



Cadia Valley Operations

Cadia Valley Operations Biodiversity Offset Area Modification

Environmental Assessment | May 2015



CADIA VALLEY OPERATIONS BIODIVERSITY OFFSET AREA MODIFICATION
ENVIRONMENTAL ASSESSMENT

PREPARED BY
RESOURCE STRATEGIES PTY LTD

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TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	OVERVIEW OF THE PROPOSED MODIFICATION	1
1.3	NEED FOR THE PROPOSED MODIFICATION	1
1.4	LEGISLATIVE FRAMEWORK	7
1.5	CONSULTATION FOR THE MODIFICATION	8
1.6	DOCUMENT STRUCTURE	8
2	OVERVIEW OF CADIA VALLEY OPERATIONS	9
2.1	BACKGROUND	9
2.2	CADIA EAST PROJECT	9
2.3	CVO BIODIVERSITY OFFSET STRATEGY	10
3	MODIFICATION DESCRIPTION	12
3.1	BELUBULA RIVER/FLYERS CREEK AREA	12
3.2	BLACK ROCK RANGE AREA	12
3.3	STRATTON VALE AREA	13
4	ENVIRONMENTAL REVIEW	14
4.1	VEGETATION CHARACTERISTICS OF THE BELUBULA RIVER/FLYERS CREEK AREA	14
4.2	VEGETATION CHARACTERISTICS OF THE BLACK ROCK RANGE AREA	16
4.3	VEGETATION CHARACTERISTICS OF THE STRATTON VALE REPLACEMENT AREA	18
4.4	ENVIRONMENTAL ASSESSMENT	21
5	CONCLUSION	22
6	REFERENCES	22

LIST OF TABLES

Table 4-1	Vegetation Communities Recorded in the Belubula River/Flyers Creek Excise Area
Table 4-2	Vegetation Communities Recorded in the Southern Black Rock Range Excise Area
Table 4-3	Vegetation Communities Recorded in the Stratton Vale Replacement Area

LIST OF FIGURES

Figure 1	Regional Location
Figure 2	Cadia Valley Operations General Arrangement – End of the Cadia East Mine Life
Figure 3	Existing CVO Rehabilitation and Woodland Enhancement Concept
Figure 4	Belubula River/Flyers Creek Offset Area
Figure 5	Black Rock Range Offset Area
Figure 6	Proposed Stratton Vale Replacement Offset Area
Figure 7	Belubula River/Flyers Creek Vegetation Communities
Figure 8	Black Rock Range Vegetation Communities – Southern Area
Figure 9	Black Rock Range Vegetation Communities – Trig Station
Figure 10	Stratton Vale Replacement Area Vegetation Communities

LIST OF APPENDICES

Appendix A	Flora Survey and Habitat Assessment
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1 INTRODUCTION

1.1 BACKGROUND

Project Approval (PA) for the Cadia East Project was granted by the New South Wales (NSW) Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) on 6 January 2010 (PA 06_0295). The approval includes all components of the mining operations at Cadia (as described in Schedule 1 of the PA) including the Cadia East underground mine, Cadia Hill open cut mine, Ridgeway underground mine, the Concentrate Dewatering Facilities, and ancillary infrastructure. These integrated operations are herein referred to as the Cadia Valley Operations (CVO).

The CVO are located approximately 25 kilometres (km) south-west of Orange, in the Central Tablelands of NSW (Figure 1). Cadia Holdings Pty Limited (CHPL) is the owner and operator of the CVO and is a wholly owned subsidiary of Newcrest Mining Limited.

The Cadia Hill open pit, Ridgeway underground mine and Cadia East underground mine are located in the Cadia Valley within Mining Lease (ML) 1405, ML 1472, ML 1481 and ML 1449 (Figure 1). The Concentrate Dewatering Facilities are located approximately 25 km to the east of the Cadia Valley in the town of Blayney (Figure 1).

Operations at the Cadia Hill open pit ceased in 2012, and are currently under care and maintenance. With the Ridgeway Deeps extension, Ridgeway is currently scheduled to cease operations by 2017.

Cadia East involves panel cave mining to extract approximately 450 million tonnes of ore over a period of 21 years. The ore contains gold, copper and some molybdenum. Cadia East extends the life of the Cadia Valley Operations to approximately 2030. Figure 2 shows the approved General Arrangement at the end of the currently approved mine life.

The Cadia East underground mine is described in full in the Cadia East Project Environmental Assessment (the Cadia East EA) (CHPL, 2009). Since the grant of PA 06_0295, the following Modifications have been granted:

- Mod 1 (2010) – a modification to allow construction of a decline beneath Cadia Hill open pit.
- Mod 2 (2010) – a modification of operations at the existing Blayney Dewatering Facility.

- Mod 3 (2011) – a modification to allow the realignment of a section of the concentrate and return water pipelines to Blayney.
- Mod 4 (2014) – a Modification to allow hydraulic preconditioning.
- Mod 5 (2014) – a Modification to allow blasting preconditioning.
- Mod 6 (2015) – a Modification to increase the production rate to 32 million tonnes per annum (pending).

A further Modification is proposed to adjust the CVO biodiversity offset area (this Modification).

1.2 OVERVIEW OF THE PROPOSED MODIFICATION

The biodiversity offset area Modification would include the following components:

- An approximately 14.2 hectare (ha) area of land would be removed from the Belubula River/Flyers Creek portion of the CVO biodiversity offset area.
- An approximately 16.5 ha area of land would be removed from the Black Rock Range portion of the CVO biodiversity offset area.
- An approximately 60.7 ha¹ replacement area within the CHPL-owned 'Stratton Vale' property would be added to the CVO biodiversity offset.

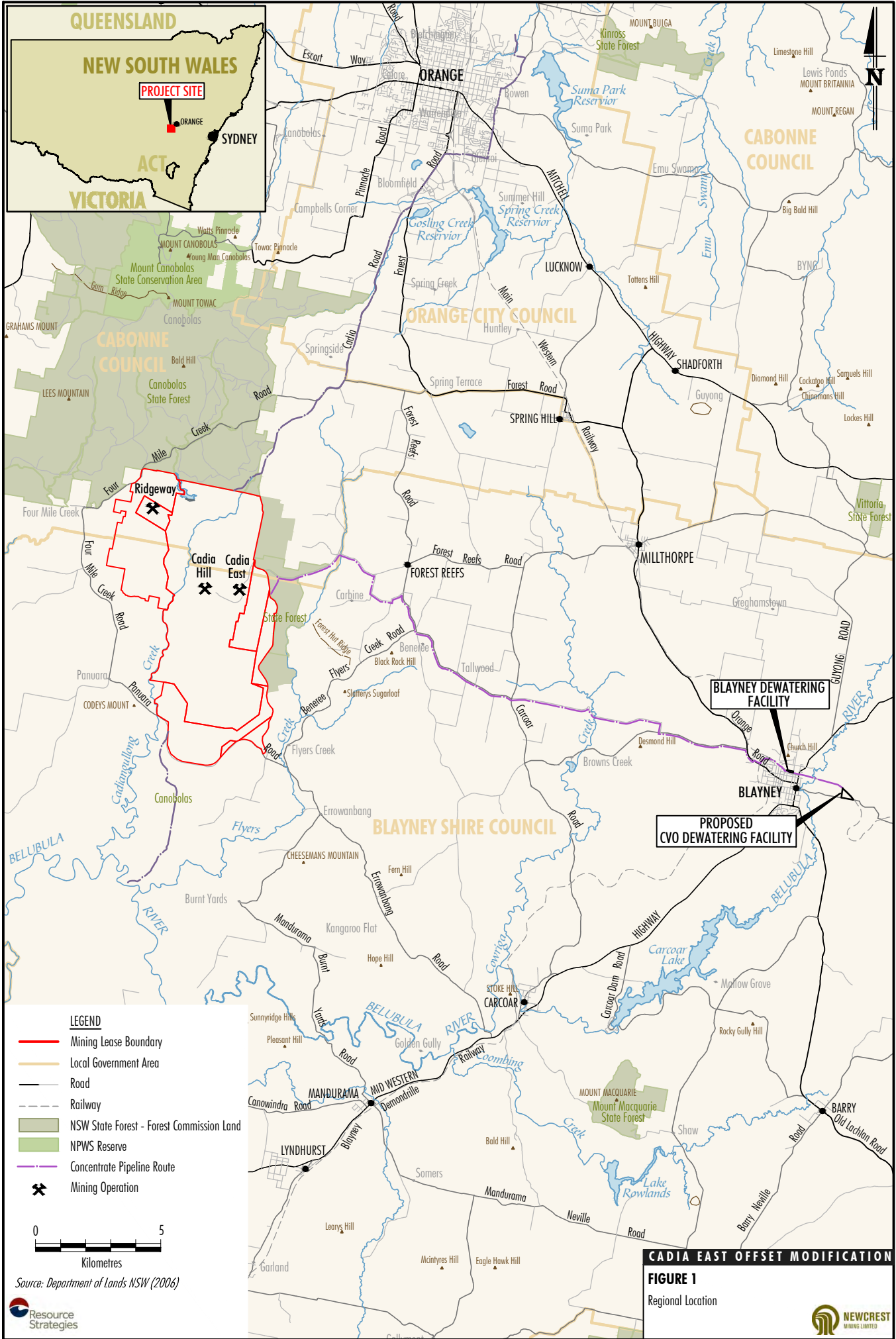
There would be no change to any of the currently approved mining operations and activities as a result of the Modification.

1.3 NEED FOR THE PROPOSED MODIFICATION

Figure 3 shows the CVO biodiversity offset strategy as described in the Cadia East EA (CHPL, 2009).

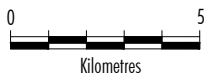
CHPL recently discovered that there are some small land parcels within the CVO biodiversity offset area nominated in PA 06_0295 that are unable to be secured in perpetuity due to several cadastral issues. These parcels of land are located near the Belubula River and Flyers Creek confluence, in the southern part of the Black Rock Range offset area, and at a Trigonometry (Trig) Station located on the ridgeline at Black Rock Range. Figures 4 and 5 show the locations of these areas.

¹ Note that the exact size of the replacement area would be subject to final survey.



LEGEND

- Mining Lease Boundary
- Local Government Area
- Road
- - - Railway
- NSW State Forest - Forest Commission Land
- NPWS Reserve
- Concentrate Pipeline Route
- ✕ Mining Operation



Source: Department of Lands NSW (2006)

