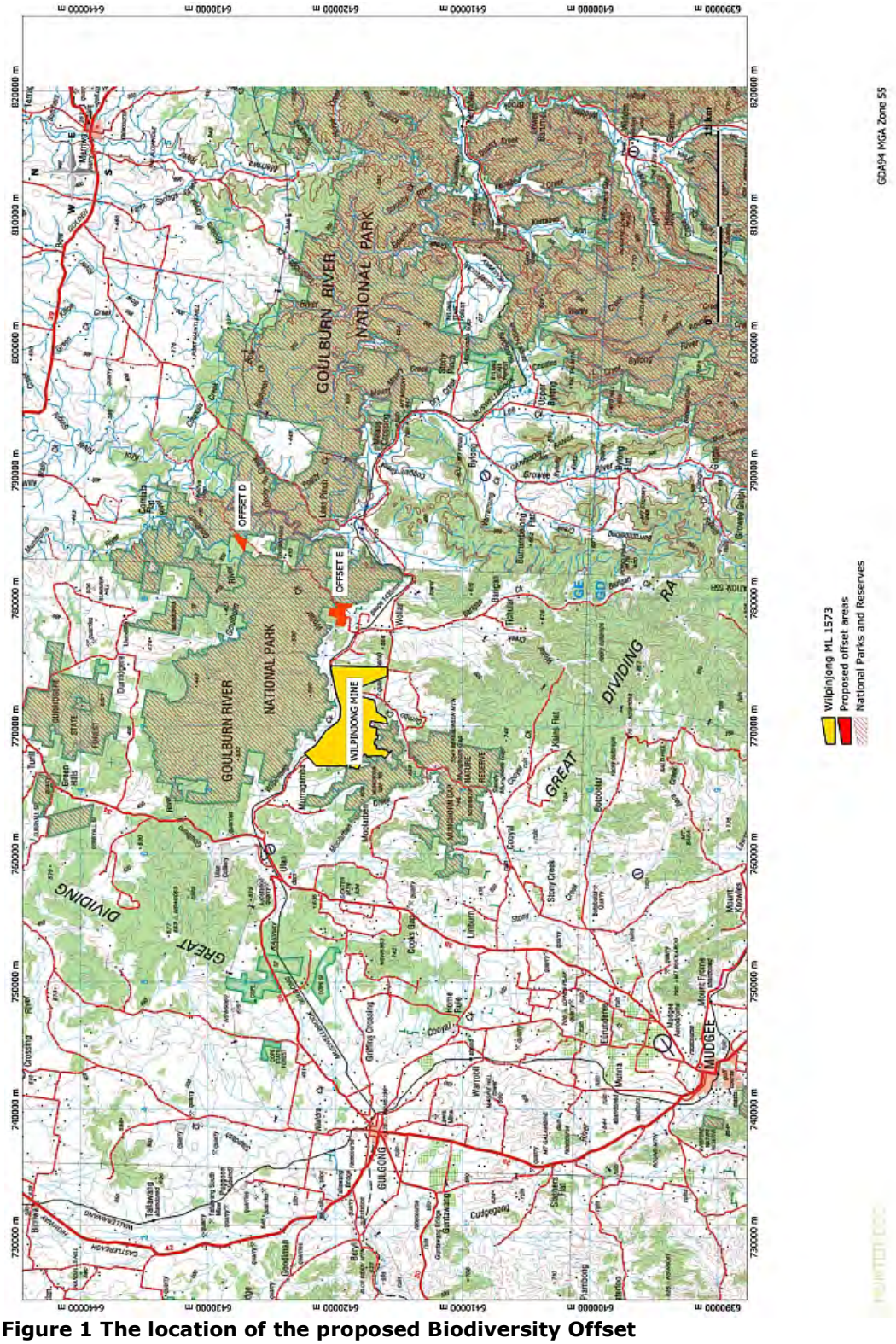

Figure 1 The location of the proposed Biodiversity Offset

Table 2 Proposed Biodiversity Offset field data collection times

Offset Area	Field Data Collection Dates
Area D	24/1/2013: 6/5/2013
Area E	24/1/2013: 7, 8, 10, 11, 12/5/2013

3 Field Survey Results

Vegetation mapping was supported by 170 ground-truth data points and 39 sample plots. **Table 3** summarises the plots and vegetation communities in each Biodiversity Offset.

Table 3 Sample plots collected from vegetation communities

Code	Community	Mapped Area (ha)	Biodiversity Offset Area (ha)	Number of plots
	Offset Area D[1]			
5a	Grassy White Box Woodland (EEC/CEEC)	9.7	9.7	1
9	Broombush Scrub	3.3	3.3	1
14	Inland Grey Box Woodland	3.0	3.0	1
15	Narrow-leaved Ironbark - Box Woodland	34.1	34.1	3
	Total	**50.1**	**50.1**	**6**
	Offset Area E			
2	Coast Grey Box Woodland	3.5	1.1	1
5a	Grassy White Box Woodland (EEC/CEEC)	32.0	32.0	5
5b	Shrubby White Box Woodland	7.6	5.2	2
7	Derived Native Grassland	37.3	4.4	3
8	Blakely's Red Gum Woodland (EEC/CEEC)	5.7	3.0	2
11	Fuzzy Box Woodland	1.1	0.0	1
12	Grey Gum - Narrow-leaved Stringybark Forest	28.7	24.7	4
13	Ironbark-Bloodwood-Redgum Woodland	72.7	72.0	6
16	Rough-barked Apple Woodland	4.2	1.6	3
17	Yellow Box Woodland (EEC/CEEC)	10.7	3.1	3
18	Shrubby Regeneration	13.6	13.6	3
	Total	**217.1**	**160.7**	**33**

Note: EEC – Endangered Ecological Community.

CEEC – Critically Endangered Ecological Community.

[1] Offset Area D contains a dam that is approximately 0.2 ha in size. This area has been excluded from vegetation calculations.

Appendices 1 and **2** provide the details of sample plots from each area and **Table 4** summarises the floristics from the plot data.

Table 4 Summary of floristics from the proposed Biodiversity Offset

Offset Area	Families	Species	Weeds
D	23	67	2
E	59	256	28
Combined	59	265	28

The dominant families were Poaceae, Asteraceae and Myrtaceae. No threatened flora species were recorded.

3.1 Vegetation

In this section floristic plot data are analysed for similarity and the results are used in combination with ground-truth data to prepare a community classification and map. As the purpose of this is to determine the suitability of the communities in the proposed Biodiversity Offset as offsets for vegetation lost due to the Modification, plot data from the Modification was also included in the analysis.

3.1.1 Data Analysis

The aim of this analysis was to determine the relationship between habitat in the proposed Biodiversity Offset and the Modification open cut extension areas (the Modification areas). As described in **Section 2**, hierarchical agglomerative clustering was applied to floristic data from the two areas that make up the proposed Biodiversity Offset and the Modification areas. This was accomplished using Primer 6 (Clarke and Gorley, 2006) and included the SIMPROF utility that designates groups that are significantly different, in this case at the 95% confidence level.

The resulting dendrogram (**Figure 2**) indicates significantly different groups by a solid black line, below which differences are at a lower level of confidence, but are never-the-less different. Progressing from the left side of the dendrogram, there are two major similar groups: grassland and grassy woodland; and all other woodland and forest habitat. Modification plot E2 (5b - Shrubby White Box Woodland) stands out as unique and this is understandable as that site contained a suite of shrub species entirely different from the other Shrubby White Box sites.

This analysis also confirms the analysis of data from the Modification report showing that the woodland communities originally mapped as different in Offset Areas G and H, are essentially the same. Thus the dendrogram analysis lumps them together with *15 Narrow-leaved Ironbark - Box Woodland.* However, for consistency with previous mapping and to avoid confusion, these communities are mapped and described separately (in the Wilpinjong Coal Open Cut Modification – Terrestrial Flora Assessment). This is not an issue for comparison between the Modification open cut extension areas and the Biodiversity Offset as there is sufficient areas/quality of all relevant Keith Classes at the Biodiversity Offset.

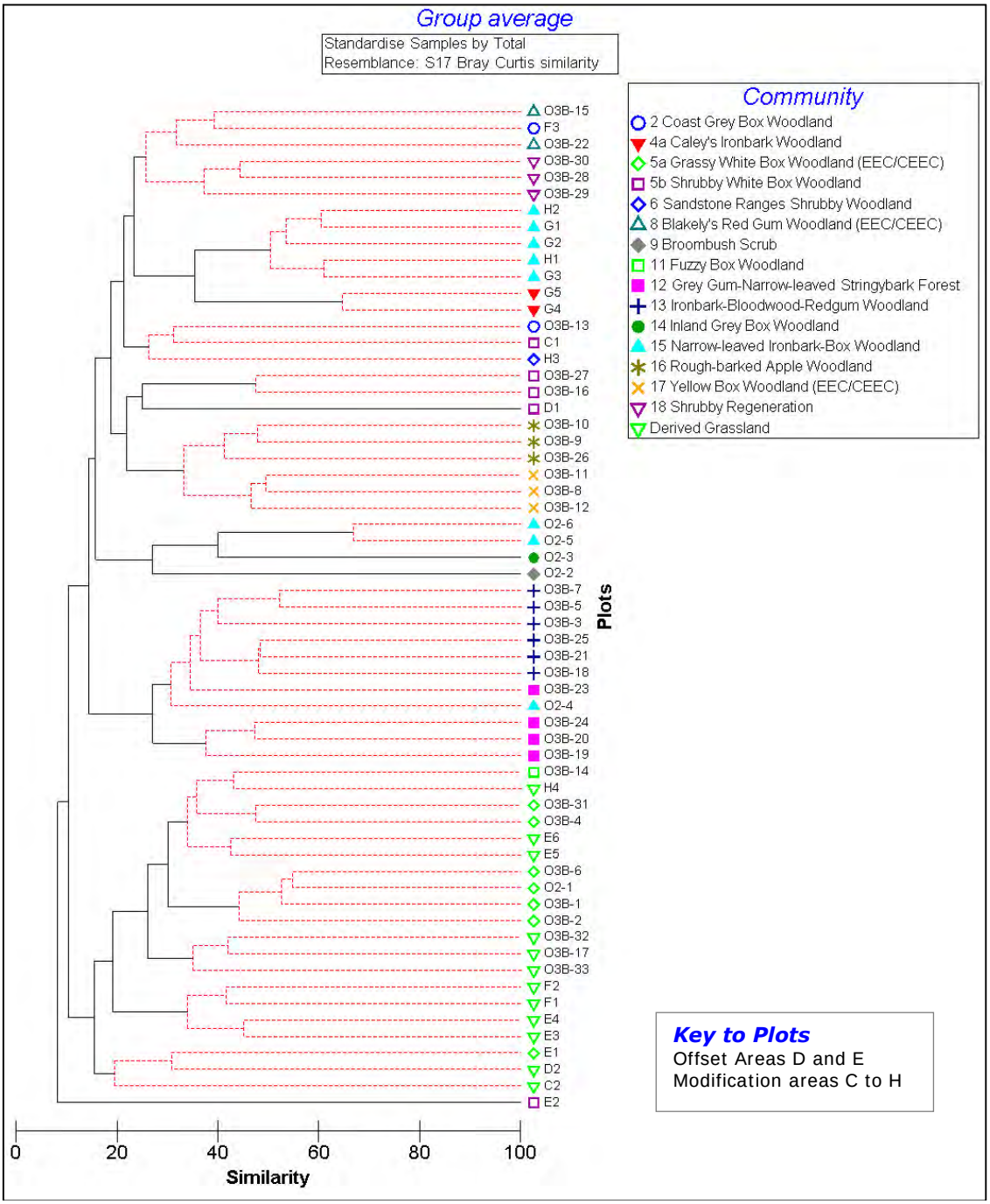

Figure 2 Dendrogram showing the similarity of sample plots from the Modification Areas and Biodiversity Offset

The grouping of all grassland and grassy woodland sites indicates that the proposed Biodiversity Offset provides equivalent habitat to that in the Modification, and that includes habitat consistent with *White Box Yellow Box Blakely's Red Gum Woodland/White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (EEC/CEEC) (box-gum EEC/CEEC).