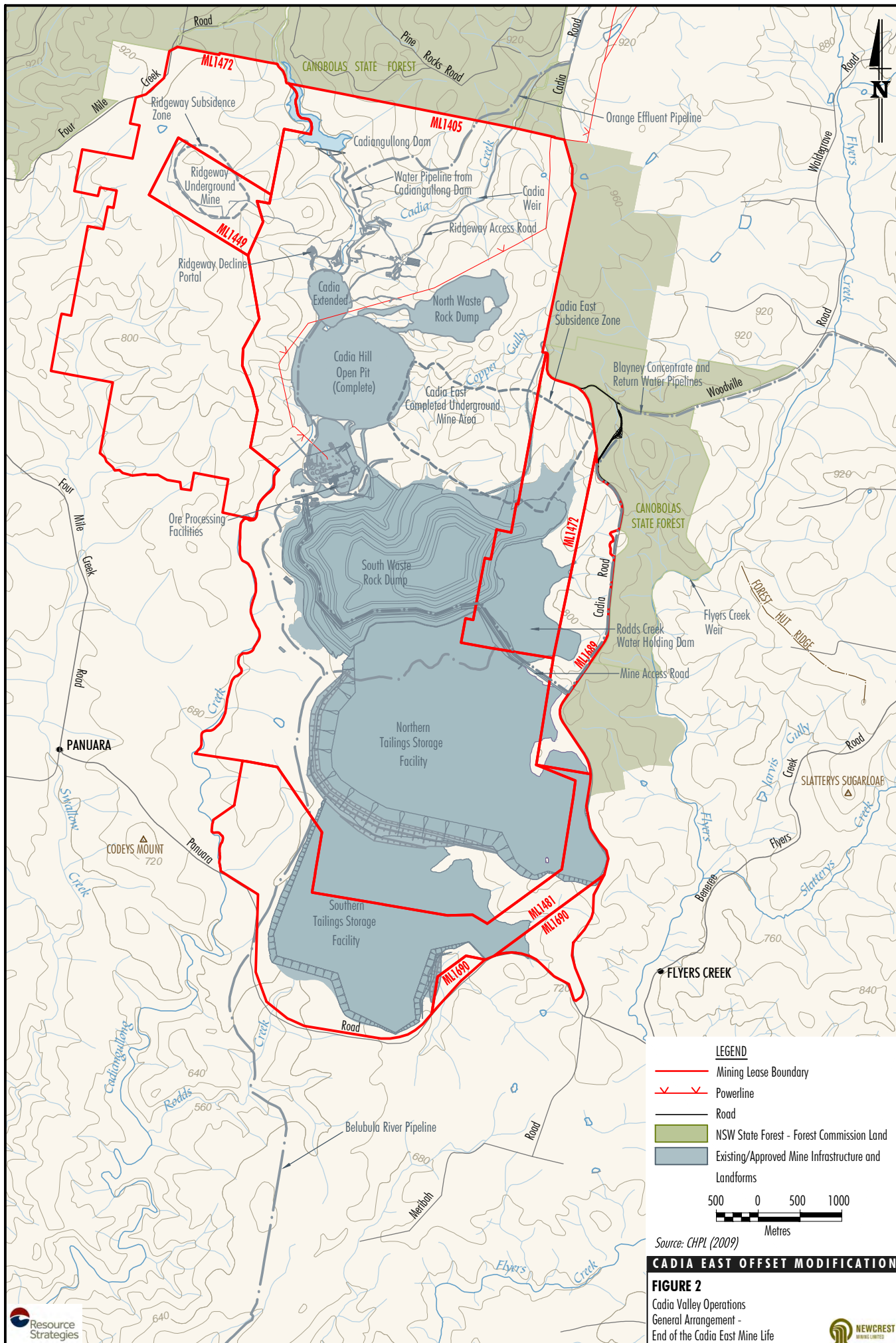


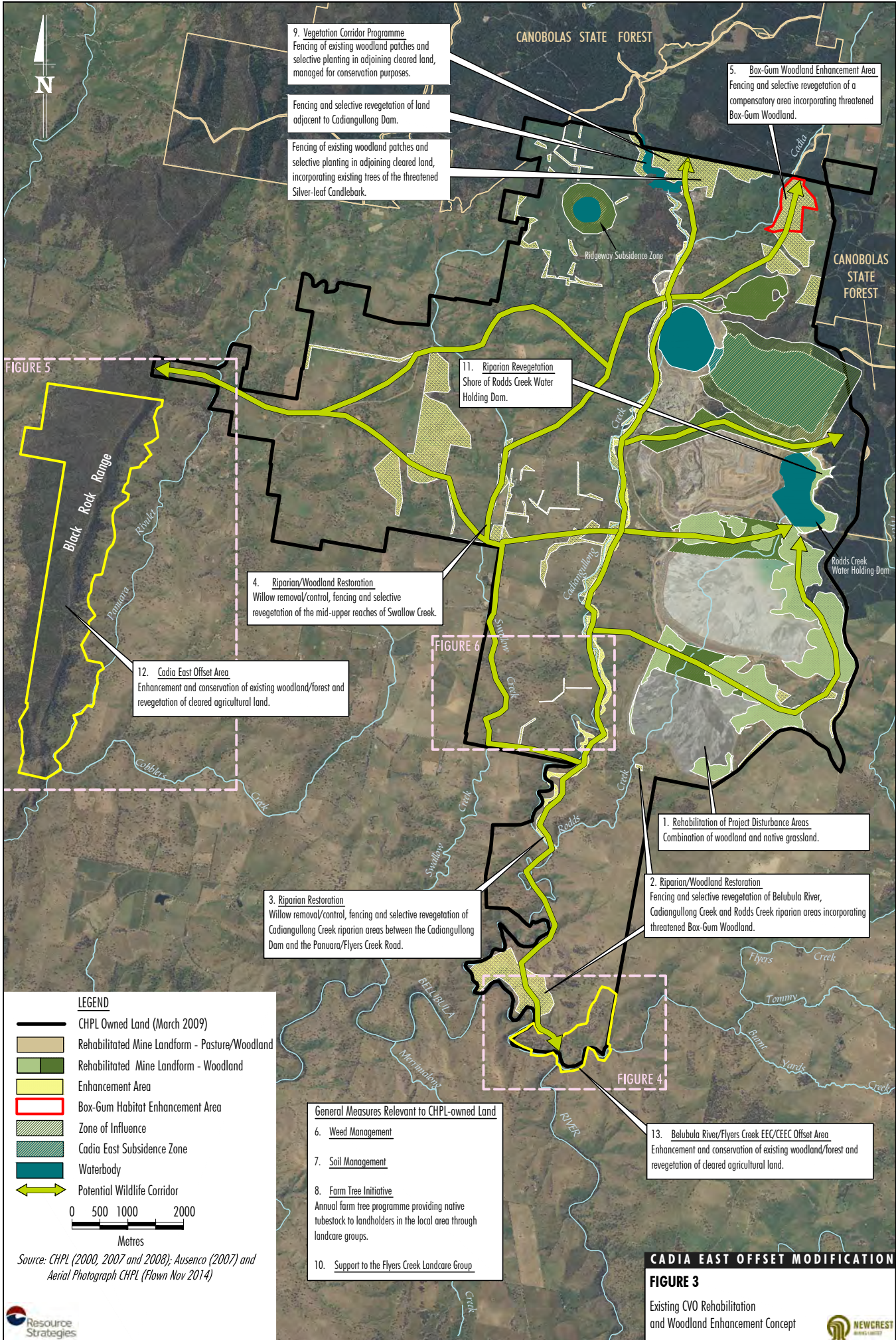
CADIA EAST OFFSET MODIFICATION

FIGURE 1

Regional Location







9. Vegetation Corridor Programme
Fencing of existing woodland patches and selective planting in adjoining cleared land, managed for conservation purposes.

Fencing and selective revegetation of land adjacent to Cadiangullong Dam.

Fencing of existing woodland patches and selective planting in adjoining cleared land, incorporating existing trees of the threatened Silver-leaf Candlebark.

5. Box-Gum Woodland Enhancement Area
Fencing and selective revegetation of a compensatory area incorporating threatened Box-Gum Woodland.

11. Riparian Revegetation
Shore of Rodds Creek Water Holding Dam.

4. Riparian/Woodland Restoration
Willow removal/control, fencing and selective revegetation of the mid-upper reaches of Swallow Creek.

12. Cadia East Offset Area
Enhancement and conservation of existing woodland/forest and revegetation of cleared agricultural land.

3. Riparian Restoration
Willow removal/control, fencing and selective revegetation of Cadiangullong Creek riparian areas between the Cadiangullong Dam and the Panuara/Flyers Creek Road.

1. Rehabilitation of Project Disturbance Areas
Combination of woodland and native grassland.

2. Riparian/Woodland Restoration
Fencing and selective revegetation of Belubula River, Cadiangullong Creek and Rodds Creek riparian areas incorporating threatened Box-Gum Woodland.

13. Belubula River/Flyers Creek EEC/CEEC Offset Area
Enhancement and conservation of existing woodland/forest and revegetation of cleared agricultural land.

LEGEND

- CHPL Owned Land (March 2009)
- Rehabilitated Mine Landform - Pasture/Woodland
- Rehabilitated Mine Landform - Woodland
- Enhancement Area
- Box-Gum Habitat Enhancement Area
- Zone of Influence
- Cadia East Subsidence Zone
- Waterbody
- Potential Wildlife Corridor

0 500 1000 2000
Metres

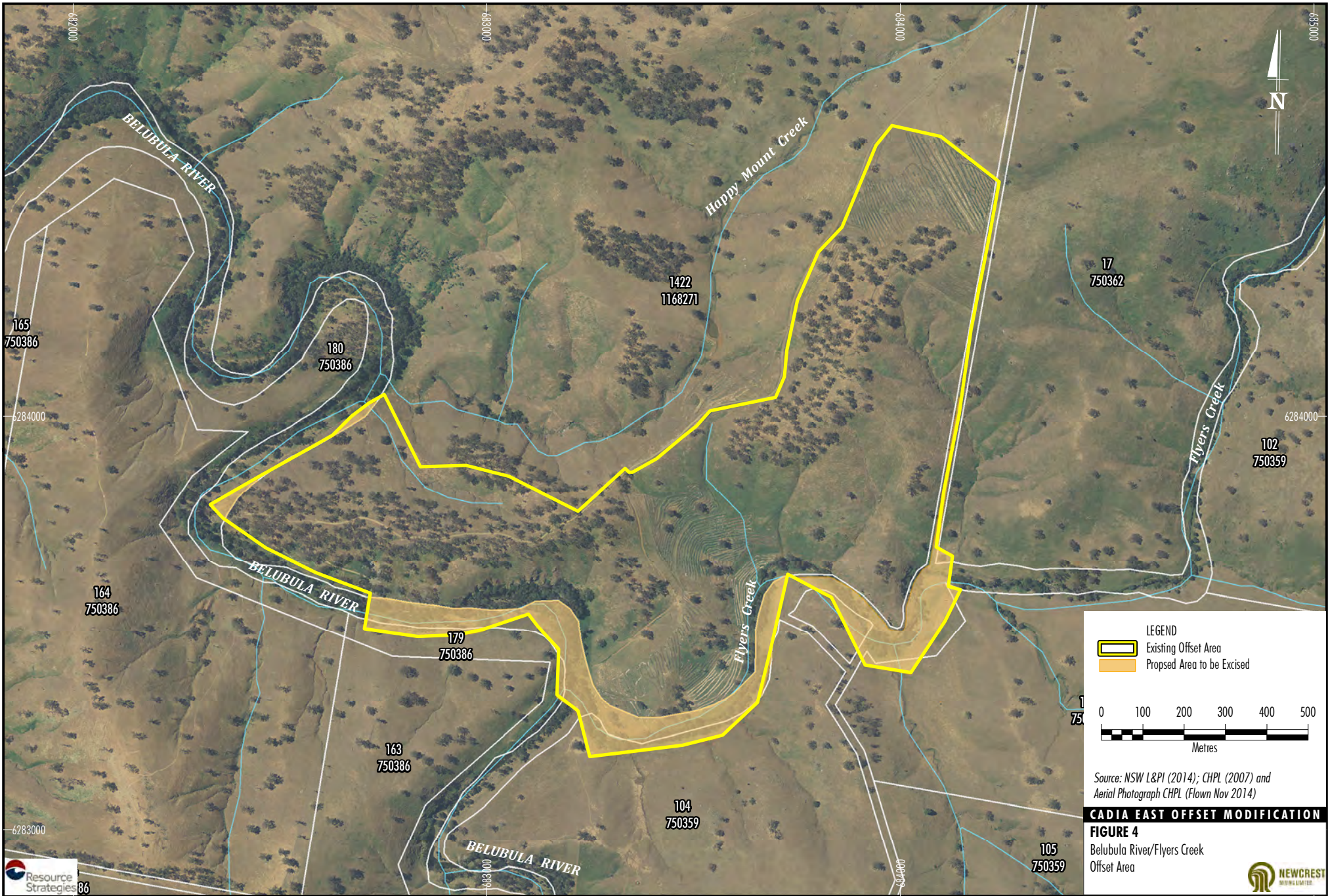
General Measures Relevant to CHPL-owned Land

6. Weed Management
7. Soil Management
8. Farm Tree Initiative
Annual farm tree programme providing native tubestock to landholders in the local area through landcare groups.
10. Support to the Flyers Creek Landcare Group

Source: CHPL (2000, 2007 and 2008); Aussenca (2007) and Aerial Photograph CHPL (Flown Nov 2014)

CADIA EAST OFFSET MODIFICATION
FIGURE 3

Existing CVO Rehabilitation and Woodland Enhancement Concept



LEGEND

- Existing Offset Area
- Proposed Area to be Excised

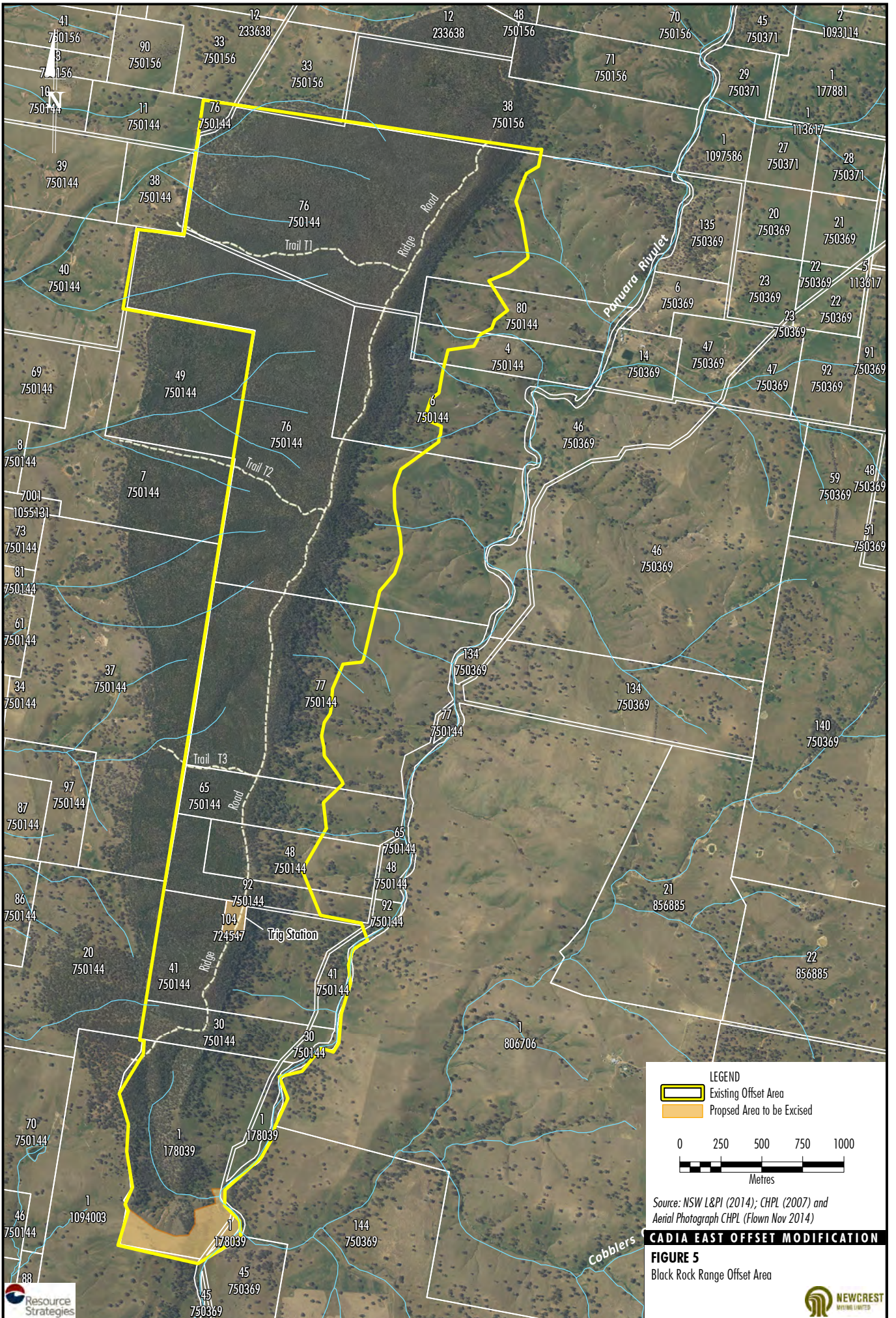
0 100 200 300 400 500
Metres

Source: NSW L&PI (2014); CHPL (2007) and Aerial Photograph CHPL (Flown Nov 2014)

CADIA EAST OFFSET MODIFICATION

FIGURE 4
Belubula River/Flyers Creek
Offset Area





LEGEND

- Existing Offset Area
- Proposed Area to be Excised

0 250 500 750 1000
Metres

Source: NSW L&PI (2014); CHPL (2007) and Aerial Photograph CHPL (Flown Nov 2014)

CADIA EAST OFFSET MODIFICATION

FIGURE 5
Black Rock Range Offset Area

A modification to PA 06_0295 is required to remove these areas from the current CVO biodiversity offset strategy, and to replace them with a new area with equal or better biodiversity values within the Stratton Vale property.