Non-metric multi-dimensional scaling (nMDS) provides further insight into the relationship between floristic plots (**Figure 3**) with ellipses grouping the dendrogram plots at a similarity slice of 15. The nMDS plot confirms the separation of grassland and grassy woodland habitat. It also shows that the majority of woodland habitat from both the proposed Biodiversity Offset and the Modification areas are grouped together. One Ironbark-Bloodwood-Redgum Woodland and four Grey Gum - Narrow-leaved Stringybark Forest plots lie outside of the larger woodland/forest group.

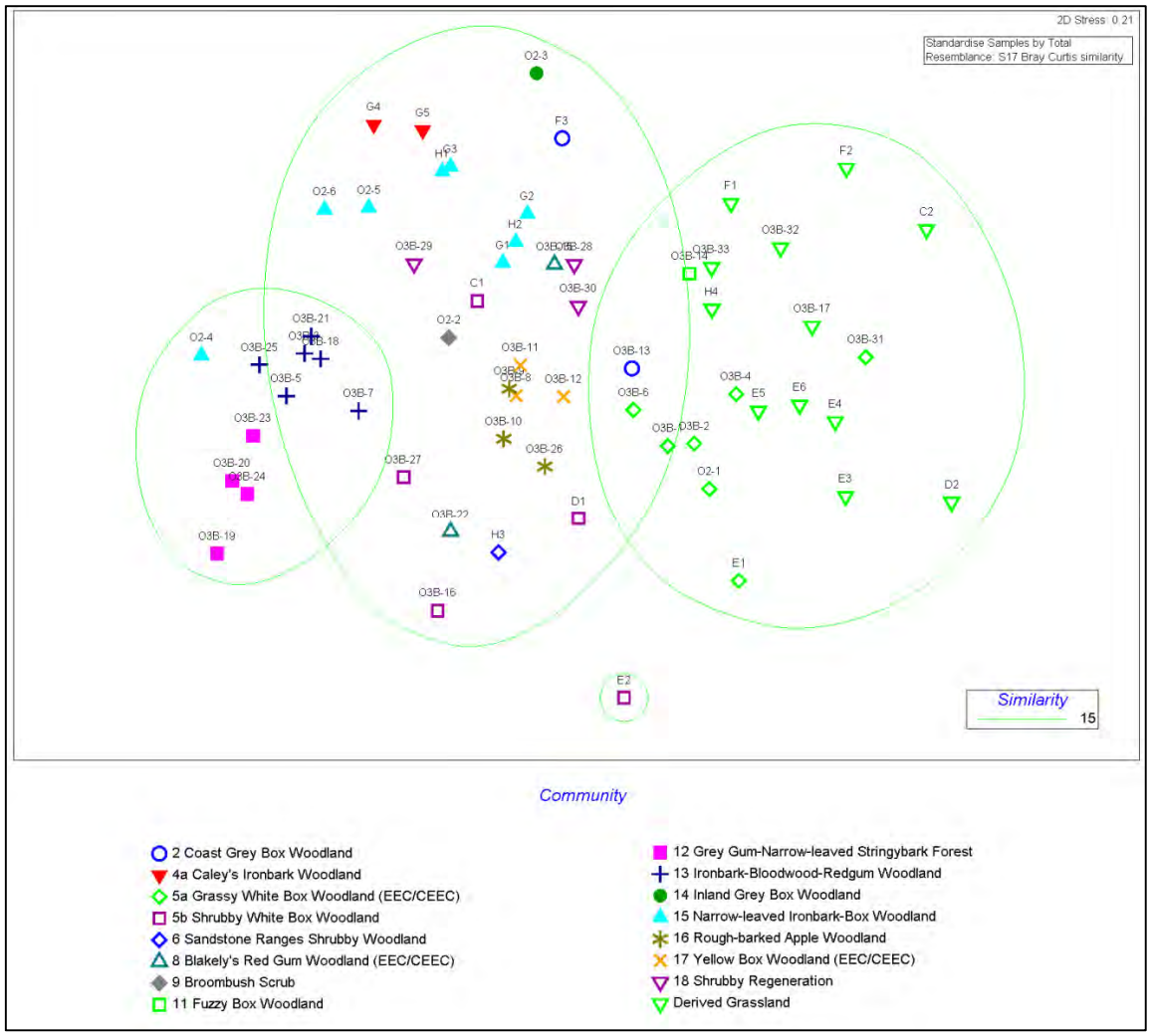

Figure 3 nMDS plot of all vegetation plot samples

3.1.2 Vegetation Communities

No systematic and detailed vegetation classification and map was available for the area in which the Biodiversity Offset Areas were located. Hill (1999) provided a broad classification and map of Goulburn River National Park and Munghorn Gap Nature Reserve, specifically for NSW National Parks and Wildlife Service fire management purposes. More recently Sivertsen *et al.* (2011) produced a draft vegetation model, Greater Hunter Native Vegetation Mapping (GHV), that includes the proposed Biodiversity Offset. The GHV model was assessed against the ground-truthed communities from the proposed Biodiversity Offset and found to be a poor representation.

The classification hierarchy used here started with the Local Community named according to the dominant canopy species and overall structure. This follows the intuitive classification used by FloraSearch (2006) and adopted for the Wilpinjong Modification. The classification was increasingly generalised by selecting the nearest match of the Local Community to the following:

- Hill (1999). There was no equivalent for some Local Communities in Hill (1999) as the dominant species were not recorded in that report.
- BioMetric classification (OEH, 2012). This classification is divided by Catchment Management Authority (CMA) boundaries and the proposed Biodiversity Offset is located towards the western extent of the Hunter Central Rivers CMA. This is adjoined by the Central West CMA, and the content of several Local Communities were best described by communities from that CMA.
- Keith (2004) provides a NSW State-wide system generalising the structure of communities at Class and Formation levels.

Appendix 3 provides the full classification table. **Figure 4** shows the vegetation communities mapped across Offset Area D, and **Figure 5** those across Offset Area E.

Summary descriptions of the Local Communities follow with detailed floristic content provided in **Appendix 4**. Photographs from each Local Community can be seen in **Appendix 5**. Summary descriptions are provided for all vegetation communities mapped on **Figures 4** and **5**. Areas given in the summary descriptions are those that are included in the proposed Biodiversity Offset. Hence there is a summary description of Community 11 (Fuzzy Box Woodland) although the area quoted is 0 ha.

2 - Coast Grey Box Woodland [1.1 ha]

Families 18, Species 32

Scattered fragments of this community were to be found across the mostly cleared land in Offset Area E, east of Mogo Road with the canopy consisting almost entirely of *Eucalyptus moluccana* (Coastal Grey Box).