- (b) *investigate ways to salvage and beneficially use resources (including timber, fauna habitat, seed and soil resources) in areas subject to subsidence as far as is reasonable and feasible,*

to the satisfaction of the Secretary.

1.4 LEGISLATIVE FRAMEWORK

New South Wales

Approval of the Modification is sought as a modification to PA 06_0295 under section 75W of the EP&A Act. Section 75W of the EP&A Act relevantly provides:

75W Modification of Minister’s approval

- (1) *In this section:*

Minister’s approval means an approval to carry out a project under this Part, and includes an approval of a concept plan.

modification of approval means changing the terms of a Minister’s approval, including:

- a) *revoking or varying a condition of the approval or imposing an additional condition of the approval, and*
- b) *changing the terms of any determination made by the Minister under Division 3 in connection with the approval.*

- (2) *The proponent may request the Minister to modify the Minister’s approval for a project. The Minister’s approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.*

- (3) *The request for the Minister’s approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*

- (4) *The Minister may modify the approval (with or without conditions) or disapprove of the modification.*

...

Relevant conditions in PA 06_0295 that pertain to the CVO biodiversity offset strategy are repeated below.

38. *The Proponent shall:*

- (a) *implement the biodiversity offset strategy as described in the EA, and summarised in Table 14 (and shown conceptually in Appendix 6); and*

Table 14: Biodiversity Offset Strategy

Area	Minimum Size
Black Rock Range Offset Area – Enhancement Area	653 ha
Black Rock Range Offset Area – Revegetation Area	173 ha
Flyers Creek and Belubula River Offset Area	112 ha
Total	938 ha

39. *Within 2 years of the date of this approval, the Proponent shall make suitable arrangements to provide appropriate long term security for the offset areas to the satisfaction of the Secretary.*

Commonwealth

Approval for the Cadia East Project (EPBC 2006/3196) was granted by a delegate of the Commonwealth Minister for the Environment in February 2010 under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act).

Relevant conditions in EPBC 2006/3196 that pertain to the CVO biodiversity offset strategy are repeated below.

1. *The person taking the action must prepare a plan to offset the loss of 23 ha of the White Box-Yellow Box-Blakely’s Red Gum grassy woodland and derived native grassland ecological community.*

The plan must include:

- *The desired outcomes of implementing the plan;*
- *The short (12 months from the date of the approval), medium (five years from the date of the approval) and long term measures that will be employed to implement the plan;*
- *Details of how the person taking the action will provide for the long term security of the offset areas and details of the timing of when this will occur;*
- *Detailed performance and completion criteria for the implementation of the plan, including details of methods to rehabilitate areas of the ecological community, and methods to control weeds, feral animals, grazing, access and bushfires;*

- *A detailed description of how the performance of the implementation of the plan would be monitored over time to achieve the performance and completion criteria;*
- *A description of the potential risks to successful management and rehabilitation in the offset area, and a description of the contingency measures that would be implemented to mitigate these risks; and*
- *Details of who is responsible for monitoring, reviewing and implementing the plan.*

The plan must be submitted to the Minister within 18 months of the date of this approval and prior to any subsidence impacts on the White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland ecological community. The plan must be approved by the Minister and the approved plan must be implemented.

1.5 CONSULTATION FOR THE MODIFICATION

CHPL consulted with the NSW Department of Planning and Environment (DP&E) and the Commonwealth Department of the Environment (DotE) with regard to the proposed Modification in February 2015.

1.6 DOCUMENT STRUCTURE

The remainder of this Environmental Assessment (EA) is structured as follows:

- | | |
|-----------|--|
| Section 1 | Provides an introduction to the Modification and the purpose of this EA, describes the structure of this EA and provides a summary of the consultation undertaken. |
| Section 2 | Describes the approved CVO operations, the existing biodiversity offset strategy and the proposed Modification. |
| Section 3 | Provides an environmental impact assessment of the proposed Modification. |
| Section 4 | Provides a conclusion to this EA. |
| Section 5 | Lists documents and reports referenced in this EA. |

This EA is supported by the following specialist assessments:

- | | |
|------------|--|
| Appendix A | Flora Survey and Habitat Assessment (FloraSearch Pty Ltd). |
|------------|--|

2 OVERVIEW OF CADIA VALLEY OPERATIONS

2.1 BACKGROUND

The CVO have provided significant economic stimulus and employment generation to the region since Cadia Hill was approved in 1996. Mining at the Cadia Hill open pit commenced in 1998 after a two year construction phase, and was placed in care and maintenance in 2012.

Ore production from the Ridgeway underground mine commenced in 2002. A significant extension to the mine, called Ridgeway Deeps, is currently being mined. With the Ridgeway Deeps extension, Ridgeway is currently scheduled to cease operations by 2017. Ridgeway Deeps uses block caving underground mining methods.

The CVO includes significant surface infrastructure developed since 1996, including ore processing, water management and staff facilities. Product concentrate is pumped to the Blayney Dewatering Facility and CVO Dewatering Facility (under construction) as a slurry, where it is dewatered and transported via rail.

The Cadia East Project involves the underground mining of a significant orebody adjacent to Cadia Hill. Cadia East was approved in 2010 and is described below.

2.2 CADIA EAST PROJECT

The major components of the Cadia East Project include:

- underground mining of approximately 450 million tonnes (Mt) of ore from the Cadia East deposit using the panel caving mining method;
- development of underground crushing, handling and conveyor systems to transfer ore and waste rock to the surface;
- development of supporting infrastructure for the underground mine including multiple ventilation shafts, and personnel and equipment access systems;
- upgrade of the existing Cadia Valley Operations ore processing facilities to accommodate the harder ore from Cadia East and to enable the total Cadia Valley Operations ore processing rate to increase from 24 Mtpa to approximately 27 Mtpa;
- construction and operation of a molybdenum recovery plant with a capacity of up to 460,000 tonnes per annum (tpa) and trucking of molybdenum products off-site;
- placement of waste rock produced by the Project in the existing South Waste Rock Dump;
- raising of the existing Northern Tailings Storage Facility (NTSF) and Southern Tailings Storage Facility (STSF) embankments to accommodate approximately 450 Mt of Cadia East tailings;
- augmentation and upgrade of the existing Cadia Valley Operations water management/supply system including development of additional pipeline/pumping systems and raising of the Rodds Creek Water Holding Dam;
- obtaining additional mining leases to facilitate the Project extensions of the STSF, NTSF, subsidence zone and Rodds Creek Water Holding Dam;
- re-alignment of a 1.1 km section of Cadia Road;
- construction of a new dewatering facility to the east of Blayney (known as the CVO Dewatering Facility);
- maintaining the existing Blayney Dewatering Facility to provide standby additional processing capacity during the peak production period from Year 3 to Year 7 and the decommissioning of this facility if it is deemed redundant after this time;
- installation of a new concentrate pipeline and return water pipeline between the Cadia Valley Operations and the CVO Dewatering Facility;
- increased rail transportation of dewatered mineral concentrate from Blayney to the eastern seaboard;
- augmentation, relocation and upgrade of supplementary surface facilities including workshops, administration and site access roads; and
- other associated modifications to existing infrastructure, plant, equipment and activities to allow mining of the Cadia East deposit and integration with the approved Cadia Valley Operations.

2.3 CVO BIODIVERSITY OFFSET STRATEGY

The Cadia East Project EA (CHPL, 2009) and PA 06_0295 describe the CVO biodiversity offset strategy. The strategy integrates rehabilitation activities with regional conservation initiatives, and was consistent with the NSW Department of Planning (now DP&E) Director-General's environmental assessment requirements (DGR's) and the NSW Department of Environment, Climate Change and Water (DECCW), DoP and the Commonwealth Department of Environment, Water, Heritage and the Arts (now DotE) biodiversity offset policies that were in place at the time.

The CVO biodiversity offset strategy, along with continued use of the on-site flora and fauna impact management measures and rehabilitation, was designed to mitigate the potential impacts associated with the clearing of approximately 238 ha of native vegetation. This vegetation included approximately 23.5 ha of NSW-listed Box-Gum Woodland Endangered Ecological Community (EEC), of which approximately 23 ha was the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community (CEEC).

The majority of the biodiversity offset area is located on Black Rock Range, which is situated approximately 11 km to the west of the CVO (Figure 3). The offset area contains approximately 653 ha of remnant vegetation and approximately 173 ha of predominantly cleared agricultural land, with the later to be fenced and revegetated. Similar vegetation communities occur in the Cadia East Project area and within the offset area, particularly White Box Woodland (community 1a), Red Stringybark/Long-leaved Box Open Forest (community 3a), and Red Box/Red Stringybark Open Forest (community 3b).

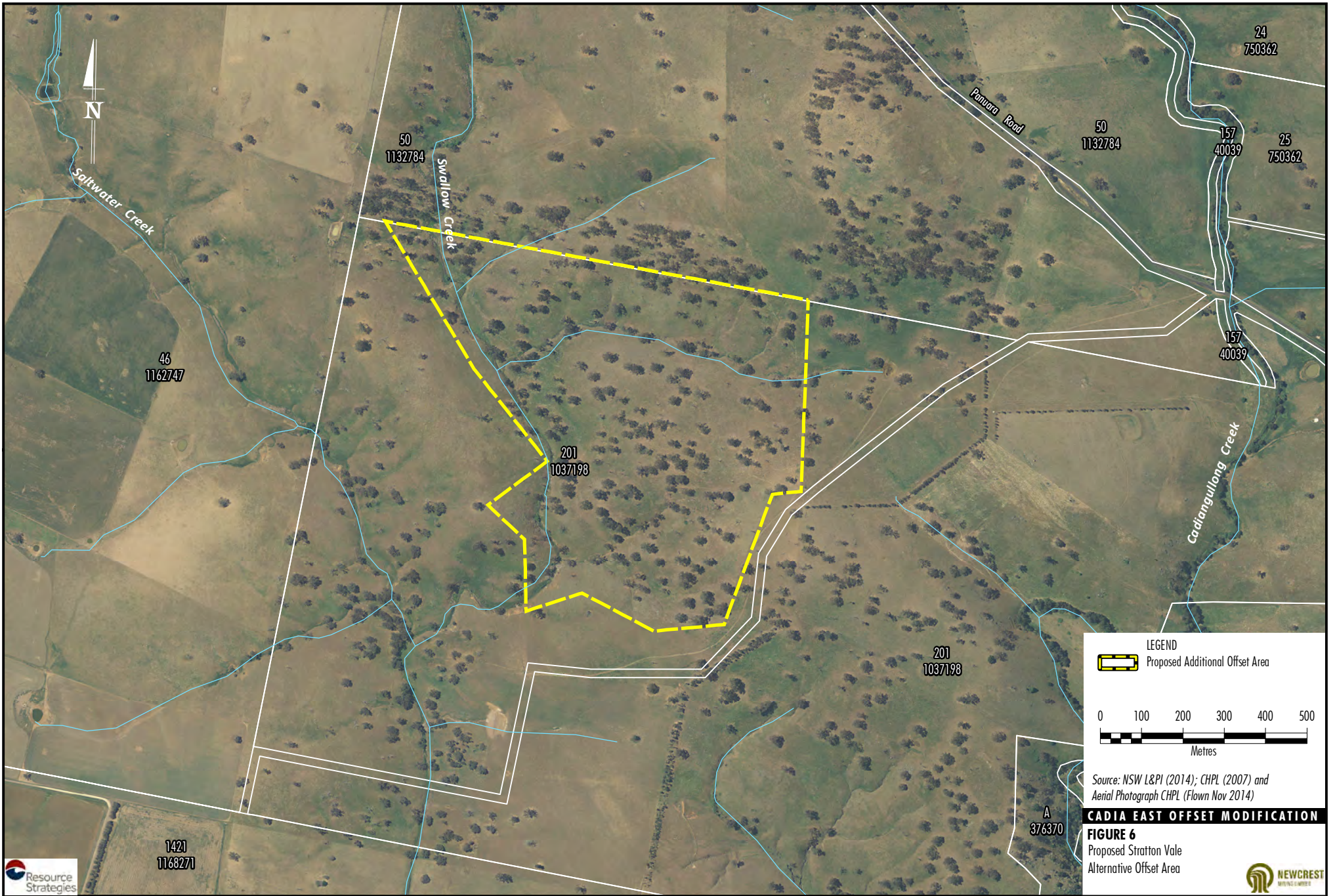
The Black Rock Range offset area contains significant areas of the NSW-listed Box-Gum Woodland EEC (i.e. approximately 210 ha) and the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community CEEC (i.e. approximately 154 ha). Figure 6 shows the 2009 mapping of vegetation communities at Black Rock Range.

The Black Rock Range offset area also adjoins approximately 1,200 metres (m) of the local creek to the east of the ridge (i.e. Panuara Rivulet). As a result, the proposed offset would directly link approximately one third of the length of Black Rock Range with Panuara Rivulet via the intervening mid and lower slopes and riparian zone. A large proportion of this area has been mapped as EEC and/or CEEC.

The Black Rock Range offset area would be linked to the existing CVO via a network of vegetation corridors, several of which are already in place. CHPL's vegetation corridor programme aims to conserve remnant vegetation, link significant areas of remnant vegetation, provide habitat for native fauna, promote the movement of genetic material between flora and fauna populations and increase the sustainability and biodiversity of CVO farms and environs (Figure 3).

Also included in the CVO biodiversity offset strategy is a 112 ha offset area located at the junction of the Belubula River and Flyers Cree (Figure 3). The Belubula River/Flyers Cree offset area includes approximately 62 ha of existing native vegetation, of which approximately 23 ha has been determined by FloraSearch Pty Ltd as meeting the criteria for the NSW-listed Box-Gum Woodland EEC and the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands CEEC. Figure 6 shows the 2011 mapping of vegetation communities at Black Rock Range.

As described in the EA, the specialist consultants who undertook the flora and fauna impact assessments (Dr Colin Bower and Dr David Goldney respectively), concluded that it is likely that the proposed offset biodiversity offset strategy would constitute a suitable offset against flora impacts associated with the Cadia East Project, and the proposed fauna impact mitigation and offset measures are likely to maintain regional fauna biodiversity in the short-term and enhance it in the long-term.



3 MODIFICATION DESCRIPTION

The biodiversity offset area Modification would include the following components:

- An approximately 14.2 ha area of land would be removed from the Belubula River/Flyers Creek portion of the CVO biodiversity offset area.
- An approximately 16.5 ha area of land would be removed from the Black Rock Range portion of the CVO biodiversity offset area.
- An approximately 60.7 ha² replacement area within the CHPL-owned Stratton Vale property would be added to the CVO biodiversity offset.

These elements are further described in the sub-sections below.

3.1 BELUBULA RIVER/FLYERS CREEK AREA

Condition 38 of PA 06_0295 requires the Belubula River/Flyers Creek component of the CVO biodiversity offset to be a minimum of 112 ha and to be located as shown conceptually in the Cadia East EA and Appendix 5 of PA 06_0295.

The shape of the Belubula River/Flyers Creek component of the CVO biodiversity offset depicted in Appendix 5 of PA 06_0295 was based on the existing perimeter fences of the Oaky Creek property.

As a result of CHPL's recent review of cadastral information, it has become apparent that these fence lines do not accurately follow the official cadastral boundary of the Oaky Creek property (i.e. Lot 1422, DP1168271 – refer to Figure 4). As indicated on the figure, there are several areas where the current boundary incorporates Crown Land associated with the Belubula River and Flyers Creek, as well as some parcels of land that are owned by other landholders on the southern side of the River and Creek.

Rather than attempt to purchase the land in question from the NSW Department of Lands and the adjoining landholders, CHPL wishes to adjust the boundary of the Belubula River/Flyers Creek component of the CVO biodiversity offset to be generally consistent with the southern boundary of Lot 1422, DP1168271 (i.e. the official southern boundary of the Oaky Creek property).

The adjustment would mean that approximately 14.2 ha would no longer form part of the Belubula River/ Flyers Creek offset area. The area to be excised is shown on Figure 4.

It should be noted that the above change would be an administrative change in order to facilitate the securing of the area in perpetuity, without the need to subdivide adjoining non CHPL-owned land and/or acquire Crown land. From a practical and on-the-ground perspective it is anticipated that the existing Oaky Creek perimeter fence lines would remain in their current position. This is because it is not considered practicable for a fence to follow the Lot 1422, DP1168271 boundary as this boundary criss-crosses the current Belubula River and Flyers Creek channels.

3.2 BLACK ROCK RANGE AREA

Condition 38 of PA 06_0295 requires the Black Rock Range component of the CVO biodiversity offset to be a minimum of 826 ha and to be located as shown conceptually in the Cadia East EA and Appendix 5 of PA 06_0295.

Currently CHPL is in the process of acquiring the portion of Black Rock Range that occurs within the 'Ulah' property (i.e. as depicted in Appendix 5 of PA 06_0295). However, during this process it has become apparent that the southern-most portion of the area to be acquired has been occupied and farmed by the neighbouring landholder for many decades (i.e. technically it is part of the Ulah property but it has not been fenced or managed as such). Rather than reclaim the land from this neighbour and include it in the offset, CHPL wishes to remove approximately 13.9 ha area from the Black Rock Range component of the CVO offset.

In addition to the above, a Trig Station is located on the ridge that runs north-south along the Black Rock Range offset area. The Trig Station sits within a small (2.6 ha) parcel of Crown Land (i.e. Lot 104 DP724547). CHPL does not intend to include this parcel of land in the Black Rock Range component of the CVO offset, as the NSW Department of Crown Lands does not wish to relinquish it.

Figure 5 shows the locations of the two areas to be excised from the Black Rock Range component of the CVO biodiversity offset area.

² Note that the exact size of the replacement area would be subject to final survey.

There are also some other parcels of Crown Land within the Black Rock Range portion of the CVO biodiversity offset area (Figure 5). These occupy a total area of approximately 20 ha and were most likely included in the original surveying of Black Rock Range and were intended to provide access between lots, or are associated with creek lines.

These parcels of Crown Land remain undeveloped and have not been formed into publically accessible roads between properties (i.e. they are now just 'paper roads') and are not fenced or managed differently to the remainder of the Black Rock Range offset area.

CHPL intends to acquire these parcels of land from the NSW Department of Lands so that they can be incorporated into the Black Rock Range offset and conserved in perpetuity.

3.3 STRATTON VALE AREA

The area that would be removed from the offset as a result of the adjustments described in Sections 3.1 and 3.2 would be replaced with a single parcel of land located on a CHPL-owned property ('Stratton Vale').

The Stratton Vale offset area is situated 1 to 2 km to the west of the CVO (Figure 6). The additional area to be added to the CVO biodiversity offset is approximately 60.7 ha in size and is predominantly covered with remnant native woodland vegetation. Swallow Creek runs in a north-south direction through the area over a distance of approximately 1,000 m.

4 ENVIRONMENTAL REVIEW

FloraSearch Pty Ltd was engaged to undertake a flora survey of the Belubula River/Flyers Creek area as well as the southern portion of the Black Rock Range biodiversity offset. FloraSearch also surveyed the proposed replacement area at Stratton Vale. A copy of the FloraSearch (2015) report is contained in Appendix A. The following sub-sections discuss the results of the survey and assessment.

4.1 VEGETATION CHARACTERISTICS OF THE BELUBULA RIVER/FLYERS CREEK AREA

The Belubula River/Flyers Creek area to be excised consists of a narrow strip of land along a section of the Belubula River and the lower reaches of Flyers Creek (Figure 7). The area is almost entirely within the riparian zone, but also includes a small amount of the adjoining lower slopes along Flyers Creek in places.

FloraSearch surveyed the Belubula River/Flyers Creek area to be excised in October 2014. Figure 7 shows the mapped vegetation communities and sample locations, and Appendix A provides details of the survey methodology. Vegetation sampling was stratified according to the standard Plant Community Types (PCT) recognised by OEH (2014a).

Fourteen native plant species and 55 introduced species were recorded during the survey, and two natural vegetation communities and one anthropogenic community were identified and mapped (Table 4-1 and Figure 7).

River Oak Forest was by far the dominant community (i.e. 11.7 ha) since much of the area is within the riparian zones of the Belubula River and Flyers Creek (Figure 7). A very small (i.e. 0.3 ha) remnant patch of Yellow Box Woodland (i.e. Community 2) was also present. However, most of the non-riparian lower slope areas were covered in exotic grasses and herbs (i.e. 2.3 ha).

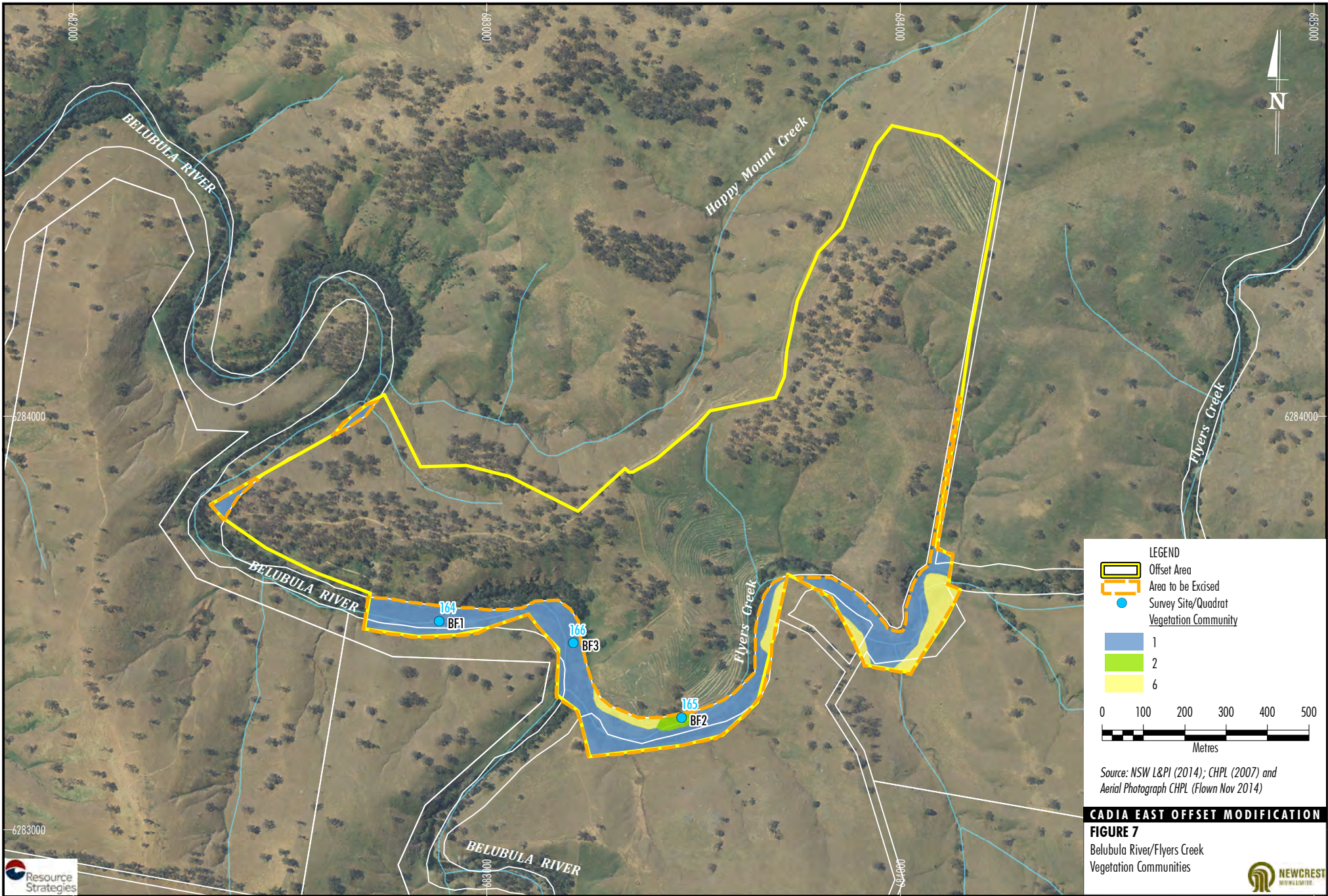
BioMetric data on vegetation condition in the Belubula River/Flyers Creek area indicated that the River Oak Forest and the small remnant of Yellow Box Woodland were both in poor condition with their ground cover in 'low' condition owing to a high dominance of exotic species; 68% exotic cover for River Oak Forest and 100% exotic cover for the area of Yellow Box Woodland (Appendix A).

No threatened flora species were identified in the existing Belubula River/Flyers Creek offset area (Appendix A).

FloraSearch (2015) used the relevant NSW and Commonwealth guidelines to determine whether any of the recorded vegetation communities conformed to the definitions of the NSW-listed Box-Gum Woodland EEC and/or the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community CEEC (Appendix A). The analysis indicated that the small 0.3 ha area of Yellow Box Woodland (i.e. Community 2) conformed to the NSW-listed Box-Gum Woodland EEC, but did not conform to the Commonwealth CEEC (due to the very poor condition of the ground cover).