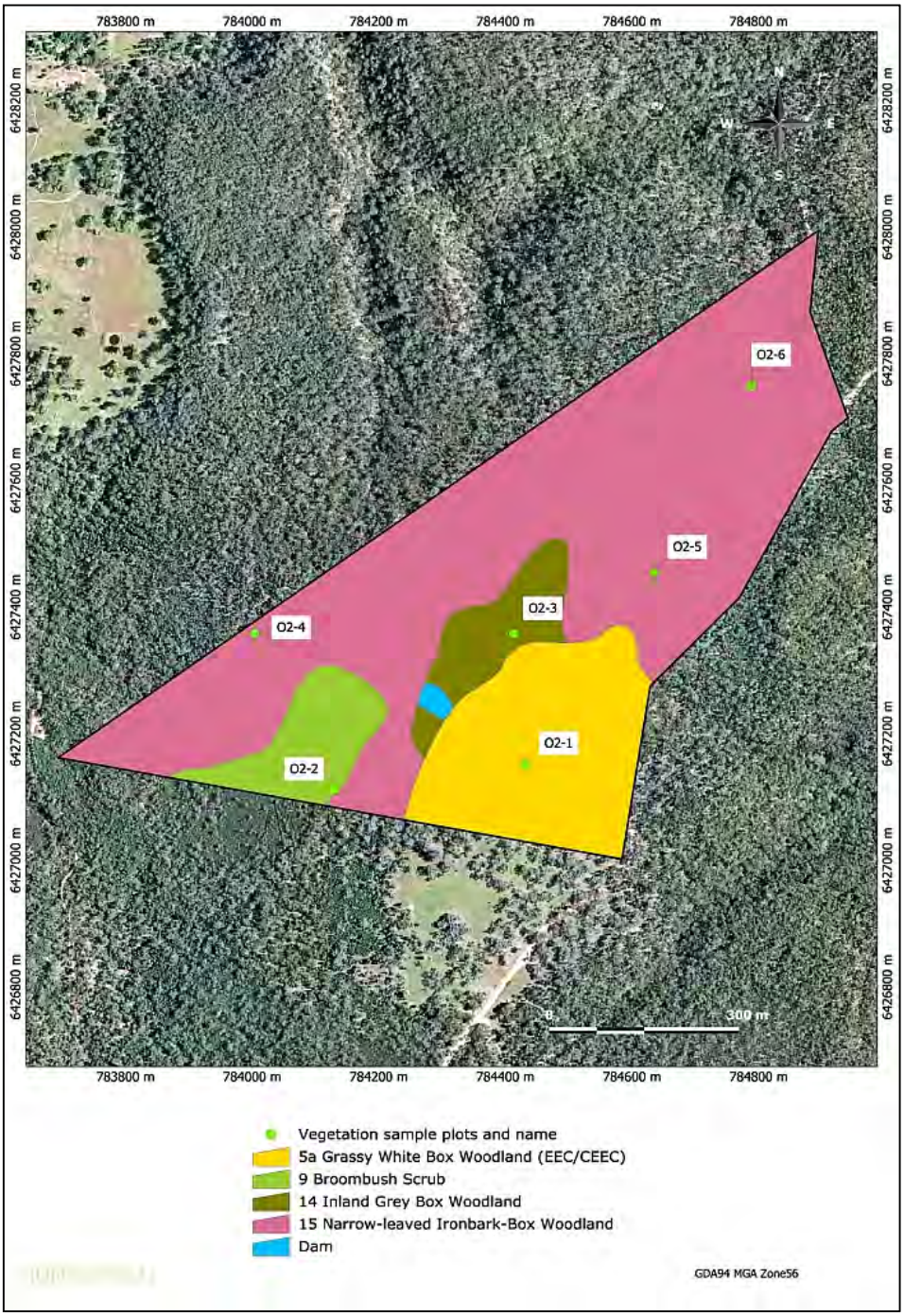

Figure 4 The vegetation mapped across Offset Area D

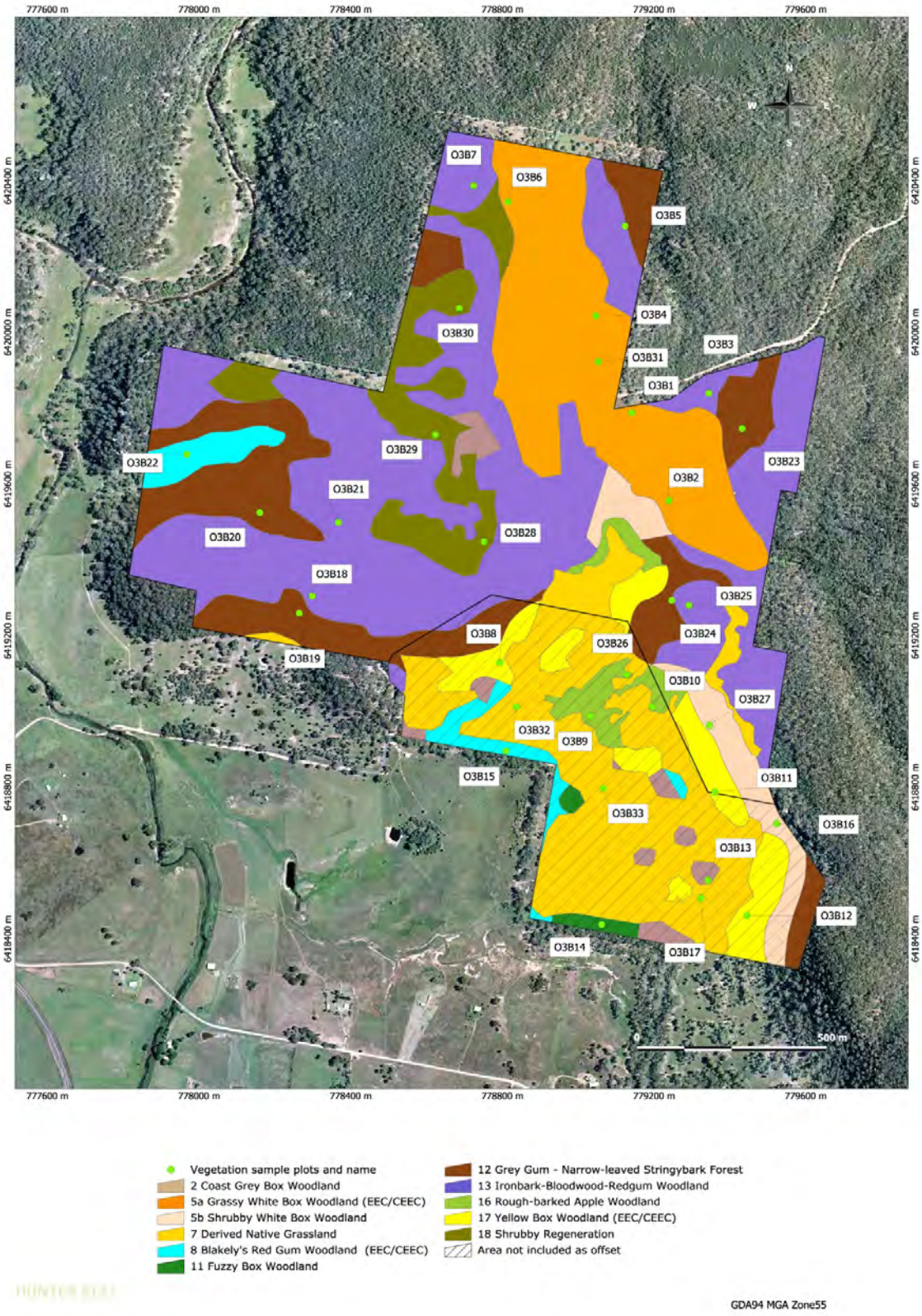

Figure 5 The vegetation mapped across Offset Area E

Shrub and ground cover species were depauperate and only present in small numbers as a consequence of cattle and macropod grazing. Most of this habitat consisted of a few mature trees with surrounding spindly regrowth.

5a - Grassy White Box Woodland (EEC/CEEC) [41.7 ha]

Families 22, Species 61

This community was present in both Offset Areas D and E with the sole canopy species being *Eucalyptus albens* (White Box). Grass species accounted for just under 40% of ground cover.

5b - Shrubby White Box Woodland [5.2 ha]

Families 26, Species 60

This habitat was present in Offset Area E and was located along the lower part of side slopes and often merged into Grey Gum – Narrow-leaved Stringybark community at the upper slope edge and Rough-barked Apple at the foot slope.

The main canopy species were *Eucalyptus albens* (White Box) and *Eucalyptus punctata* (Grey Gum). Shrubs consisted of *Acacia implexa, Acacia linearifolia, Indigofera coronillifolia, Dodonaea triangularis, Persoonia linearis*, and *Cassinia quinquefaria*.

Ground cover was generally sparse with the grass *Paspalidium gracile* being most plentiful along with small herbs and sedges with *Lomandra confertifolia* subsp. *rubiginosa* being common.

7 - Derived Native Grassland [4.4 ha]

Families 18, Species 47

This habitat dominated the low lying land east of Mogo Road with just under 30% of species being weeds. Because this grassland was surrounded by, or contained islands of, various woodland habitat, some of which was consistent with the definition of box-gum EEC/CEEC, it could not be subdivided into threatened and non-threatened. Conservatively in the Biodiversity Offset, these areas have not been included in the area calculations for EEC/CEEC.

8 - Blakely's Red Gum Woodland (EEC/CEEC) [3.0 ha]

Families 21, Species 46

This community was found in two locations in Offset Area E, on the flats of mostly cleared land east of Mogo Road, and on the valley floor of a well forested gully on the western side of Mogo Road; in both areas the canopy was dominated by *Eucalyptus blakelyi* (Blakely's Red Gum). The eastern portion canopy was dominated by regrowth with the ground cover primarily *Carex appressa* tussocks.

The western portion canopy consisted of mature trees over grassy ground cover with scattered shrubs.

9 - Broombush Scrub [3.3 ha]

Families 9, Species 21

Located in Offset Area D the canopy consisted of *Eucalyptus microcarpa* (Inland Grey Box) and *Eucalyptus sideroxylon* (Mugga Ironbark). The dominant feature of this community was a dense shrub layer of *Melaleuca uncinata* (Broombush).

11 - Fuzzy Box Woodland [0 ha]

Families 7, Species 19

Remnants of *Eucalyptus conica* (Fuzzy Box) woodland were present in the low areas east of Mogo Road in Offset Area E and was a grassy woodland with over half of the ground species being grasses. *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* is a NSW EEC noted as a highly cleared (95%) community. It also appears to be a highly cleared community in the Sydney Basin Bioregion in which the proposed offset land is located (C. Driscoll pers. obs.).

12 - Grey Gum - Narrow-leaved Stringybark Forest [24.7 ha]

Families 27, Species 52

This community was located on rocky upper side-slopes in Offset Area E. The dominant canopy species were *Eucalyptus punctata* (Grey Gum), and either *Eucalyptus tenella* (Narrow-leaved Stringybark) or *Eucalyptus sparsifolia* (Narrow-leaved Stringybark).

There was a mid-storey of *Callitris endlicheri* (Black Cypress) and shrubs *Cassinia quinquefaria, Acrotriche rigida, Brachyloma daphnoides, Acacia linearifolia* and *Persoonia linearis*. Ground cover was sparse with grasses *Cleistochloa rigida* and *Microlaena stipoides* predominant.

13 - Ironbark-Bloodwood-Redgum Woodland [72.0 ha]

Families 24, Species 89

A highly variable community in Offset Area E that could well split into two or three communities with analysis of more plot data, a task beyond the scope and requirement of the current project.

The common canopy species across the entire habitat was *Eucalyptus crebra* (Narrow-leaved ironbark) with localised inclusions of two other ironbarks, *Eucalyptus fibrosa* (Red Ironbark) and *Eucalyptus beyeriana* (Beyer's Ironbark).

In addition to the ironbarks, the red gums *Eucalyptus dwyeri* (Dwyer's Red Gum) and *Eucalyptus dealbata* (Tumbledown Red Gum) were often present, as well as *Corymbia trachyphloia* subsp. *amphistomatica* (Brown Bloodwood). *Callitris endlicheri* (Black Cypress) was also scattered throughout. The shrub layer was also diverse with the dominant species being *Acrotriche rigida, Leucopogon muticus, Styphelia triflora, Dodonaea viscosa* and *Brachyloma daphnoides*. Ground cover contained 18 grass species along with creepers, herbs and sedges.

14 - Inland Grey Box Woodland [3.0 ha]

Families 5, Species 10

Located in Offset Area D, the canopy of this community consisted entirely of *Eucalypts microcarpa* (Inland Grey Box). There was a dominant shrub, *Acacia montana*, and the ground cover was primarily native grasses, in particular *Aristida vagans*.

15 - Narrow-leaved Ironbark – Box Woodland [34.1 ha]

Families 15, Species 40

This community was found only in Offset Area D. The vegetation mapping for Offset Area D initially included a Red Ironbark community, however preliminary analysis indicated that it was appropriate for this habitat to be absorbed into the Narrow-leaved Ironbark – Box community. The dominant canopy species was *Eucalyptus crebra* (Narrow-leaved Ironbark) along with *Eucalyptus fibrosa* (Red Ironbark) and *Eucalyptus albens* (White Box). *Callitris endlicheri* (Black Cypress) was often the dominant canopy species. There were two dominant shrubs, *Acacia montana* and *Acacia triptera*, with latter sometimes forming impenetrable barriers; *Dodonaea triangularis* was also locally abundant.

A *Grevillea* species was also common in some areas and could best be described as having affinity with *Grevillea patulifolia* (confirmed by R. Makinson Sydney Herbarium), a species whose known distribution is south of Sydney. Ground cover contained grass species along with creepers, herbs and sedges.

16 - Rough-barked Apple Woodland [1.6 ha]

Families 32, Species 76

This habitat was present in Offset Area E, generally around the fringes of the cleared grassland area with the only canopy species being *Angophora floribunda* (Rough-barked Apple). Scattered shrubs included *Bursaria spinosa*, *Melicytus dentatus*, *Daviesia genistifolia, Acrotriche rigida* and *Styphelia triflora*. Ground cover contained 20 grass species along with creepers, herbs and sedges.

17 - Yellow Box Woodland (EEC/CEEC) [3.1 ha]

Families 28, Species 66

This community was primarily located at the footslopes around the open grassland of Offset Area E, east of Mogo Road with the only canopy species being *Eucalyptus melliodora* (Yellow Box). It was primarily a grassy community with 12 grass species present. Scattered shrubs consisted of *Cassinia quinquefaria, Cassinia arcuata, Acrotriche rigida, Styphelia triflora, Acacia decora, Acacia implexa* and *Acacia linearifolia.*

18 - Shrubby Regeneration [13.6 ha]

Families 20, Species 64

This habitat was present in Offset Area E and was previously cleared land that was regenerating.

Regenerating canopy species were *Angophora floribunda* (Rough-barked Apple), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus dealbata* (Tumbledown Red Gum). Shrubs consisted primarily of *Acacia falciformis, Acacia linearifolia, Babingtonia cunninghamii, Bursaria spinosa* and *Persoonia linearis*. There were 27 grass species that included four introduced species.

3.2 Habitat Condition

Shrubby woodland and forest habitat throughout the proposed Biodiversity Offset was in good condition. It was evident that some areas had regenerated from past clearing (demonstrated by an old disc harrow rusting away in the scrub at one location) but diversity was excellent. While some weed species were recorded, they did not dominate anywhere.

The condition of the grassy woodland, particularly the White Box grassy woodland was typical of that habitat across its range consisting of scattered canopy trees over cleared grassland. The canopy density varied from open woodland to scattered paddock trees but with an overall diverse native species content. Most of this habitat had been regularly grazed to varying degrees and it is expected that it would regenerate if grazing were to be removed, or at least substantially reduced.

Open grassland had good diversity and was not anywhere dominated by weeds. Again this habitat was regularly grazed and removal or substantial reduction of grazing should result in good regeneration. There were few to no regenerating canopy trees in this habitat and so restoration to the communities from which the grassland was derived would require active planting of canopy species.

4 Conclusion

Similarity analysis presented in **Section 3.1.1** showed that the habitat in the proposed Biodiversity Offset was a good match for that in the Modification, particularly the box-gum EEC/CEEC. Habitat assessment in **Section 3.2** showed that the Biodiversity Offset is in good condition with very few weeds and that reduced stocking rates along with select planting would improve habitat and flora values.

5 References

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Appendix 1 Offset Area D Plot Data

Table values are Braun-Blanquet cover-abundance scores

Family and Species Names | Plot Number	1	2	3	4	5	6
Adiantaceae						
Cheilanthes sieberi		2			1	
Apiaceae						
Actinotus helianthi				1		
Asteraceae						
Calotis lappulacea	3					
Cactaceae						
**Opuntia stricta*	2					
Casuarinaceae						
Allocasuarina gymnanthera				4		
Chenopodiaceae						
Einadia nutans	1					
Clusiaceae						
**Hypericum perforatum*	2					
Cupressaceae						
Callitris endlicheri				3		
Cyperaceae						
Cyperus gracilis	1					
Gahnia aspera	1	2	4	1	5	5
Lepidosperma laterale				1		
Dilleniaceae						
Hibbertia circumdans				1		
Epacridaceae						
Acrotriche rigida		2		2	3	4
Astroloma humifusum				1		
Leucopogon muticus				3		1
Lissanthe strigosa		1				1
Melichrus urceolatus					2	1
Fabaceae (Faboideae)						
Desmodium varians	1	1				
Glycine clandestina	1					
Fabaceae (Mimosoideae)						
Acacia montana		1	4		3	3
Acacia triptera				3	1	
Iridaceae						
Patersonia sericea				1		

Family and Species Names | Plot Number	1	2	3	4	5	6
Lomandraceae						
Lomandra confertifolia	1					
Lomandra filiformis subsp. coriacea				1		
Lomandra filiformis subsp. filiformis	1		1			
Lomandra glauca				2		
Lomandra multiflora	1			1		
Lomandra patens				2		1
Malvaceae						
Sida corrugata	2	1				
Myrtaceae						
Calytrix tetragona				1		
Corymbia trachyphloia				1		
Eucalyptus albens	5				1	2
Eucalyptus crebra					5	5
Eucalyptus dwyeri				1		
Eucalyptus fibrosa				4		
Eucalyptus microcarpa		5	5			
Eucalyptus sideroxylon		2				
Melaleuca uncinata		5		1		
Phormiaceae						
Dianella longifolia				1		
Plantaginaceae						
Plantago gaudichaudii	1					
Poaceae						
Aristida calycina var. calycina				1		
Aristida personata			3		1	
Aristida ramosa	4	1		1		
Aristida vagans		1	3		4	3
Austrostipa mollis				1		
Austrostipa scabra subsp. falcata	3	3	2			
Austrostipa scabra subsp. scabra					1	
Chloris truncata		1				
Chloris ventricosa	2					
Cleistochloa rigida				1		
Dichanthium sericeum	2					
Enteropogon ramosus	1					
Entolasia stricta		1				
Eragrostis brownii					2	
Eragrostis leptostachya		1	2		1	

Family and Species Names | Plot Number	1	2	3	4	5	6
Poaceae (Continued)						
Microlaena stipoides		3				
Panicum effusum		1	1		1	
Panicum queenslandicum	2					
Poa sieberiana	1					
Rytidosperma auriculatum	1					
Rytidosperma eriantha		1				
Rytidosperma setaceum	2	1				
Rytidosperma tenuior			1			
Proteaceae						
Grevillea patulifolia					1	3
Hakea dactyloides				1		
Sapindaceae						
Dodonaea triangularis					2	
Solanaceae						
Solanum sp.		1				

*Introduced species.

Appendix 2 Offset Area E Plot Data

Table values are Braun-Blanquet cover-abundance scores

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Adiantaceae																
Cheilanthes distans																1
Cheilanthes sieberi	1	2			1			1	1	1						2
Aizoaceae																
Tetragonia microptera																1
Anthericaceae																
Laxmannia gracilis			2										1			
Thysanotus juncifolius																
Apiaceae																
**Cyclospermum leptophyllum*																
Asclepiadaceae																
**Gomphocarpus fruticosus*																
Asteraceae																
**Bidens pilosa*													1			
**Carthamus lanatus*																
**Chondrilla juncea*				1												
**Cirsium vulgare*										1					1	
**Conyza bonariensis*																
**Hypochaeris radicata*				2										1		
**Tagetes minuta*	2															
**Taraxacum officinale*																
Calocephalus citreus								1								
Calotis cuneifolia													1			1
Calotis lappulacea	3	2		1		2						1	2	1		
Cassinia arcuata				1		1		3	2	1	1	3	1	3	3	1
Cassinia cunninghamii					1											
Cassinia quinquefaria												1				3
Chrysocephalum apiculatum						1										
Chrysocephalum semipapposum	1							1	1	1	1	1		2		
Euchiton sphaericus																
Gamochaeta coarctatum																
Glossocardia bidens								1								
Olearia elliptica																
Ozothamnus diosmifolius																
Podolepis jaceoides																
Sigesbeckia orientalis subsp. orientalis																
Vittadinia cervicularis var. subcervicularis																1

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Asteraceae (Continued)																
Vittadinia cuneata	1															
Brassicaceae																
**Lepidium bonariense*														1		
Coronopus didymus																
Lepidium pseudohyssopifolium												1				
Cactaceae																
**Opuntia stricta*	1	1				1					1					
Campanulaceae																
Wahlenbergia communis	1	1		1		1		1	1		1	1	1		1	
Wahlenbergia luteola								1								1
Caryophyllaceae																
**Paronychia brasiliana*													2			1
**Petrorhagia nanteuilii*																
Stellaria pungens																1
Casuarinaceae																
Allocasuarina gymnanthera							1									
Chenopodiaceae																
Einadia hastata	2							1		1		1	3			2
Einadia nutans									1			1				2
Einadia trigonos subsp. leiocarpa																
Clusiaceae																
**Hypericum perforatum*	3	3		1		1		1	1	1		1	1	2		
Convolvulaceae																
Convolvulus erubescens									1		1					
Cuscuta australis																
Dichondra repens								1	2	3	1				2	
Dichondra species A	1	1				1			1			2				2
Crassulaceae																
Crassula colorata																1
Cucurbitaceae																
**Cucumis myriocarpus*																
Cupressaceae																
Callitris endlicheri			1				2		1							
Cyperaceae																
Carex appressa															5	
Carex inversa				1												
Cyperus gracilis	1					1						1	1			
Fimbristylis dichotoma								1			1			1		

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Cyperaceae (Continued)																
Gahnia aspera			1	1		2	2	1	2	3		1	1		1	1
Lepidosperma laterale			2		1		2									
Scleria mackaviensis											1					
Dilleniaceae																
Hibbertia acicularis								1								
Hibbertia circumdans							1									
Hibbertia monogyna																
Epacridaceae																
Acrotriche rigida			5		3		3	3	6	1	3					
Astroloma humifusum			1					1	1		1	1				
Brachyloma daphnoides			1		1											
Leucopogon muticus			2		2		1									
Lissanthe strigosa								1								
Melichrus erubescens											1	1				
Melichrus urceolatus			3			1										
Styphelia triflora			2		2		1	1	2	1	1	1				
Euphorbiaceae																
Chamaesyce drummondii												1				
Phyllanthus hirtellus					1											
Poranthera microphylla																
Fabaceae (Faboideae)																
Bossiaea obcordata					1		1									
Bossiaea prostrata											2					
Daviesia genistifolia								1		2		2				
Daviesia pubigera							1									
Desmodium brachypodum									1							
Desmodium varians	1	1				1	1	1		1	1	1	1			1
Glycine clandestina								1			1	1	1		2	1
Glycine tabacina	1					1										
Hardenbergia violacea			1				1									
Hovea lanceolata																
Hovea linearis							1									
Indigofera coronillifolia																2
Oxylobium pultenea																
Podolobium ilicifolium					1											1
Pultenaea microphylla			1				1			1						
Swainsona bracteata						1										
Zornia dyctiocarpa var. dyctiocarpa										1						

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Fabaceae (Mimosoideae)																
Acacia amoena					1											
Acacia buxifolia subsp. buxifolia					1		1									
Acacia decora												1				
Acacia doratoxylon																
Acacia falciformis																
Acacia filicifolia																
Acacia implexa			2						1	1	1	2	1			1
Acacia leucolobia																
Acacia linearifolia							1	1								3
Acacia penninervis					1											
Acacia triptera					2											
Acacia ulicifolia																
Acacia uncinata					1		1									
Geraniaceae																
Erodium crinitum																
Geranium potentilloides var. potentilloides																
Geranium solanderi	1							1	1	1						
Pelargonium australe																
Goodeniaceae																
Goodenia stephensonii																
Iridaceae																
Patersonia sericea																
Juncaceae																
Juncus bufonius													1			
Juncus homalocaulis													1			
Juncus subsecundus																
Juncus usitatus																
Lamiaceae																
**Marrubium vulgare*	1			1												
Mentha satureioides										2					2	
Scutellaria humilis																
Linaceae																
**Linum trigynum*										1						
Lobeliaceae																
Isotoma axillaris																
Lomandraceae																
Lomandra bracteata																
Lomandra confertifolia	2	2		2	2	4	2	3	1		1	2	2			

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Lomandraceae (Continued)																
Lomandra confertifolia subsp. pallida												2				
Lomandra confertifolia subsp. rubiginosa			2													4
Lomandra filiformis subsp. coriacea			1			1	1									
Lomandra filiformis subsp. filiformis																
Lomandra glauca			2		1		1									
Lomandra multiflora			1			1	1	2	1			1				
Lomandra patens	1					1		1								1
Loranthaceae																
Amyema miquelii												1	1			
Amyema quandang var. quandang								1								
Dendrophthoe glabrescens								1								
Malvaceae																
**Modiola caroliniana*																
Sida corrugata	2			1		2						1	1	2		
Sida cunninghamii																
Myoporaceae																
Eremophila debilis																
Myrtaceae																
Angophora floribunda									6	6						3
Babingtonia cunninghamii			1													
Corymbia trachyphloia			4		3		3									
Eucalyptus albens	4	3		1		5										3
Eucalyptus beyeriana					2											
Eucalyptus blakelyi															6	
Eucalyptus conica														5		
Eucalyptus crebra			1		3		2									
Eucalyptus dealbata																
Eucalyptus dwyeri			2													
Eucalyptus fibrosa					3		3									
Eucalyptus melliodora								6			5	5				
Eucalyptus moluccana													6			
Eucalyptus punctata							1									2
Eucalyptus sparsifolia																
Eucalyptus tenella																1
Kunzea parvifolia																
Leptospermum parvifolium																
Melaleuca thymifolia																