**Table 4-1
Vegetation Communities Recorded in the Belubula River/Flyers Creek Excise Area**

Community No.	PCT Code	Area (ha)	Short Name	Plant Community Type (OEH, 2014b)	Dominant Species on Study Areas
1	85	11.7	River Oak Forest	<i>River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregions</i>	River Oak (<i>Casuarina cunninghamiana</i>), River Red Gum (<i>Eucalyptus camaldulensis</i>)
2	277	0.3	Yellow Box Woodland (Box-Gum Woodland EEC)	<i>Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion</i>	Yellow Box (<i>Eucalyptus melliodora</i>), Apple Box (<i>Eucalyptus bridgesiana</i>)
6	N/A	2.3	Exotic Grassland	-	Great Brome (<i>Bromus diandrus</i>), Soft Brome (<i>Bromus hordeaceus</i>), <i>Vulpia muralis</i> , Wimmera Ryegrass (<i>Lolium rigidum</i>)



CADIA EAST OFFSET MODIFICATION

FIGURE 7
Belubula River/Flyers Creek
Vegetation Communities



FloraSearch (2015) evaluated the fauna habitat values of the Belubula River and Flyers Creek area to be excised.

The River Oak Forest had moderate habitat value due to the relatively dense stands of River Oak (*Casuarina cunninghamiana*) and River Red Gum (*Eucalyptus camaldulensis*). The Belubula River and Flyers Creek watercourses provide water for wildlife and habitat for aquatic fauna.

The other parts of the Belubula River and Flyers Creek area to be excised were considered to have low habitat value for the following reasons:

- The open grassland areas were dominated by exotic species and have limited habitat value, except for macropods, granivorous birds such as finches and common insectivorous birds adapted to grasslands such as Yellow-tailed Thornbills and Magpies.
- There are limited opportunities for reptiles with few logs on the ground or surface rocks for habitat on both areas.
- The area has some retained old growth trees with hollows suitable for a variety of wildlife, but they are scattered in a mostly cleared landscape with limited habitat available to denning or nesting species that depend on woodlands and forests.
- The area lacks dense shrub cover required by some bird species for nesting and foraging.

4.2 VEGETATION CHARACTERISTICS OF THE BLACK ROCK RANGE AREA

Southern Black Rock Range Area

This area is located at the southernmost extremity of the Black Rock Range biodiversity offset where it meets the Panuara Rivulet. It comprises steep east and south facing slopes descending from a dome-shaped hill (approximately 570 metres Australian Height Datum [m AHD]) and a ridge extending to its west (approximately 600 m AHD). It also includes some of the lower slopes along Panuara Rivulet.

Twenty native plant species and 29 introduced species were recorded during the FloraSearch (2015) survey, and two natural vegetation communities and one anthropogenic community were identified and mapped (Table 4-2 and Figure 8).

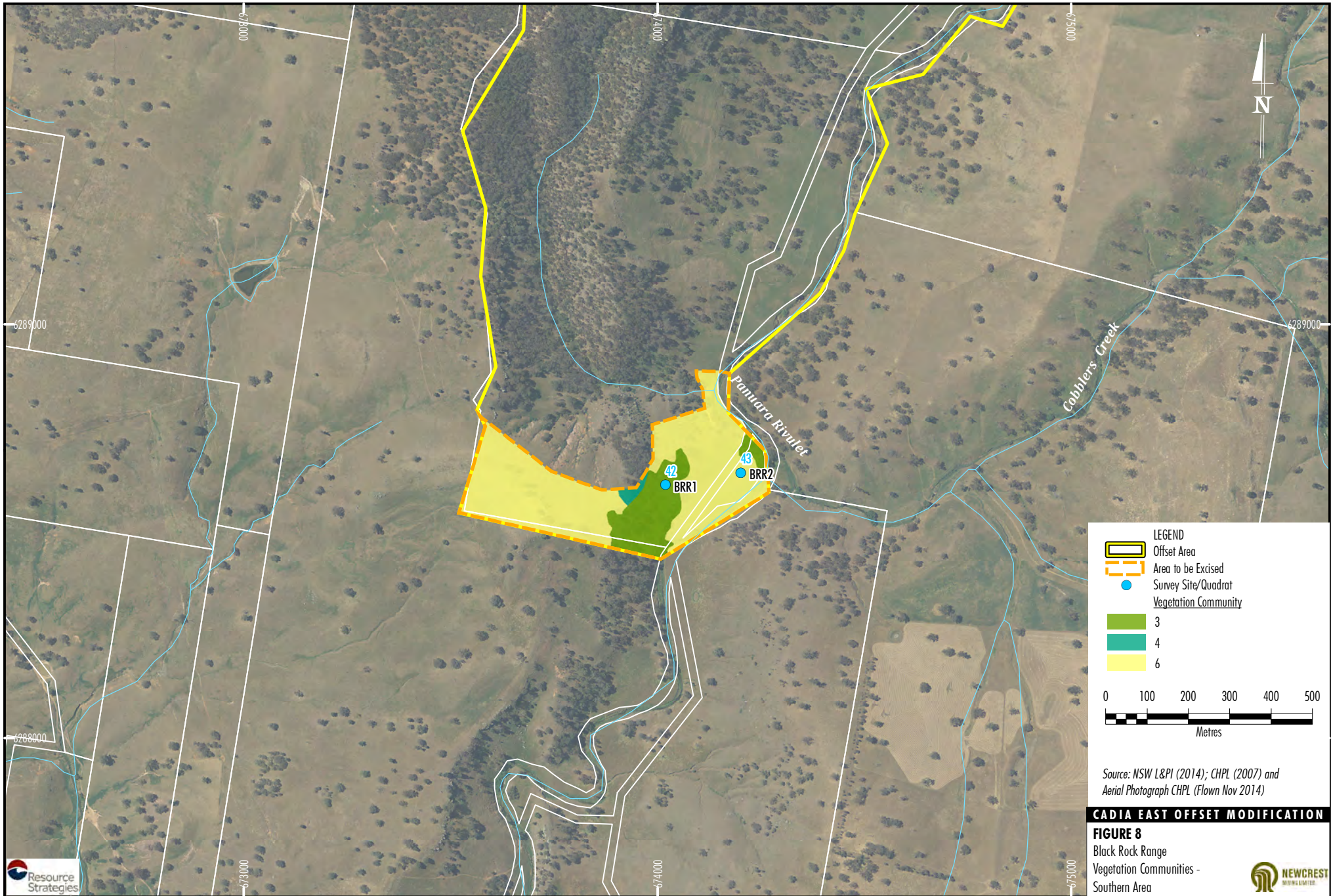
Exotic grassland was the dominant vegetation community (i.e. 11 ha), with two small areas of White-Box Woodland (i.e. total 2.7 ha) and a very small area (i.e. 0.2 ha) of Red Stringybark Woodland also occurring.

BioMetric data for the southern Black Rock Range area, indicated that the vegetation was in poor condition. The groundcover was in low condition with much greater than 50% cover by exotic species for the White Box Woodland (72%) and the Exotic Grassland (90%) (Appendix A).

No threatened flora species were identified in the southern Black Rock Range area (Appendix A).

**Table 4-2
Vegetation Communities Recorded in the Southern Black Rock Range Excise Area**

Community No.	PCT Code	Area (ha)	Short Name	Plant Community Type (OEH, 2014b)	Dominant Species on Study Areas
3	266	2.7	White Box Woodland (Box- Gum Woodland EEC)	<i>White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion</i>	White Box (<i>Eucalyptus albens</i>)
4	1095	0.2	Red Stringybark Woodland	<i>Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion</i>	Red Stringybark (<i>Eucalyptus macrorhyncha</i>), Red Box (<i>Eucalyptus polyanthemos</i>)
6	N/A	11.0	Exotic Grassland	-	Great Brome (<i>Bromus diandrus</i>), Soft Brome (<i>Bromus hordeaceus</i>), <i>Vulpia muralis</i> , Wimmera Ryegrass (<i>Lolium rigidum</i>)



LEGEND

- Offset Area
- Area to be Excised
- Survey Site/Quadrat

Vegetation Community

- 3
- 4
- 6

0 100 200 300 400 500
Metres

Source: NSW L&PI (2014); CHPL (2007) and Aerial Photograph CHPL (Flown Nov 2014)

CADIA EAST OFFSET MODIFICATION

FIGURE 8
Black Rock Range
Vegetation Communities -
Southern Area



FloraSearch (2015) used the relevant NSW and Commonwealth guidelines to determine whether any of the recorded vegetation communities conformed to the definitions of the NSW-listed Box-Gum Woodland EEC and/or the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community CEEC. The analysis indicated that the 2.7 ha area of White Box Woodland (i.e. Community 3) conformed to the NSW-listed Box-Gum Woodland EEC, but did not conform to the Commonwealth CEEC.

As per the Belubula River/Flyers Creek area to be excised, the fauna habitat values of the southern Black Rock Range area to be excised were considered by FloraSearch (2015) to be low.

Black Rock Range Trig Station Area

Figure 9 shows the mapped vegetation communities in the vicinity of the Trig Station at Black Rock Range based on the mapping conducted for the Cadia East Project (FloraSearch, 2009). As indicated on the figure, the Trig Station contains a small area of vegetation classified as the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community CEEC (i.e. approximately 0.5 ha). However, the area is located on the steeply sloping eastern face of the ridgeline (i.e. is inaccessible to vehicles) and would be entirely encompassed by the Black Rock Range offset and would, in effect, be managed as part of the offset (i.e. livestock would be excluded and other management measures for weeds and fire would be applied to this area). The revised LBMP would describe how this area would be managed.

4.3 VEGETATION CHARACTERISTICS OF THE STRATTON VALE REPLACEMENT AREA

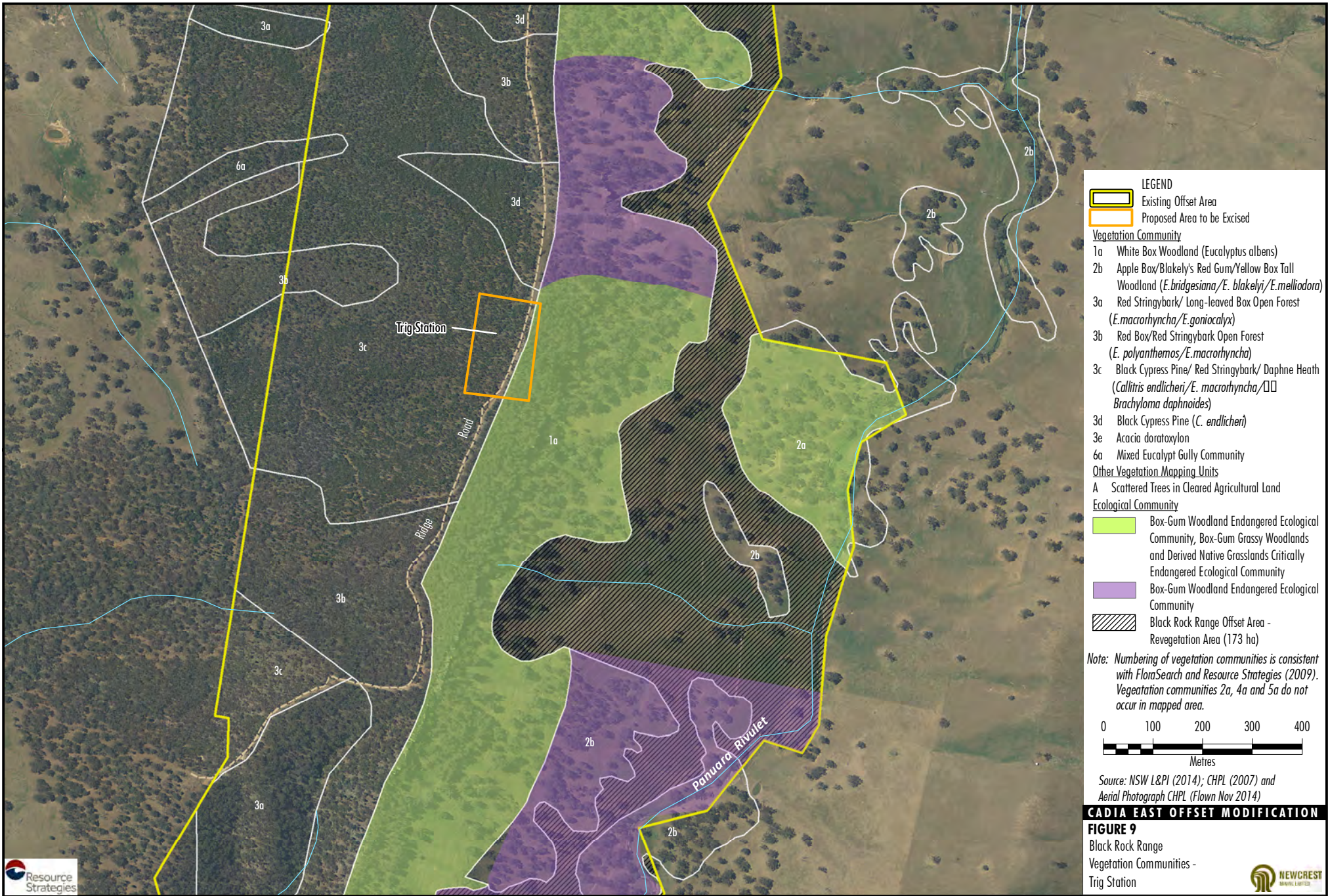
The Stratton Vale replacement area occupies approximately 60.7 ha of undulating hilly land. The area includes the riparian zone of Swallow Creek (i.e. approximately 1000 m), a small part of the lower slope to its west and parts of three unnamed tributary gullies entering from the east. Elevations vary between approximately 600 m AHD on Swallow Creek in the south-west corner, to 680 m AHD in the north-east corner. The Stratton Vale replacement area is currently used for livestock grazing.