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Oxalidaceae																
Oxalis chnoodes																
Oxalis sp.																
Phormiaceae																
Dianella longifolia			2				1		1	1	1				1	1
Stypandra glauca																
Pittosporaceae																
Billardiera mutabilus																
Bursaria spinosa					2				1			2				
Plantaginaceae																
**Plantago lanceolata*								1		1						
Plantago debilis																
Plantago gaudichaudii		1							1							
Plantago turrifera													1			
Poaceae																
**Bromus catharticus*																
**Paspalum dilatatum*																
**Setaria parviflora*																
**Setaria verticillata*																
**Sporobolus africanus*																
Aristida calycina var. calycina																
Aristida calycina var. praealta																
Aristida contorta			1													
Aristida echinata																
Aristida personata	2			3					1							
Aristida ramosa	5	3	1	3	2	3	2	2	2	2	3		1	5	2	1
Aristida ramosa x vagans						1		1			1	1				
Aristida vagans	2	2	3		1	2	1	3	2	2	4	3	2	2	2	
Arundinella nepalensis			2													
Austrostipa densiflora																1
Austrostipa scabra subsp. falcata	2			1		3						2	2	3		
Austrostipa scabra subsp. scabra		3														
Austrostipa verticillata																1
Bothriochloa decipiens										1				1		
Chloris truncata						1										
Chloris ventricosa				1		1										
Cleistochloa rigida					2											
Cymbopogon refractus	3		1					1	1		1	1		2		
Dichanthium sericeum				2		1										

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Poaceae (Continued)																
Dichelachne crinita			1													
Dichelachne rara								1					1		1	
Digitaria brownii				1					1				1	1		
Digitaria diffusa																
Digitaria ramularis																
Echinopogon caespitosus																
Echinopogon ovatus										1						
Enneapogon gracilis		2		2												
Enteropogon ramosus																
Eragrostis alveiformis																
Eragrostis brownii			1											1		
Eragrostis elongata																
Eragrostis leptostachya				1	1				1							
Eragrostis sororia																
Eriochloa pseudoacrotricha					1											
Eulalia aurea			2													
Lachnagrostis filiformis																
Microlaena stipoides			1		2		1			3			1		2	1
Panicum effusum			2		1	2	1					1				
Panicum queenslandicum		1		1		1			1					1		
Paspalidium gracile																3
Poa sieberiana										1						
Poa sp.																
Poa tenera																
Rytidosperma auriculatum						1										
Rytidosperma bipartita													2			
Rytidosperma duttoniana											1					
Rytidosperma eriantha									1			1				
Rytidosperma fulva				2						1	2		1			
Rytidosperma monticola								1								
Rytidosperma setaceum	2															
Rytidosperma tenuior		2												1		
Sporobolus creber				2					1				1	1	1	
Themeda australis						1		1	1	1	2	1				
Tragus australianus																
Polygalaceae																
Polygala japonica								1								

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Polygonaceae (Continued)																
Rumex brownii				1		1										
Primulaceae																
**Anagallis arvensis*		1														
Proteaceae																
Grevillea patulifolia			3													
Grevillea ramosissima subsp. ramosissima							1									
Persoonia linearis			3		1						1	1			1	
Ranunculaceae																
Clematis glycinoides										1						
Rhamnaceae																
Cryptandra amara																
Cryptandra spinescens																
Rosaceae																
**Rosa rubiginosa*								1	1	2			1		3	
Acaena sp.								1								
Rubus parvifolius																
Rubiaceae																
Asperula sp.																
Galium gaudichaudii		1								1						1
Galium liratum																1
Pomax umbellata					1											
Rutaceae																
Boronia anethifolia																
Philotheca sp.												1				
Santalaceae																
Exocarpos strictus			1													
Sapindaceae																
Dodonaea boroniifolia																
Dodonaea cuneata																
Dodonaea triangularis																2
Dodonaea viscosa																
Scrophulariaceae																
Veronica calycina																
Veronica plebeia										1			1			1
Solanaceae																
Solanum sp.	1					1	1			1						1

Family and Species Names | Plot Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sterculiaceae																
Brachychiton populneus										1						
Stylidiaceae																
Stylidium laricifolium																
Thymelaeaceae																
Pimelea curviflora var. sericea		2		1				2								
Verbenaceae																
**Verbena bonariensis*																
Violaceae																
Melicytus dentatus										1					1	
Viola hederacea																
Zamiaceae																
Macrozamia reducta					1					1						

* Introduced species.

Appendix 2 Offset Area E Plot Data (Continued)

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Adiantaceae																	
Cheilanthes distans										1							
Cheilanthes sieberi		1			1		1	1	1				1	1			
Aizoaceae																	
Tetragonia microptera																	
Anthericaceae																	
Laxmannia gracilis												1	1	1			3
Thysanotus juncifolius																	1
Apiaceae																	
**Cyclospermum leptophyllum*	2																
Asclepiadaceae																	
**Gomphocarpus fruticosus*										1							
Asteraceae																	
**Bidens pilosa*																	
**Carthamus lanatus*	1														3		
**Chondrilla juncea*															1		
**Cirsium vulgare*																	
**Conyza bonariensis*						1								1			1
**Hypochaeris radicata*												1			2		
**Tagetes minuta*										2							
**Taraxacum officinale*						1											1
Calocephalus citreus																	
Calotis cuneifolia																	
Calotis lappulacea	2	1								1				1	1		1
Cassinia arcuata		3	1			1					1	4	5	3			
Cassinia cunninghamii																	
Cassinia quinquefaria				1	2			2	2	1	1						
Chrysocephalum apiculatum																	
Chrysocephalum semipapposum													1				1
Euchiton sphaericus						1											
Gamochaeta coarctatum																	1
Glossocardia bidens																	
Olearia elliptica		1															
Ozothamnus diosmifolius		1	2														
Podolepis jaceoides													1				
Sigesbeckia orientalis subsp. orientalis						1											

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Asteraceae (Continued)																	
Vittadinia cervicularis var. subcervicularis																	
Vittadinia cuneata																	1
Brassicaceae																	
**Lepidium bonariense*																	
Coronopus didymus															1		
Lepidium pseudohyssopifolium																	
Cactaceae																	
**Opuntia stricta*								1		1	1						
Campanulaceae																	
Wahlenbergia communis			1							1	1	1					1
Wahlenbergia luteola																	
Caryophyllaceae																	
**Paronychia brasiliana*	1																1
**Petrorhagia nanteuilii*																	1
Stellaria pungens																	
Casuarinaceae																	
Allocasuarina gymnanthera																	
Chenopodiaceae																	
Einadia hastata											1						
Einadia nutans										1							
Einadia trigonos subsp. leiocarpa								1					1				
Clusiaceae																	
**Hypericum perforatum*	1									3					1	1	1
Convolvulaceae																	
Convolvulus erubescens										1							
Cuscuta australis					1												
Dichondra repens						2				1	2						
Dichondra species A										1							
Crassulaceae																	
Crassula colorata																	
Cucurbitaceae																	
**Cucumis myriocarpus*															1		
Cupressaceae																	
Callitris endlicheri		2	1	1	4			3	4	2	3						
Cyperaceae																	
Carex appressa																	
Carex inversa																1	

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Cyperaceae (Continued)																	
Cyperus gracilis						1											
Fimbristylis dichotoma	2											1		1	1	1	1
Gahnia aspera	1	1		1	1	4	3	1	1	1	2	3	3	3		1	1
Lepidosperma laterale				1	1		2		1		2		1				
Scleria mackaviensis										1							
Dilleniaceae																	
Hibbertia acicularis																	
Hibbertia circumdans		1							1								
Hibbertia monogyna							1										
Epacridaceae																	
Acrotriche rigida		2	1	1	2		4	3	2	1	1		1				
Astroloma humifusum		1			1						1		3	1			
Brachyloma daphnoides		3			1		3		2				2				
Leucopogon muticus		4	1		3		1	2	3								
Lissanthe strigosa																	
Melichrus erubescens								1	1	1							
Melichrus urceolatus							1										
Styphelia triflora		3		2	2		3	1		1	1						
Euphorbiaceae																	
Chamaesyce drummondii																	
Phyllanthus hirtellus			1				1		1		2						
Poranthera microphylla						1											
Fabaceae (Faboideae)																	
Bossiaea obcordata																	
Bossiaea prostrata																	
Daviesia genistifolia																	
Daviesia pubigera		1															
Desmodium brachypodum						1				1							
Desmodium varians	1				1	2				1	1			1			
Glycine clandestina					1						1						
Glycine tabacina																	
Hardenbergia violacea				1		1					1						
Hovea lanceolata			2														
Hovea linearis																	
Indigofera coronillifolia										2							
Oxylobium pultenea													1				
Podolobium ilicifolium					1						1						
Pultenaea microphylla					1												

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Fabaceae (Faboideae) (Continued)																	
Swainsona bracteata																	
Zornia dyctiocarpa var. dyctiocarpa																	
Fabaceae (Mimosoideae)																	
Acacia amoena					1												
Acacia buxifolia subsp. buxifolia																	
Acacia decora																	
Acacia doratoxylon									1								
Acacia falciformis														1			
Acacia filicifolia						1											
Acacia implexa										1	1						
Acacia leucolobia		1															
Acacia linearifolia		1		2	1	2	1	1	1		1			2			
Acacia penninervis																	
Acacia triptera					3												
Acacia ulicifolia								1									
Acacia uncinata					1		1							1			
Geraniaceae																	
Erodium crinitum															1		
Geranium potentilloides var. potentilloides										1							
Geranium solanderi										1							
Pelargonium australe								1									
Goodeniaceae																	
Goodenia stephensonii											3						
Iridaceae																	
Patersonia sericea							1										
Juncaceae																	
Juncus bufonius																	
Juncus homalocaulis																	
Juncus subsecundus												1					
Juncus usitatus																1	
Lamiaceae																	
**Marrubium vulgare*																	
Mentha satureioides	2																
Scutellaria humilis										2							
Linaceae																	
**Linum trigynum*	1																

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Lobeliaceae																	
Isotoma axillaris								1									
Lomandraceae																	
Lomandra bracteata							2			1							
Lomandra confertifolia										1	1				1		1
Lomandra confertifolia subsp. pallida																	
Lomandra confertifolia subsp. rubiginosa		1	2						2		4						
Lomandra filiformis subsp. coriacea				1										1			
Lomandra filiformis subsp. filiformis		1			1				1								
Lomandra glauca		3	2		2		1						1	1			
Lomandra multiflora																	
Lomandra patens				1		1				1	1						
Loranthaceae																	
Amyema miquelii																	
Amyema quandang var. quandang																	
Dendrophthoe glabrescens																	
Malvaceae																	
**Modiola caroliniana*	1																
Sida corrugata														2	1		
Sida cunninghamii								1									
Myoporaceae																	
Eremophila debilis										1							
Myrtaceae																	
Angophora floribunda		1				2	1			5	1	3					
Babingtonia cunninghamii														1			
Corymbia trachyphloia																	
Eucalyptus albens											3						
Eucalyptus beyeriana																	
Eucalyptus blakelyi						6											
Eucalyptus conica																	
Eucalyptus crebra		4		3	3				2		1	1		1			
Eucalyptus dealbata									3				1				
Eucalyptus dwyeri		1			3												
Eucalyptus fibrosa													1				
Eucalyptus melliodora																	
Eucalyptus moluccana																	
Eucalyptus punctata			4	4			4	4									