FloraSearch surveyed the Stratton Vale replacement area in October 2014. Twenty-three native plant species and 46 introduced species were recorded during the survey, and three native vegetation communities and one anthropogenic community were identified and mapped (Table 4-3 and Figure 10).

The original woodland vegetation on Stratton Vale has been thinned historically and now comprises mostly widely spaced trees separated by grassland dominated by exotic grasses and legumes. The larger treeless areas have been mapped by as Exotic Grassland on Figure 10. Some areas of derived native grassland also occur. These are dominated by grazing-tolerant native species including Speargrass (*Austrostipa scabra*) on the dry north-facing slopes and Red Grass (*Bothriochloa macra*) on south-facing slopes.

**Table 4-3
Vegetation Communities Recorded in the Stratton Vale Replacement Area**

Community No.	PCT Code	Area (ha)	Short Name	Plant Community Type (OEH, 2014b)	Dominant Species on Study Areas
2	277	15.6	Yellow Box Woodland (Box-Gum Woodland EEC)	<i>Blakely's Red Gum – Yellow Box grassy woodland of the NSW South Western Slopes Bioregion</i>	Yellow Box (<i>Eucalyptus melliodora</i>), Apple Box (<i>Eucalyptus bridgesiana</i>)
3	266	29.8	White Box Woodland (Box-Gum Woodland EEC)	<i>White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion</i>	White Box (<i>Eucalyptus albens</i>)
5	N/A	1.2	Derived Grassland	-	Speargrass (<i>Austrostipa scabra</i>), Red Grass (<i>Bothriochloa macra</i>)
6	N/A	14.1	Exotic Grassland	-	Great Brome (<i>Bromus diandrus</i>), Soft Brome (<i>Bromus hordeaceus</i>), <i>Vulpia muralis</i> , Wimmera Ryegrass (<i>Lolium rigidum</i>)



LEGEND

- Existing Offset Area
- Proposed Area to be Excised

Vegetation Community

- 1a White Box Woodland (*Eucalyptus albens*)
- 2b Apple Box/Blakely's Red Gum/Yellow Box Tall Woodland (*E. bridgesiana/E. blakelyi/E. melliodora*)
- 3a Red Stringybark/ Long-leaved Box Open Forest (*E. macrohyncha/E. goniocalyx*)
- 3b Red Box/Red Stringybark Open Forest (*E. polyanthemos/E. macrohyncha*)
- 3c Black Cypress Pine/ Red Stringybark/ Daphne Heath (*Callitris endlicheri/E. macrohyncha/□□ Brachyloma daphnoides*)
- 3d Black Cypress Pine (*C. endlicheri*)
- 3e Acacia doratoxylon
- 6a Mixed Eucalypt Gully Community

Other Vegetation Mapping Units

- A Scattered Trees in Cleared Agricultural Land

Ecological Community

- Box-Gum Woodland Endangered Ecological Community, Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community
- Box-Gum Woodland Endangered Ecological Community
- Black Rock Range Offset Area - Revegetation Area (173 ha)

Note: Numbering of vegetation communities is consistent with FloraSearch and Resource Strategies (2009). Vegetation communities 2a, 4a and 5a do not occur in mapped area.

0 100 200 300 400
Metres



Source: NSW L&PI (2014); CHPL (2007) and Aerial Photograph CHPL (Flown Nov 2014)

CADIA EAST OFFSET MODIFICATION





FIGURE 9
Black Rock Range
Vegetation Communities - Trig Station



LEGEND

-  Replacement Offset Area
-  Survey Site/Quadrat

Vegetation Community

-  2
-  3
-  5
-  6

0 100 200 300 400 500
Metres

Source: NSW L&PI (2014); CHPL (2007) and Aerial Photograph CHPL (Flown Nov 2014)

CADIA EAST OFFSET MODIFICATION

FIGURE 10
Stratton Vale Replacement Area
Vegetation Communities



BioMetric vegetation condition data collected in the Stratton Vale replacement area indicated that the vegetation was in relatively poor condition (Appendix A). The groundcover was in low condition with greater than 50% cover by exotic species in both the Yellow Box Woodland (62%) and White Box Woodland (80%).

No threatened flora species were identified in the Stratton Vale replacement area.

FloraSearch (2015) used the relevant NSW and Commonwealth guidelines to determine whether any of the recorded vegetation communities conformed to the definitions of the NSW-listed Box-Gum Woodland EEC and/or the Commonwealth-listed Box-Gum Grassy Woodlands and Derived Native Grasslands Critically Endangered Ecological Community CEEC. The analysis indicated that all Box-Gum Woodland remnants (i.e. Community 2 [15.6 ha] and Community 3 [29.8 ha]) conformed to the NSW-listed Box-Gum Woodland EEC, but did not conform to the Commonwealth CEEC.

The fauna habitat values of the Stratton Vale replacement area were evaluated by FloraSearch (2015) and were considered to be relatively high for the following reasons:

- Many of the remnant trees at Stratton Vale are very large and clearly pre-date European settlement. One tree hosts the nest of a Little Eagle (*Hieraaetus morphnoides*), which is listed as Vulnerable under the TSC Act. In addition, many of the White Box trees have hollows suitable for parrots and a nesting population of the Vulnerable Superb Parrot (*Polytelis swainsonii*) is present on and around the investigation area.
- While the groundcover is generally dominated by exotic species, there is a good representation of native perennial grasses, potentially providing habitat for granivorous birds favouring native grass seed, such as finches and the Superb Parrot.
- Swallow Creek provides water for wildlife and habitat for aquatic fauna.

Current habitat limitations identified by FloraSearch (2015) included a general lack of tall and low shrubs that would provide cover and nesting habitat for many birds including finches, babbler, thornbills and others. There are also limited opportunities for most reptiles owing to very dense exotic grass cover over much of the area and relatively few logs on the ground.

4.4 ENVIRONMENTAL ASSESSMENT

The proposed Modification would result in the substitution of 30.7 ha of land within the existing CVO biodiversity offset (i.e. 14.2 ha at the Belubula River/Flyers Creek and 16.5 ha at Black Rock Range), with approximately 60.7 ha within the Stratton Vale replacement area. CHPL believes that this would provide a net environmental benefit, solve the current cadastral boundary issue, and allow the CVO biodiversity offset to be secured in perpetuity as required by PA 06_0295 and EPBC 2006/3196.

The existing vegetation condition and habitat value of the areas to be excised is generally low, whereas the habitat value of the replacement area is higher.

More than a third of the areas to be excised is exotic grassland (i.e. 13.3 ha), which has been extensively cleared. Of the remaining areas, approximately 2.7 ha of White Box Woodland (i.e. Community 3) at Black Rock Range conformed to the NSW-listed Box-Gum Woodland EEC. The excision of this area would be compensated for by the inclusion of 45.4 ha of remnant native vegetation at Stratton Vale that conforms to the NSW-listed Box-Gum Woodland EEC.

Approximately 1 ha of vegetation that is mapped as conforming to the Commonwealth Box-Gum Woodland CEEC is located in the Trig Station area at Black Rock Range. The Stratton Vale replacement area does not contain any vegetation that meets the Commonwealth CEEC criteria. However, because the Trig Station area at Black Rock Range is located on the steeply sloping eastern face of the ridgeline (i.e. is inaccessible to vehicles) and would be entirely encompassed by the Black Rock Range offset, it would remain protected (i.e. livestock would be excluded and other management measures for weeds and fire would be applied to this area). The revised LBMP would describe how the Trig Station area would be managed as part of the Black Rock Range offset area.

The proposed Stratton Vale replacement area contains approximately 1,000 m of direct frontage to Swallow Creek. This would effectively replace the sections of Panuara Rivulet, Belubula River and Flyers Creek that would be formally removed from the CVO offset. However, it should be noted that from a practical and on-the-ground perspective the Belubula/Flyers Creek offset area would still include the majority of the Crown land that directly fronts the River/Creek because the existing fence lines for the Oak Creek property are likely to remain in place.

5 CONCLUSION

The proposed Modification would address the recently identified issue with cadastral boundaries within the CVO biodiversity offset area as currently depicted in the Cadia East Project EA (CHPL, 2009) and PA 06_0295. If approved it would allow CHPL to secure the biodiversity in perpetuity as required by PA 06_0295 and EPBC 2006/3196.

The proposal would result in the excision of 30.7 ha of land within the existing CVO biodiversity offset and replacement of it with approximately 60.7 ha within the CHPL-owned Stratton Vale. The quantity and quality of vegetation within the Stratton Vale replacement area is such that there would be a net environmental gain as a result of the proposed Modification.

6 REFERENCES

FloraSearch and Resource Strategies (2009) *Cadia East Project Flora Assessment*. Report prepared for Cadia Holdings Pty Limited.

Office of Environment and Heritage (2014) *VIS Classification 2.1*.
Website: <http://www.environment.nsw.gov.au/NSWVCA20PRapp/search/pctsearch.aspx>
Accessed: November 2014.

APPENDIX A
FLORA SURVEY AND HABITAT ASSESSMENT

FLORA AND FAUNA HABITAT SURVEY OF PROPOSED CHANGES TO THE CADIA VALLEY
OPERATIONS BIODIVERSITY OFFSET AREAS

PREPARED BY

FLORASEARCH

APRIL 2015

Project No. NEC-14-81

Document No. 00672361

TABLE OF CONTENTS (continued)

LIST OF TABLES

Table 1	Number of Quadrats conducted within each Vegetation Community on each Study Area
Table 2	Modified Braun-Blanquet Cover Abundance Rating Scale
Table 3	Vegetation Types in the Existing Offset Areas
Table 4	Summary of Flora Species Numbers in the Existing Offset Areas
Table 5	Vegetation Condition Data – Belubula River/Flyers Creek Area
Table 6	Vegetation Condition Data – Black Rock Range Area
Table 7	Belubula River/Flyers Creek Area- Conformance with Identification Criteria for the Box-Gum Woodland EEC/CEEC
Table 8	Black Rock Range Area- Conformance with Identification Criteria for the Box-Gum Woodland EEC/CEEC
Table 9	Vegetation Types in the Proposed Stratton Vale Replacement Area
Table 10	Vegetation Condition Data – Proposed Stratton Vale Replacement Area
Table 11	Proposed Stratton Vale Replacement Area - Conformance with Identification Criteria for the Box-Gum Woodland EEC/CEEC

LIST OF FIGURES

Figure 1	Study Areas
Figure 2	Belubula River / Flyers Creek Study Area Vegetation Communities
Figure 3	Black Rock Range Study Area Vegetation Communities
Figure 4	Stratton Vale Study Area Vegetation Communities
Figure 5	NSW Box Gum Woodland Identification Key
Figure 6	Commonwealth Flowchart for the Identification of the Box Gum Woodland CEEC

LIST OF APPENDICES

Appendix 1	Flora Species and Cover Abundance on Each Quadrat
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1 INTRODUCTION

Cadia Holdings Pty. Limited (CHPL) has recently discovered that two small parcels of land in the original Cadia Valley Operations (CVO) biodiversity offset are unable to be secured in perpetuity due to several cadastral issues. These areas are located in the southern part of the Black Rock Range offset area and in the vicinity of the Belubula River and Flyers Creek confluence. The net effect is that CHPL requires 28.1 hectares (ha) of alternative suitable native vegetation/fauna habitat in order to replace the area unable to be secured.

FloraSearch has been commissioned by CHPL to undertake flora surveys and habitat assessments of the two parcels of land to be excised, and to survey a potential replacement area located in the CHPL-owned Stratton Vale property. The surveys and habitat assessments are to be included in an Environmental Assessment, which is being prepared to support a Modification application to the CVO Project Approval under Section 75W of the *Environmental Planning and Assessment Act, 1979* (EP&A Act).

In this report the attributes of the two land parcels to be excised are determined through the application of appropriate survey methods and compared with the same data from the potential replacement area at Stratton Vale. The three areas are herein referred to as the study areas.

The objectives of the surveys are to:

- sample the natural vegetation on the study areas using standard flora survey techniques;
- determine the Plant Community Types (PCT) present within each study area;
- compile a flora species list for each study area;
- conduct targeted searches for potentially occurring threatened flora species, populations and communities; and
- determine the distribution of *White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community* listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community* (CEEC) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (commonly known as Box-Gum Woodlands); and
- assess the habitat quality for fauna within each study area.

2 REGIONAL SETTING

The three study areas are located in undulating to steep hilly country to the west and south west of the CVO mining tenements (Figure 1). The study areas vary from 28 kilometres (km) to 34 km south west of Orange, the nearest major population centre. The nearest named locality is Panuara, a small hamlet only 1.4 km north of the Stratton Vale investigation area. Apart from the CVO, the other major land uses in the surrounding district are softwood plantation forestry (Canobolas State Forest), livestock grazing and viticulture (Angullong Vineyard).

The main watercourses in the study areas are the Belubula River and its tributaries Flyers Creek, Cadiangullong Creek, Swallow Creek and Panuara Rivulet (Figure 1). The proposed Stratton Vale replacement area includes a section of Swallow Creek, and the existing offset area at the south end of the Black Rock Range borders the Panuara Rivulet.

The study areas lie within the Central Tablelands botanical region and close to the boundary of the Central Western Slopes botanical region (Anderson, 1961). They are also within the South Eastern Highlands Biogeographical Region and close to the boundary with the South Western Slopes Biogeographical Region (Thackway and Cresswell, 1995). Given the study areas are situated close to the boundaries of major botanical and biogeographical regions, it is likely that the study area flora would contain a blend of species characteristic of both sets of regions.