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Myrtaceae (Continued)																	
Eucalyptus sparsifolia							3										
Eucalyptus tenella			5	4				3			1						
Kunzea parvifolia					3												
Leptospermum parvifolium					2												
Melaleuca thymifolia						1											
Oxalidaceae																	
Oxalis chnoodes	1																1
Oxalis sp.	1															1	1
Phormiaceae																	
Dianella longifolia				1		1		1		1	1						
Stypandra glauca									1								
Pittosporaceae																	
Billardiera mutabilus		1															
Bursaria spinosa												1					
Plantaginaceae																	
**Plantago lanceolata*						1											
Plantago debilis	1												1				
Plantago gaudichaudii																	
Plantago turrifera																	
Poaceae																	
**Bromus catharticus*																	1
**Paspalum dilatatum*	1											1					
**Setaria parviflora*												1				1	
**Setaria verticillata*														1			
**Sporobolus africanus*												1					
Aristida calycina var. calycina					2												
Aristida calycina var. praealta																	1
Aristida contorta																	
Aristida echinata						2											
Aristida personata						2				2	1		1				
Aristida ramosa	2				1				1	5		4	1	3	3	2	3
Aristida ramosa x vagans																	
Aristida vagans		1			2	2	1		1	2	1	3	3	3		1	3
Arundinella nepalensis						3								1			
Austrostipa densiflora																	
Austrostipa scabra subsp. falcata										2		1					
Austrostipa scabra subsp. scabra		1												1	2		
Austrostipa verticillata																	

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Poaceae (Continued)																	
Bothriochloa decipiens												2			4	6	
Chloris truncata																	1
Chloris ventricosa														1			
Cleistochloa rigida		2		3				2	3								
Cymbopogon refractus										1	1	1					
Dichanthium sericeum															1		
Dichelachne crinita																	
Dichelachne rara		1		1		2						2	1			1	
Digitaria brownii														1	1	3	2
Digitaria diffusa												1					
Digitaria ramularis					1				1		1		1				
Echinopogon caespitosus												1					
Echinopogon ovatus																	
Enneapogon gracilis															2		
Enteropogon ramosus															1		
Eragrostis alveiformis	1														1	1	
Eragrostis brownii					1							2	1	2		1	1
Eragrostis elongata															1		1
Eragrostis leptostachya						1						1			1		
Eragrostis sororia													1	1			
Eriochloa pseudoacrotricha																	
Eulalia aurea																	
Lachnagrostis filiformis						1											
Microlaena stipoides		2			1	4	1	1	1	1	1	3	2				
Panicum effusum	1				1				1	1		1	1	1	1		
Panicum queenslandicum															1	1	
Paspalidium gracile								2		1	3						
Poa sieberiana																	
Poa sp.							1										
Poa tenera										1							
Rytidosperma auriculatum										1							
Rytidosperma bipartita		1			2												
Rytidosperma duttoniana											1				1		
Rytidosperma eriantha													1				
Rytidosperma fulva							1									1	
Rytidosperma monticola												1					
Rytidosperma setaceum															1		
Rytidosperma tenuior	1										1	1	1				

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Poaceae (Continued)																	
Sporobolus creber	5											1		1	2	6	2
Themeda australis										2							2
Tragus australianus															2		
Polygalaceae																	
Polygala japonica																	
Polygonaceae																	
Rumex brownii															1		
Primulaceae																	
**Anagallis arvensis*	1					1											
Proteaceae																	
Grevillea patulifolia		1															
Grevillea ramosissima subsp. ramosissima																	
Persoonia linearis		3	2	3	2		4	2	4		1		1				
Ranunculaceae																	
Clematis glycinoides						1											
Rhamnaceae																	
Cryptandra amara													3				
Cryptandra spinescens													3				
Rosaceae																	
**Rosa rubiginosa*						1				1							
Acaena sp.						1				1							
Rubus parvifolius						1											
Rubiaceae																	
Asperula sp.						1											
Galium gaudichaudii																	
Galium liratum																	
Pomax umbellata		1			1		1	1	1								
Rutaceae																	
Boronia anethifolia									2								
Philotheca sp.		1															
Santalaceae																	
Exocarpos strictus			1			3		1	1	1			2				
Sapindaceae																	
Dodonaea boroniifolia									2								
Dodonaea cuneata								2									
Dodonaea triangularis											2						
Dodonaea viscosa		1															

Family and Species Names | Plot Number	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Scrophulariaceae																	
Veronica calycina											1						
Veronica plebeia											1						
Solanaceae																	
Solanum sp.				1				1		1	2						
Sterculiaceae																	
Brachychiton populneus								1		1							
Stylidiaceae																	
Stylidium laricifolium			2	1							1						
Thymelaeaceae																	
Pimelea curviflora var. sericea																	
Verbenaceae																	
**Verbena bonariensis*	1					1										1	1
Violaceae																	
Melicytus dentatus																	
Viola hederacea						2											
Zamiaceae																	
Macrozamia reducta													1				

*Introduced species.

Appendix 3 Community Classification

Code	Local Community	Biodiversity Offset	Hill (1999)	BioMetric Type	Formation (Keith 2004)	Class (Keith 2004)
2	Coast Grey Box Woodland	E	-	HU551 Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin	Grassy Woodlands	Coastal Valley Grassy Woodlands
5a	Grassy White Box Woodland (EEC/CEEC)[1]	D	WL2 Box Woodland on Basalt	HU654 White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South	Grassy Woodlands	Western Slopes Grassy Woodlands
		E	AOW1 Box Alluvial Open Woodland	HU654 White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South		
5b	Shrubby White Box Woodland	E	WL2 Box Woodland on Basalt	HU653 White Box - Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin	Dry Sclerophyll Forests (Shrub/grass subformation)	Western Slopes Dry Sclerophyll Woodlands
7	Derived Native Grassland	E	-	HU671 Derived grasslands of the slopes on the Merriwa Plateau	Grasslands	Western Slopes Grasslands
8	Blakely's Red Gum Woodland (EEC/CEEC)[1]	E	AOW1 Box Alluvial Open Woodland	CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
9	Broombush Scrub	D	LOF1 Low Open Forest - Scrub Complex on Sandstone Plateau	CW119 Broombush shrubland of the sand plains of the Pilliga region, subtropical sub-humid climate zone	Dry Sclerophyll Forests (Shrub/grass subformation)	Pilliga Outwash Dry Sclerophyll Forests
11	Fuzzy Box Woodland	E	-	CW139 Fuzzy Box on loams in the Nandewar Bioregion and northern Brigalow Belt South Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
12	Grey Gum - Narrow-leaved Stringybark Forest	E	OF2 Exposed Open Forest on Sandstone Ridges	HU552 Grey Gum - Narrow-leaved Stringybark - ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin	Dry Sclerophyll Forests (Shrubby subformation)	Western Slopes Dry Sclerophyll Forests

Code	Local Community	Biodiversity Offset	Hill (1999)	BioMetric Type	Formation (Keith 2004)	Class (Keith 2004)
13	Ironbark-Bloodwood-Redgum Woodland	E	OF1 Ironbark Open Forest on Sandstone	CW136 Dwyer's Red Gum woodland on siliceous substrates in the Brigalow Belt South Bioregion	Dry Sclerophyll Forests (Shrubby subformation)	Western Slopes Dry Sclerophyll Forests
14	Inland Grey Box Woodland	D	-	HU547 'Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
15	Narrow-leaved Ironbark – Box Woodland	D	AOF2 Narrow-leaved Ironbark Alluvial Open Forest	HU551 Grey Box - Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin	Grassy Woodlands	Coastal Valley Grassy Woodlands
16	Rough-barked Apple Woodland	E	AOF1 Apple Alluvial Open Forest	HU605 Rough-barked apple grassy open forest on valley flats of the North Coast and Sydney Basin	Dry Sclerophyll Forests (Shrubby subformation)	North Coast Dry Sclerophyll Forests
17	Yellow Box Woodland (EEC/CEEC)[1]	E	AOW1 Box Alluvial Open Woodland	HU654 White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South	Grassy Woodlands	Western Slopes Grassy Woodlands
18	Shrubby Regeneration	E	-	-	-	-

[1] New South Wales Endangered Ecological Community *White Box, Yellow Box, Blakely's Red Gum Grassy Woodland*; Commonwealth Critically Endangered Ecological Community *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*.

Conservation status under the *Environment Protection and Biodiversity Conservation Act, 1999* and *Threatened Species Conservation Act, 1995* current as of 8 July 2013.

Appendix 4 Floristic Content of Vegetation Communities

Vegetation Community 2 - Coast Grey Box Woodland 3B-13

Anthericaceae
Laxmannia gracilis
Asteraceae
**Bidens pilosa*
Calotis cuneifolia
Calotis lappulacea
Cassinia arcuata
Campanulaceae
Wahlenbergia communis
Caryophyllaceae
**Paronychia brasiliana*
Chenopodiaceae
Einadia hastata
Clusiaceae
**Hypericum perforatum*
Cyperaceae
Cyperus gracilis
Gahnia aspera
Fabaceae (Faboideae)
Desmodium varians
Glycine clandestina
Fabaceae (Mimosoideae)
Acacia implexa
Juncaceae
Juncus bufonius
Juncus homalocaulis
Lomandraceae
Lomandra confertifolia
Loranthaceae
Amyema miquelii
Malvaceae
Sida corrugata
Myrtaceae
Eucalyptus moluccana
Plantaginaceae
Plantago turrifera

Poaceae
Aristida ramosa
Aristida vagans
Austrostipa scabra subsp. falcata
Dichelachne rara
Digitaria brownii
Microlaena stipoides
Rytidosperma bipartita
Rytidosperma fulva
Sporobolus creber
Rosaceae
**Rosa rubiginosa*
Scrophulariaceae
Veronica plebeia

* Introduced species.

Vegetation Community 5a - Grassy White Box Woodland (ECC/CEEC) 2-1, 3B-1, 2 , 4, 6 & 31

Adiantaceae
Cheilanthes sieberi
Asteraceae
**Chondrilla juncea*
**Hypochaeris radicata*
**Tagetes minuta*
Calotis lappulacea
Cassinia arcuata
Chrysocephalum apiculatum
Chrysocephalum semipapposum
Vittadinia cuneata
Cactaceae
**Opuntia stricta*
Campanulaceae
Wahlenbergia communis
Chenopodiaceae
Einadia hastata
Einadia nutans
Clusiaceae
**Hypericum perforatum*
Convolvulaceae
Dichondra species A
Cyperaceae
Carex inversa
Cyperus gracilis
Gahnia aspera
Epacridaceae
Melichrus urceolatus
Fabaceae (Faboideae)
Desmodium varians
Glycine clandestina
Glycine tabacina
Swainsona bracteata
Geraniaceae
Geranium solanderi
Lamiaceae
**Marrubium vulgare*
Lomandraceae
Lomandra confertifolia
Lomandra filiformis subsp.
Lomandra filiformis subsp.
Lomandra multiflora

Lomandra patens
Malvaceae
Sida corrugata
Myrtaceae
Eucalyptus albens
Plantaginaceae
Plantago gaudichaudii
Poaceae
Aristida personata
Aristida ramosa
Aristida ramosa x vagans
Aristida vagans
Austrostipa scabra subsp. falcata
Austrostipa scabra subsp. scabra
Chloris truncata
Chloris ventricosa
Cymbopogon refractus
Dichanthium sericeum
Digitaria brownii
Enneapogon gracilis
Enteropogon ramosus
Eragrostis leptostachya
Panicum effusum
Panicum queenslandicum
Poa sieberiana
Rytidosperma auriculatum
Rytidosperma fulva
Rytidosperma setaceum
Rytidosperma tenuior
Sporobolus creber
Themeda australis
Polygonaceae
Rumex brownii
Primulaceae
**Anagallis arvensis*
Rubiaceae
Galium gaudichaudii
Solanaceae
Solanum sp.
Thymelaeaceae
Pimelea curviflora var. sericea

* Introduced species.