3 GENERAL DESCRIPTION OF THE STUDY AREAS

3.1 EXISTING OFFSET AREAS

Belubula River/Flyers Creek

The Belubula River/Flyers Creek study area comprises a narrow strip along a section of the Belubula River and the lower reaches of Flyers Creek (Figure 2). The study area is almost entirely within the riparian zone, but also includes a small amount of the adjoining lower slopes along Flyers Creek in places.

South End of Black Rock Range

This area is at the southernmost extremity of Black Rock Range where it meets the Panuara Rivulet (Figure 3). It comprises steep east and south facing slopes descending from a dome-shaped hill (570 metres Australian Height Datum [m AHD]) and ridge extending to its west (600 m AHD), as well as flats along Panuara Rivulet. The lowest altitude in the study area is approximately 505 m beside the Panuara Rivulet. The soils are predominantly stony clays with small areas of alluvial/colluvial soils on the river flats.

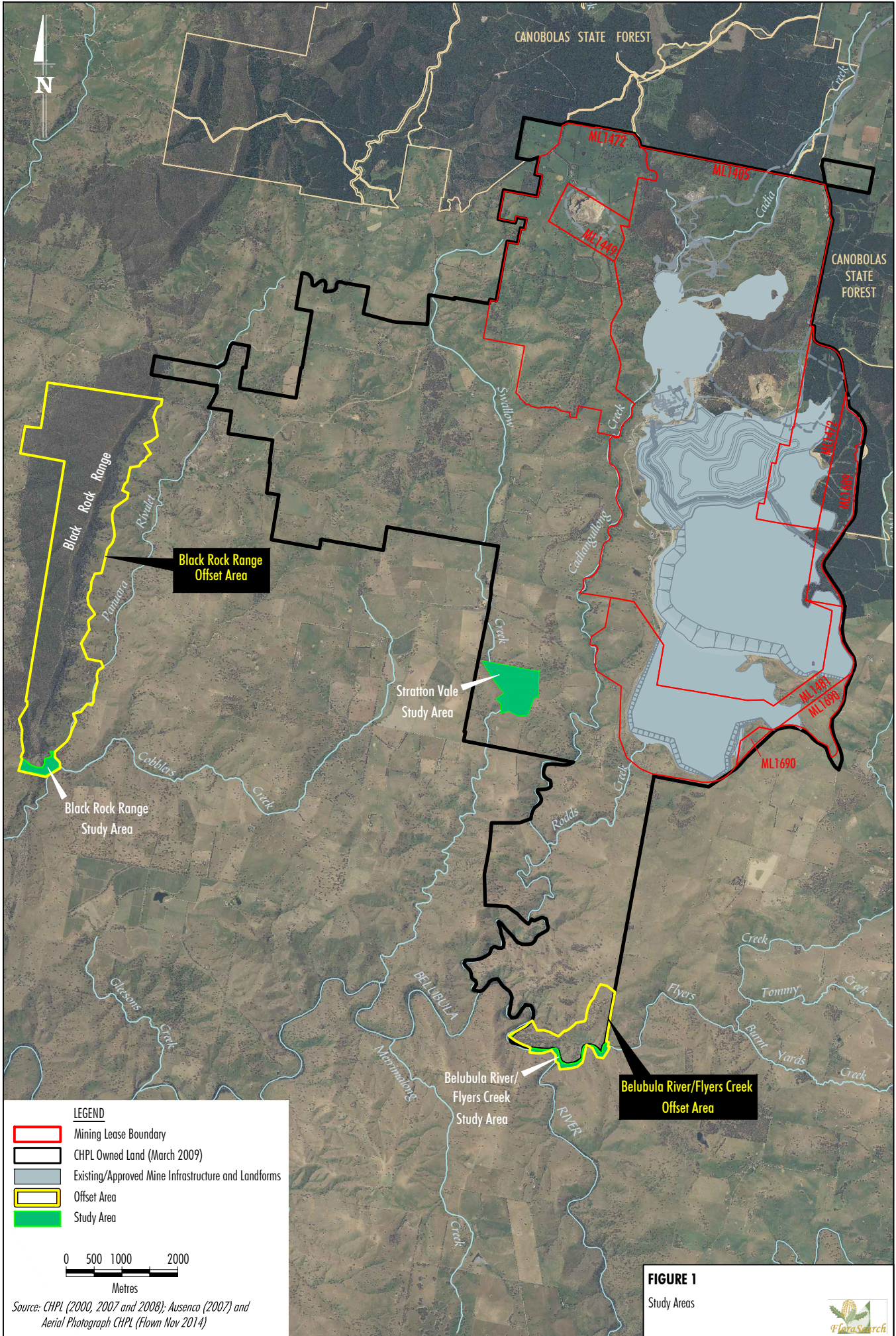
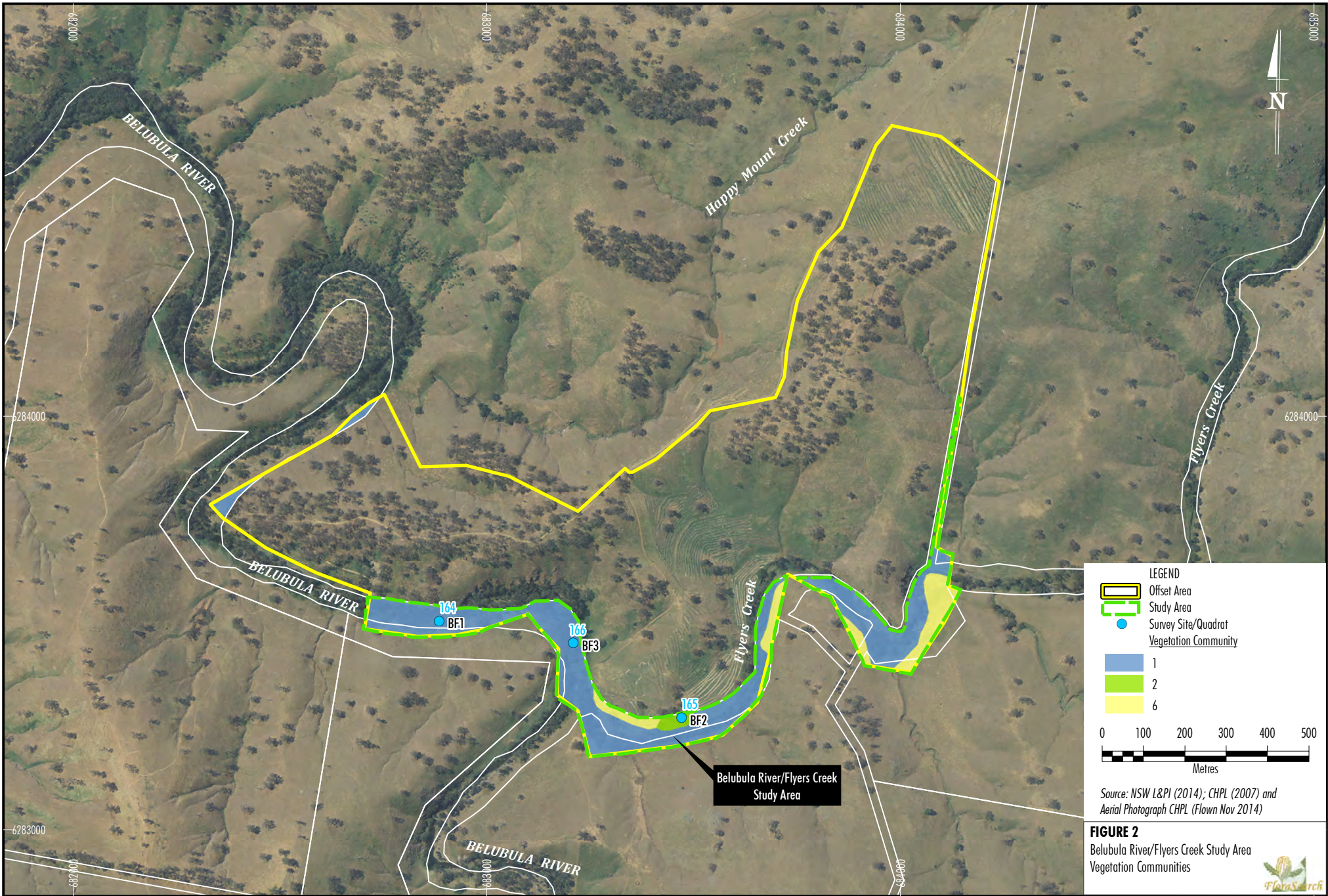
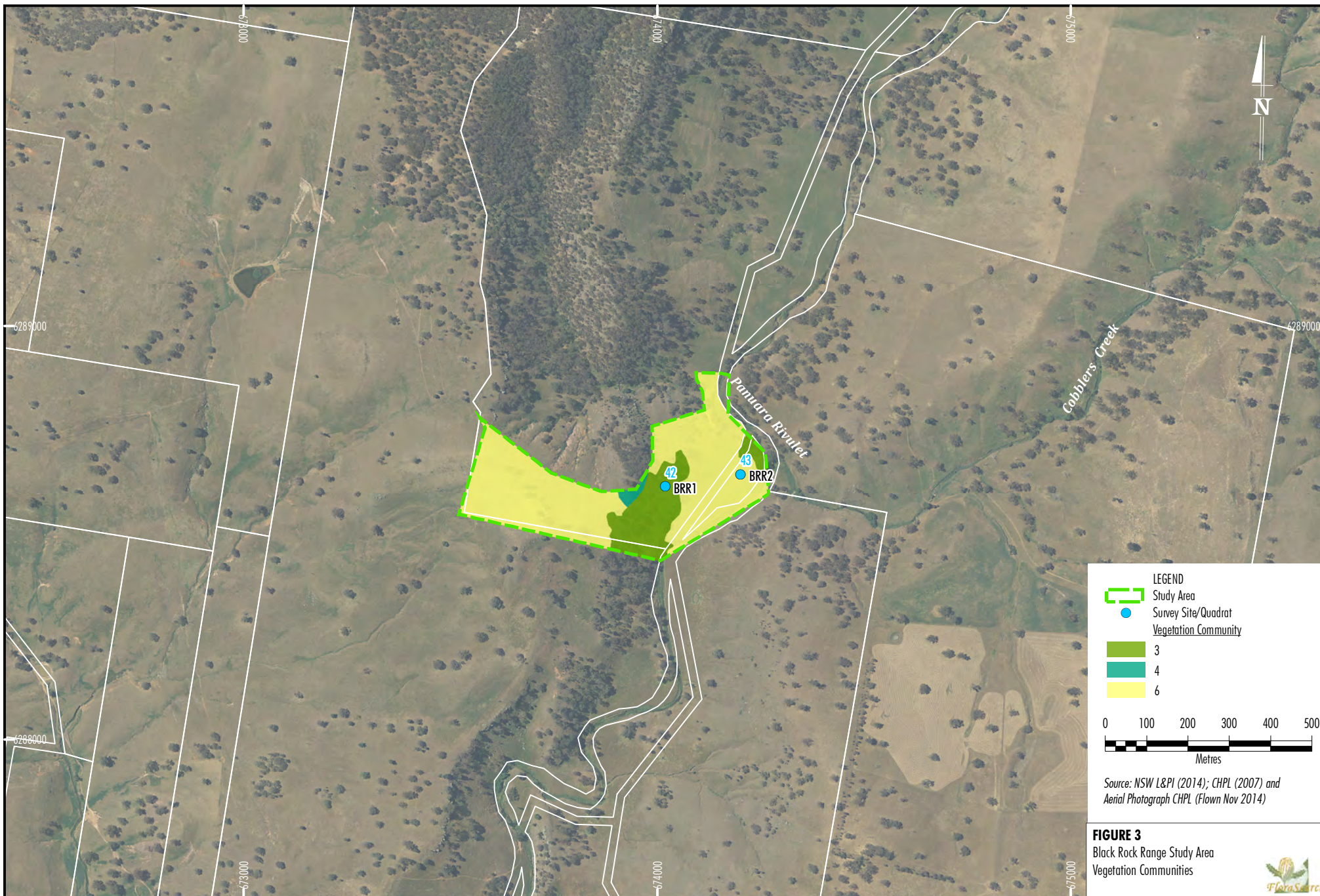


FIGURE 1
Study Areas







3.2 INVESTIGATION AREA

Stratton Vale

The proposed Stratton Vale replacement area of approximately 60.7 ha comprises undulating hilly country along Swallow Creek (Figure 4). The Study area includes the riparian zone of Swallow Creek, a small part of the lower slope to its west and parts of three unnamed tributary gullies entering from the east. Elevations on the Study area vary between approximately 600 m AHD on Swallow Creek in the south-west corner to 680 m AHD in the north-east corner, a relief of 80 m. The proposed Stratton Vale replacement area is currently used for livestock grazing. Pasture improvement by ground equipment is likely to have occurred there in the decades after World War II, when government subsidies for fertiliser use were available.

4 METHODS

4.1 SURVEY TIMING

The survey was conducted in spring and summer 2014 as follows:

- Belubula River/Flyers Creek – 27 October;
- Black Rock Range – 28 October and 12 December; and
- Stratton Vale – 31 October.

Seasonal conditions leading up to the survey were favourable for the growth of ground cover species, even though rainfall was 12 percent below average for the period January to September 2014¹.

4.2 VEGETATION SAMPLING

Vegetation was documented by two methods; standard quadrat sampling and random meanders, as recommended by the New South Wales (NSW) Office of Environment and Heritage (OEH) (Department of Environment and Conservation [DEC], 2004; OEH, 2014a), and summarised below. Figures 2-4 show the locations of quadrat sites. Vegetation sampling was stratified according to the standard Plant Community Types (PCT) recognised by OEH (2014b).