Vegetation Community 5b - Shrubby White Box Woodland 3B-16 & 27

Adiantaceae
Cheilanthes distans
Cheilanthes sieberi
Aizoaceae
**Tetragonia microptera*
Asteraceae
Calotis cuneifolia
Cassinia arcuata
Cassinia quinquefaria
Vittadinia cervicularis var.
Cactaceae
**Opuntia stricta*
Campanulaceae
Wahlenbergia communis
Wahlenbergia luteola
Caryophyllaceae
**Paronychia brasiliana*
Stellaria pungens
Chenopodiaceae
Einadia hastata
Einadia nutans
Convolvulaceae
Dichondra repens
Dichondra species A
Crassulaceae
Crassula colorata
Cupressaceae
Callitris endlicheri
Cyperaceae
Gahnia aspera
Lepidosperma laterale
Epacridaceae
Acrotriche rigida
Astroloma humifusum
Styphelia triflora
Euphorbiaceae
Phyllanthus hirtellus
Fabaceae (Faboideae)
Desmodium varians
Glycine clandestina
Hardenbergia violacea
Indigofera coronillifolia
Podolobium ilicifolium
Fabaceae (Mimosoideae)
Acacia implexa
Acacia linearifolia

Goodeniaceae
Goodenia stephensonii
Lomandraceae
Lomandra confertifolia
Lomandra confertifolia subsp.
Lomandra patens
Myrtaceae
Angophora floribunda
Eucalyptus albens
Eucalyptus crebra
Eucalyptus punctata
Eucalyptus tenella
Phormiaceae
Dianella longifolia
Poaceae
Aristida personata
Aristida ramosa
Aristida vagans
Austrostipa densiflora
Austrostipa verticillata
Cymbopogon refractus
Digitaria ramularis
Microlaena stipoides
Paspalidium gracile
Rytidosperma duttoniana
Rytidosperma tenuior
Proteaceae
Persoonia linearis
Rubiaceae
Galium gaudichaudii
Galium liratum
Sapindaceae
Dodonaea triangularis
Scrophulariaceae
Veronica calycina
Veronica plebeia
Solanaceae
Solanum sp.
Stylidiaceae
Stylidium laricifolium

* Introduced species.

Vegetation Community 7 - Derived Native Grassland 3B-17, 32 & 33

Anthericaceae
Laxmannia gracilis
Thysanotus juncifolius
Apiaceae
**Cyclospermum leptophyllum*
Asteraceae
**Carthamus lanatus*
**Conyza bonariensis*
**Taraxacum officinale*
Calotis lappulacea
Chrysocephalum semipapposum
Gamochaeta coarctatum
Vittadinia cuneata
Campanulaceae
Wahlenbergia communis
Caryophyllaceae
**Paronychia brasiliana*
**Petrorhagia nanteuilii*
Clusiaceae
**Hypericum perforatum*
Cyperaceae
Carex inversa
Fimbristylis dichotoma
Gahnia aspera
Fabaceae (Faboideae)
Desmodium varians
Juncaceae
Juncus usitatus
Lamiaceae
Mentha satureioides
Linaceae
**Linum trigynum*
Lomandraceae
Lomandra confertifolia

Malvaceae
**Modiola caroliniana*
Oxalidaceae
Oxalis chnoodes
Oxalis sp.
Plantaginaceae
Plantago debilis
Poaceae
**Bromus catharticus*
**Paspalum dilatatum*
**Setaria parviflora*
Aristida calycina var. praealta
Aristida ramosa
Aristida vagans
Bothriochloa decipiens
Chloris truncata
Dichelachne rara
Digitaria brownii
Eragrostis alveiformis
Eragrostis brownii
Eragrostis elongata
Panicum effusum
Panicum queenslandicum
Rytidosperma fulva
Rytidosperma tenuior
Sporobolus creber
Themeda australis
Primulaceae
**Anagallis arvensis*
Verbenaceae
**Verbena bonariensis*

* Introduced species.

Vegetation Community 8 - Blakely's Red Gum Woodland (EEC/CEEC) 3B-15 & 22

Asteraceae
**Cirsium vulgare*
**Conyza bonariensis*
**Taraxacum officinale*
Cassinia arcuata
Euchiton sphaericus
Sigesbeckia orientalis subsp. orientalis
Campanulaceae
Wahlenbergia communis
Convolvulaceae
Dichondra repens
Cyperaceae
Carex appressa
Cyperus gracilis
Gahnia aspera
Euphorbiaceae
Poranthera microphylla
Fabaceae (Faboideae)
Desmodium brachypodum
Desmodium varians
Glycine clandestina
Hardenbergia violacea
Fabaceae (Mimosoideae)
Acacia filicifolia
Acacia linearifolia
Lamiaceae
Mentha satureioides
Lomandraceae
Lomandra patens
Myrtaceae
Angophora floribunda
Eucalyptus blakelyi
Melaleuca thymifolia
Phormiaceae
Dianella longifolia
Plantaginaceae
**Plantago lanceolata*

Poaceae
Aristida echinata
Aristida personata
Aristida ramosa
Aristida vagans
Arundinella nepalensis
Dichelachne rara
Eragrostis leptostachya
Lachnagrostis filiformis
Microlaena stipoides
Sporobolus creber
Primulaceae
**Anagallis arvensis*
Proteaceae
Persoonia linearis
Ranunculaceae
Clematis glycinoides
Rosaceae
**Rosa rubiginosa*
Acaena sp.
Rubus parvifolius
Rubiaceae
Asperula sp.
Santalaceae
Exocarpos strictus
Verbenaceae
**Verbena bonariensis*
Violaceae
Melicytus dentatus
Viola hederacea

* Introduced species.

Vegetation Community 9 - Broombush Scrub 2-2

Adiantaceae
Cheilanthes sieberi
Cyperaceae
Gahnia aspera
Epacridaceae
Acrotriche rigida
Lissanthe strigosa
Fabaceae (Faboideae)
Desmodium varians
Fabaceae (Mimosoideae)
Acacia montana
Malvaceae
Sida corrugata
Myrtaceae
Eucalyptus microcarpa
Eucalyptus sideroxylon
Melaleuca uncinata
Poaceae
Aristida ramosa
Aristida vagans
Austrostipa scabra subsp. falcata
Chloris truncata
Entolasia stricta
Eragrostis leptostachya
Microlaena stipoides
Panicum effusum
Rytidosperma eriantha
Rytidosperma setaceum
Solanaceae
Solanum sp.

* Introduced species.

Vegetation Community 11 – Fuzzy Box Woodland 3B-14

Asteraceae
**Hypochaeris radicata*
Calotis lappulacea
Cassinia arcuata
Chrysocephalum semipapposum
Brassicaceae
**Lepidium bonariense*
Clusiaceae
**Hypericum perforatum*
Cyperaceae
Fimbristylis dichotoma
Malvaceae
Sida corrugata
Myrtaceae
Eucalyptus conica
Poaceae
Aristida ramosa
Aristida vagans
Austrostipa scabra subsp. falcata
Bothriochloa decipiens
Cymbopogon refractus
Digitaria brownii
Eragrostis brownii
Panicum queenslandicum
Rytidosperma tenuior
Sporobolus creber

Vegetation Community 12 - Grey Gum - Narrow-leaved Stringybark Forest 3B-19, 20, 23

Adiantaceae
Cheilanthes sieberi
Asteraceae
Cassinia arcuata
Cassinia quinquefaria
Ozothamnus diosmifolius
Cactaceae
**Opuntia stricta*
Campanulaceae
Wahlenbergia communis
Chenopodiaceae
Einadia trigonos subsp. leiocarpa
Cupressaceae
Callitris endlicheri
Cyperaceae
Gahnia aspera
Lepidosperma laterale
Dilleniaceae
Hibbertia monogyna
Epacridaceae
Acrotriche rigida
Brachyloma daphnoides
Leucopogon muticus
Melichrus erubescens
Melichrus urceolatus
Styphelia triflora
Euphorbiaceae
Phyllanthus hirtellus
Fabaceae (Faboideae)
Hardenbergia violacea
Hovea lanceolata
Fabaceae (Mimosoideae)
Acacia linearifolia
Acacia ulicifolia
Acacia uncinata
Geraniaceae
Pelargonium australe
Iridaceae
Patersonia sericea
Lobeliaceae
Isotoma axillaris

Lomandraceae
Lomandra bracteata
Lomandra confertifolia subsp. rubiginosa
Lomandra filiformis subsp. coriacea
Lomandra glauca
Lomandra patens
Malvaceae
Sida cunninghamii
Myrtaceae
Angophora floribunda
Eucalyptus crebra
Eucalyptus punctata
Eucalyptus sparsifolia
Eucalyptus tenella
Phormiaceae
Dianella longifolia
Poaceae
Aristida vagans
Cleistochloa rigida
Dichelachne rara
Microlaena stipoides
Paspalidium gracile
Poa sp.
Rytidosperma fulva
Proteaceae
Persoonia linearis
Rubiaceae
Pomax umbellata
Santalaceae
Exocarpos strictus
Sapindaceae
Dodonaea cuneata
Solanaceae
Solanum sp.
Sterculiaceae
Brachychiton populneus
Stylidiaceae
Stylidium laricifolium

Vegetation Community 13 - Ironbark-Bloodwood-Redgum Woodland 3B-3, 5, 7, 18, 21 & 25

Adiantaceae
Cheilanthes sieberi
Anthericaceae
Laxmannia gracilis
Asteraceae
Calotis lappulacea
Cassinia arcuata
Cassinia cunninghamii
Cassinia quinquefaria
Olearia elliptica
Ozothamnus diosmifolius
Casuarinaceae
Allocasuarina gymnanthera
Convolvulaceae
Cuscuta australis
Cupressaceae
Callitris endlicheri
Cyperaceae
Gahnia aspera
Lepidosperma laterale
Dilleniaceae
Hibbertia circumdans
Epacridaceae
Acrotriche rigida
Astroloma humifusum
Brachyloma daphnoides
Leucopogon muticus
Melichrus erubescens
Melichrus urceolatus
Styphelia triflora
Euphorbiaceae
Phyllanthus hirtellus
Fabaceae (Faboideae)
Bossiaea obcordata
Daviesia pubigera
Desmodium varians
Glycine clandestina
Hardenbergia violacea
Hovea linearis
Podolobium ilicifolium
Myrtaceae
Angophora floribunda
Babingtonia cunninghamii
Corymbia trachyphloia
Eucalyptus beyeriana
Eucalyptus crebra
Eucalyptus dealbata
Eucalyptus dwyeri
Eucalyptus fibrosa
Eucalyptus punctata
Kunzea parvifolia
Leptospermum parvifolium
Phormiaceae
Dianella longifolia
Stypandra glauca
Pittosporaceae
Billardiera mutabilus
Bursaria spinosa
Poaceae
Aristida calycina var. calycina
Aristida contorta
Aristida ramosa
Aristida vagans
Arundinella nepalensis
Austrostipa scabra subsp. scabra
Cleistochloa rigida
Cymbopogon refractus
Dichelachne crinita
Dichelachne rara
Digitaria ramularis
Eragrostis brownii
Eragrostis leptostachya
Eriochloa pseudoacrotricha
Eulalia aurea
Microlaena stipoides
Panicum effusum
Rytidosperma bipartita

Proteaceae
Grevillea patulifolia
Grevillea ramosissima subsp. ramosissima
Pultenaea microphylla
Fabaceae (Mimosoideae)
Acacia amoena
Acacia buxifolia subsp. buxifolia
Acacia doratoxylon
Acacia implexa
Acacia leucolobia
Acacia linearifolia
Acacia penninervis
Acacia triptera
Acacia uncinata
Lomandraceae
Lomandra confertifolia
Lomandra confertifolia subsp. rubiginosa
Lomandra filiformis subsp. coriacea
Lomandra filiformis subsp. filiformis
Lomandra glauca
Lomandra multiflora
Persoonia linearis

Rubiaceae
Pomax umbellata
Rutaceae
Boronia anethifolia
Philotheca sp.
Santalaceae
Exocarpos strictus
Sapindaceae
Dodonaea boroniifolia
Dodonaea viscosa
Solanaceae
Solanum sp.
Zamiaceae
Macrozamia reducta

* Introduced species.

Vegetation Community 14 - Inland Grey Box Woodland 2-3

Cyperaceae
Gahnia aspera
Fabaceae (Mimosoideae)
Acacia montana
Lomandraceae
Lomandra filiformis subsp. filiformis
Myrtaceae
Eucalyptus microcarpa
Poaceae
Aristida personata
Aristida vagans
Austrostipa scabra subsp. falcata
Eragrostis leptostachya
Panicum effusum
Rytidosperma tenuior

* Introduced species.

Vegetation Community 15 - Narrow-leaved Ironbark - Box Woodland 2- 4, 5 & 6

Adiantaceae
Cheilanthes sieberi
Apiaceae
Actinotus helianthi
Casuarinaceae
Allocasuarina gymnanthera
Cupressaceae
Callitris endlicheri
Cyperaceae
Gahnia aspera
Lepidosperma laterale
Dilleniaceae
Hibbertia circumdans
Epacridaceae
Acrotriche rigida
Astroloma humifusum
Leucopogon muticus
Lissanthe strigosa
Melichrus urceolatus
Fabaceae (Mimosoideae)
Acacia montana
Acacia triptera
Iridaceae
Patersonia sericea
Lomandraceae
Lomandra filiformis subsp coriacea
Lomandra glauca
Lomandra multiflora
Lomandra patens
Myrtaceae
Calytrix tetragona
Corymbia trachyphloia
Eucalyptus albens
Eucalyptus crebra
Eucalyptus dwyeri
Eucalyptus fibrosa
Melaleuca uncinata
Phormiaceae
Dianella longifolia

Poaceae
Aristida calycina var. calycina
Aristida personata
Aristida ramosa
Aristida vagans
Austrostipa mollis
Austrostipa scabra subsp. scabra
Cleistochloa rigida
Eragrostis brownii
Eragrostis leptostachya
Panicum effusum
Proteaceae
Grevillea patulifolia
Hakea dactyloides
Sapindaceae
Dodonaea triangularis

* Introduced species.

Vegetation Community 16 - Rough-barked Apple Woodland 3B-9, 10 & 26

Adiantaceae
Cheilanthes distans
Cheilanthes sieberi
Asclepiadaceae
**Gomphocarpus fruticosus*
Asteraceae
**Cirsium vulgare*
**Tagetes minuta*
Calotis lappulacea
Cassinia arcuata
Cassinia quinquefaria
Chrysocephalum semipapposum
Cactaceae
**Opuntia stricta*
Campanulaceae
Wahlenbergia communis
Chenopodiaceae
Einadia hastata
Einadia nutans
Clusiaceae
**Hypericum perforatum*
Convolvulaceae
Convolvulus erubescens
Dichondra repens
Dichondra species A
Cupressaceae
Callitris endlicheri
Cyperaceae
Gahnia aspera
Scleria mackaviensis
Epacridaceae
Acrotriche rigida
Astroloma humifusum
Melichrus erubescens
Styphelia triflora
Fabaceae (Faboideae)
Daviesia genistifolia
Desmodium brachypodum
Desmodium varians
Indigofera coronillifolia

Fabaceae (Mimosoideae)
Acacia implexa
Geraniaceae
Geranium potentilloides var. potentilloides
Geranium solanderi
Lamiaceae
Mentha satureioides
Scutellaria humilis
Linaceae
**Linum trigynum*
Lomandraceae
Lomandra bracteata
Lomandra confertifolia
Lomandra multiflora
Lomandra patens
Myoporaceae
Eremophila debilis
Myrtaceae
Angophora floribunda
Phormiaceae
Dianella longifolia
Pittosporaceae
Bursaria spinosa
Plantaginaceae
**Plantago lanceolata*
Plantago gaudichaudii
Poaceae
Aristida personata
Aristida ramosa
Aristida vagans
Austrostipa scabra subsp. falcata
Bothriochloa decipiens
Cymbopogon refractus
Digitaria brownii
Echinopogon ovatus
Eragrostis leptostachya
Microlaena stipoides
Panicum effusum
Panicum queenslandicum
Paspalidium gracile

Poaceae (Continued)
Poa sieberiana
Poa tenera
Rytidosperma auriculatum
Rytidosperma eriantha
Rytidosperma fulva
Sporobolus creber
Themeda australis
Ranunculaceae
Clematis glycinoides
Rosaceae
**Rosa rubiginosa*
Acaena sp.
Rubiaceae
Galium gaudichaudii
Exocarpos strictus
Santalaceae
Pultenaea microphylla
Zornia dyctiocarpa var. dyctiocarpa
Scrophulariaceae
Veronica plebeia
Solanaceae
Solanum sp.
Sterculiaceae
Brachychiton populneus
Violaceae
Melicytus dentatus
Zamiaceae
Macrozamia reducta

* Introduced species.

Vegetation Community 17 - Yellow Box Woodland (ECC/CEEC) 3B-8, 11 & 12

Adiantaceae
Cheilanthes sieberi
Asteraceae
Calocephalus citreus
Calotis lappulacea
Cassinia arcuata
Cassinia quinquefaria
Chrysocephalum semipapposum
Glossocardia bidens
Brassicaceae
Lepidium pseudohyssopifolium
Cactaceae
**Opuntia stricta*
Campanulaceae
Wahlenbergia communis
Wahlenbergia luteola
Chenopodiaceae
Einadia hastata
Einadia nutans
Clusiaceae
**Hypericum perforatum*
Convolvulaceae
Convolvulus erubescens
Dichondra repens
Dichondra species A
Cyperaceae
Cyperus gracilis
Fimbristylis dichotoma
Gahnia aspera
Scleria mackaviensis
Dilleniaceae
Hibbertia acicularis
Epacridaceae
Acrotriche rigida
Astroloma humifusum
Lissanthe strigosa
Melichrus erubescens
Styphelia triflora
Euphorbiaceae
Chamaesyce drummondii
Fabaceae (Faboideae)
Bossiaea prostrata
Daviesia genistifolia
Desmodium varians
Glycine clandestina
Fabaceae (Mimosoideae)
Acacia decora

Acacia implexa
Acacia linearifolia
Geraniaceae
Geranium solanderi
Lomandraceae
Lomandra confertifolia
Lomandra confertifolia subsp. pallida
Lomandra multiflora
Lomandra patens
Loranthaceae
Amyema miquelii
Amyema quandang var. quandang
Dendrophthoe glabrescens
Malvaceae
Sida corrugata
Myrtaceae
Eucalyptus melliodora
Phormiaceae
Dianella longifolia
Pittosporaceae
Bursaria spinosa
Plantaginaceae
**Plantago lanceolata*
Poaceae
Aristida ramosa
Aristida ramosa x vagans
Aristida vagans
Austrostipa scabra subsp. falcata
Cymbopogon refractus
Dichelachne rara
Panicum effusum
Rytidosperma duttoniana
Rytidosperma eriantha
Rytidosperma fulva
Rytidosperma monticola
Themeda australis
Polygalaceae
Polygala japonica
Proteaceae
Persoonia linearis
Rosaceae
**Rosa rubiginosa*
Acaena sp.
Rutaceae
Philotheca sp.
Thymelaeaceae
Pimelea curviflora var. sericea

* Introduced species.

Vegetation Community 18 - Shrubby Regeneration 3B-28, 29 & 30

Adiantaceae
Cheilanthes sieberi
Anthericaceae
Laxmannia gracilis
Asteraceae
**Conyza bonariensis*
**Hypochaeris radicata*
Calotis lappulacea
Cassinia arcuata
Chrysocephalum semipapposum
Podolepis jaceoides
Campanulaceae
Wahlenbergia communis
Chenopodiaceae
Einadia trigonos subsp. leiocarpa
Cyperaceae
Fimbristylis dichotoma
Gahnia aspera
Lepidosperma laterale
Epacridaceae
Acrotriche rigida
Astroloma humifusum
Brachyloma daphnoides
Fabaceae (Faboideae)
Desmodium varians
Oxylobium pultenea
Fabaceae (Mimosoideae)
Acacia falciformis
Acacia linearifolia
Acacia uncinata
Juncaceae
Juncus subsecundus
Lomandraceae
Lomandra filiformis subsp.
Lomandra glauca
Malvaceae
Sida corrugata
Myrtaceae
Angophora floribunda
Babingtonia cunninghamii
Eucalyptus crebra
Eucalyptus dealbata
Eucalyptus fibrosa

Pittosporaceae
Bursaria spinosa
Plantaginaceae
Plantago debilis
Poaceae
**Paspalum dilatatum*
**Setaria parviflora*
**Setaria verticillata*
**Sporobolus africanus*
Aristida personata
Aristida ramosa
Aristida vagans
Arundinella nepalensis
Austrostipa scabra subsp. falcata
Austrostipa scabra subsp. scabra
Bothriochloa decipiens
Chloris ventricosa
Cymbopogon refractus
Dichelachne rara
Digitaria brownii
Digitaria diffusa
Digitaria ramularis
Echinopogon caespitosus
Eragrostis brownii
Eragrostis leptostachya
Eragrostis sororia
Microlaena stipoides
Panicum effusum
Rytidosperma eriantha
Rytidosperma monticola
Rytidosperma tenuior
Sporobolus creber
Proteaceae
Persoonia linearis
Rhamnaceae
Cryptandra amara
Cryptandra spinescens
Santalaceae
Exocarpos strictus
Zamiaceae
Macrozamia reducta

* Introduced species.

Appendix 5 Photographs of Vegetation Communities

Vegetation Community:	2 – Coast Grey Box Woodland
Biodiversity Offset:	E

Vegetation Community:	5a – Grassy White Box Woodland (EEC/CEEC)
Biodiversity Offset:	D and E

Vegetation Community:	5b – Shrubby White Box Woodland
Biodiversity Offset:	E

Vegetation Community:	7 – Derived Native Grassland
Biodiversity Offset:	E

Vegetation Community:	8 – Blakely's Red Gum Woodland (EEC/CEEC)
Biodiversity Offset:	E

Vegetation Community:	9 – Broombush Scrub
Biodiversity Offset:	D

Vegetation Community:	11 – Fuzzy Box Woodland
Biodiversity Offset:	E

Vegetation Community:	12 – Grey Gum – Narrow-leaved Stringybark Forest
Biodiversity Offset:	E

Vegetation Community:	13 – Ironbark–Bloodwood–Redgum Woodland
Biodiversity Offset:	E

Vegetation Community:	14 – Inland Grey Box Woodland
Biodiversity Offset:	D

Vegetation Community:	15 – Narrow-leaved Ironbark – Box Woodland
Biodiversity Offset:	D

Vegetation Community:	16 – Rough-barked Apple Woodland
Biodiversity Offset:	E

Vegetation Community:	17 – Yellow Box Woodland (EEC/CEEC)
Biodiversity Offset:	E

Vegetation Community:	18 – Shrubby Regeneration
Biodiversity Offset:	E