¹ Bureau of Meteorology Station Number 063113, Angullong, 4.2 km south east of the south end of Black Rock Range.



4.2.1 Quadrat Sampling

Flora on the Study areas was sampled with 20 × 20 m (0.04 ha) quadrat sites (Table 1, Figures 2-4). Sampling intensity was based on the approximate areas of each vegetation zone in each study area (DEC, 2004). Within each plot the dominant species in each vegetation stratum were recorded, with an estimate of the percentage of the ground surface covered by their canopies. A list of all vascular plant species present within the quadrat was also made with each being assigned a cover abundance rating using a modified Braun-Blanquet scale (Table 2). Details recorded for each site included its Global Positioning System (GPS) position, landform, physiography, topsoil characteristics, disturbance, vegetation structural formation and general comments.

Table 1
Number of Quadrats conducted within each Vegetation Community on each Study Area.

Community No.	PCT		Current Offset Areas		Replacement Area
	No.	Name	Belubula River	Black Rock Range	Stratton Vale
1	85	<i>River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregions</i>	2	N/A	N/A
2	277	<i>Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion</i>	1	0	2
3	266	<i>White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion</i>	N/A	1	2
4	1095	<i>Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion</i>	N/A	0	N/A
5 ¹	N/A	Derived Grassland	N/A	N/A	0 ²
6 ¹	N/A	Exotic Grassland	0	1	0

¹ No equivalent PCT has been described for this vegetation type.

² Derived grassland occupied only very small areas and was not sampled.

N/A = Not applicable

Table 2
Modified Braun-Blanquet Cover Abundance Rating Scale

Rating	Percent Ground Cover	Rating	Percent Ground Cover
1	<1, rare	5	6 to 25
2	<5, uncommon	6	26 to 50
3	<5, common	7	51 to 75
4	<5, abundant	8	76 to 100

4.2.2 Random Meanders

Random meanders were undertaken for 30 minutes from each quadrat site. Random meanders were aimed at detecting the presence of any threatened flora species that may occur.

4.2.3 Habitat Quality

The condition of the native vegetation on the study areas and their value as fauna habitat was measured using the OEH BioMetric terrestrial biodiversity assessment methodology (Gibbons *et al.* 2005). BioMetric measurements form part of the input to the NSW Property Vegetation Plan Developer, which is used to assist decision making for applications to clear native vegetation under the NSW *Native Vegetation Act, 2003*. This methodology allows the value of vegetation to be assessed in a repeatable fashion for comparison with established benchmarks for the vegetation types on the study area (Department of Environment and Climate Change [DECC], 2008a).

The 20 × 20 m flora survey plots were extended to 50 × 20 m for 'Biometric' measurements (Figures 2-4). Ten condition parameters used in BioMetric to assess site value were measured in each plot. The measurement methods were based on Appendix 3 of the BioMetric Operational Manual (Gibbons *et al.*, 2005). The parameters and methodology are:

- Native plant species diversity: - the number of native plant species in the 20 × 20 m subplot.
- Native overstorey cover: – mean percent cover of ground by the foliage of the uppermost vegetation layer; trees or tall shrubs (>1 m) at 10 points along a 50 m transect along the long axis of the plot.
- Native midstorey cover: – mean percent cover of ground by the foliage of the middle vegetation layer; tall shrubs (>1 m), low trees and regeneration at 10 points along a 50 m transect along the long axis of the plot.
- Native groundcover – grasses: - presence or absence of native grasses at 50 points 1m apart on a 50 m transect along the long axis of the plot.
- Native groundcover – shrubs: - mean percent cover of ground by the foliage of low shrubs (>1 m) and regeneration at 10 points along a 50 m transect along the long axis of the plot.
- Native groundcover – other: - Presence or absence of native herbs, sedges, rushes, ferns and other groundcover species at 50 points 1m apart on a 50m transect along the long axis of the plot.
- Exotic plant cover: – Presence or absence of exotic species at 50 points 1m apart on a 50m transect along the long axis of the plot.
- Number of trees with hollows: - All living and dead standing trees with their centres in the 50 × 20 quadrat were examined for hollows capable of harbouring wildlife. Hollows are defined as tree holes > 5 centimetres (cm) diameter, having depth, and > 1 m above the ground.
- Regeneration: - The proportion of overstorey trees species on the 50 × 20 m quadrat that are regenerating.

- Total length of fallen logs: - The length of fallen logs > 10 cm diameter and > 0.5 m long was totalled for the whole 50 × 20 m quadrat.

4.2.4 Flora Species Listing

All observed plant species were recorded, whether identified on formal sample sites or not. Some less common plants were only observed on one occasion whilst moving around the site. Where plants could not be quickly identified in the field, a sample was taken for later examination. Samples were preserved in a plant press and identified using a binocular microscope and flora keys. The principal reference was the Flora of New South Wales (Ed. G. Harden 1990-2002) and it is used as the basis for plant naming in this report along with any updates on the PlantNet web site of the Royal Botanic Gardens and Domain Trust Sydney (PlantNet, 2014).

4.2.5 Vegetation Mapping

The distribution of PCTs on the study areas was determined by visiting all parts of each area by 4WD vehicle and on foot. The vegetation was examined with binoculars where access was difficult or dangerous, as on very steep slopes. Vegetation distribution was mapped in the field onto high resolution aerial photographs.

4.2.6 Determination of Box - Gum Woodland Status as EEC (TSC Act) or CEEC (EPBC Act)

The *White Box Yellow Box Blakely's Red Gum Woodland* vegetation community is listed as endangered under the TSC Act and the analogous *White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived native grasslands critically endangered ecological community* is listed under the EPBC Act. These woodlands are commonly referred to as Box – Gum Woodlands.

The Box-Gum Woodland EEC/CEEC is characterised by one or more of the following species in varying proportions and combinations; White Box, Yellow Box or Blakely's Red Gum (NPWS undated, DEH 2006). Native grass and herbaceous species generally dominate the ground layer, and shrubs are usually sparse or absent, though they may be locally common (ibid.). A predominantly grassy, rather than shrubby understorey is a defining characteristic of the community (ibid.).

This community is widespread on the western slopes and tablelands of New South Wales and occurs commonly in the region around Cadia. Because it occurs on relatively deep high fertility soils, it has been extensively cleared historically for cropping and grazing over its entire range. Very few remnants remain in close to pristine condition. Most examples of Box-Gum Woodland are small patches of trees or isolated single trees on farmland. In nearly all cases the former understorey shrub species have completely disappeared and most of the native herbs and grasses have also been eliminated by farming and grazing. Remnants in fair to good condition occur mainly in cemetery reserves, crown reserves and in some travelling stock routes and reserves. The key characteristic for defining remnant quality of this community is the condition of the understorey in terms of the relative absence of weeds and the presence of close to the full suite of original herbs and grasses. Some native components of this community are more sensitive to disturbance than others and the presence of these indicates the remnant is in good condition.

Guidelines for determining whether particular Box-Gum Woodland remnants conform to the definitions of the EEC and/or CEEC have identification keys or flowcharts based on community criteria (NPWS undated, DEH 2006) (Figures 5 and 6). Remnants must meet all relevant key or flowchart criteria to be recognised as part of the EEC or CEEC. The NSW and Commonwealth jurisdictions have taken fundamentally different approaches to conservation of Box-Gum Woodlands. The NSW community recognition criteria and key are very broad, such that all predominantly grassy Box-Gum Woodland remnants, including those that are highly degraded, are included in the EEC unless they occur in urban backyards or cropping paddocks (NPWS undated). Accordingly, all remnants on the Study areas are considered to be part of the NSW EEC in this report.

By contrast, the Commonwealth listing of Critically Endangered seeks to focus protection on the highest quality remnants, that is, those that have retained a significant proportion of the original floristic diversity of the community. For this study, the most important Commonwealth criterion is at the second line in the flow diagram (Figure 6) which asks whether the understorey is predominantly native. The explanatory notes below the flow diagram (Figure 6) indicate the question refers to perennial not annual species. It also recommends that surveys be conducted in late autumn when annual growth of exotic species is absent. Accordingly for surveys conducted at other times of the year great care is needed to assess perennial not annual species when determining whether a patch meets Commonwealth CEEC criteria. The most important BioMetric measures that focus on this issue are the proportions of *native groundcover – grasses* and *native groundcover – other*, both of which measure mainly perennial species.

Identifying Box-Gum Woodland

Following is a key for use in determining whether Box-Gum Woodland exists on a site. Where doubt exists over an appropriate category (e.g. whether the site is mainly grassy or is shrubby), use a precautionary approach that assumes that the community is present.

At each stage there are two alternatives. Choose which is most like the site under consideration, and proceed to the alternative numbered in the right margin.

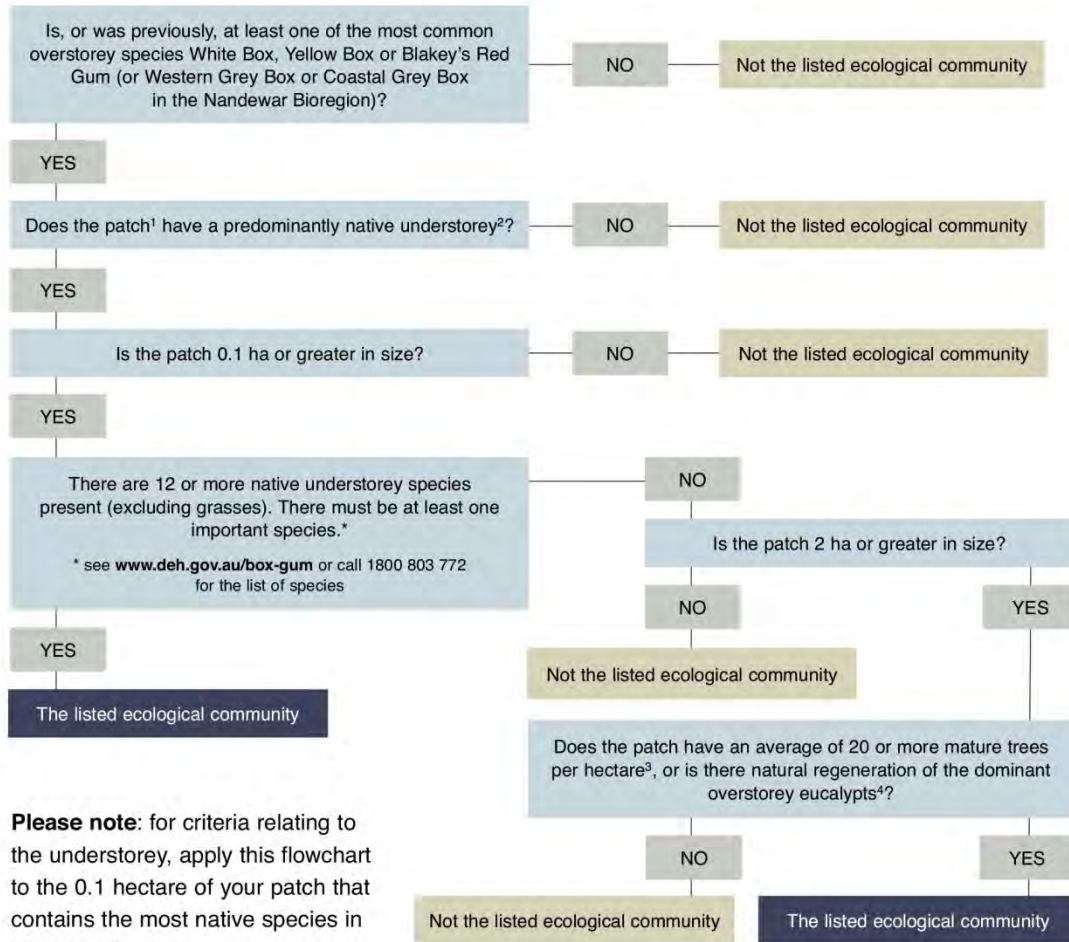
- 1 The site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions: **2**
- 1* The site is outside the above bioregions: **2**
the site is not Box-Gum Woodland
- 2 There are no native species in the understorey, and the site is unlikely to respond to assisted natural regeneration (see section on Degraded Sites, page 3):
the site is not Box-Gum Woodland
- 2* The understorey is otherwise: **3**
- 3 The site has trees: **4**
- 3* The site is treeless, but is likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing: **5**
- 4 White Box, Yellow Box or Blakely's Red Gum, or a combination of these species, are or were present: **5**
- 4* White Box, Yellow Box or Blakely's Red Gum have never been present:
the site is not Box-Gum Woodland
- 5 The site is predominantly grassy:
the site is Box-Gum Woodland
- 5* The understorey of the site is dominated by shrubs excluding pioneer species (see section on The Understorey: page 2):
the site is not Box-Gum Woodland

Figure 5. NSW Box-Gum Woodland identification key (NPWS undated).

[Under this key and the explanatory text in NPWS (undated), all Yellow Box, White Box and Blakely's Red Gum trees in the Bioregions at Point 1 are part of the EEC unless they occur in urban backyards, cropping paddocks or have heavy native shrub cover.]

The flowchart below represents the lowest condition at which patches are included in the listed ecological community. This is not the ideal state of the ecological community. Large patches, those that link remnants in the landscape, those that occur in highly cleared areas, those that contain rare, declining or threatened species, and those that represent the entire range of the ecological community, are important for the long-term future of the ecological community.

Determining if your land has an area of the listed ecological community



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

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

Patches must be assessed at a scale of 0.1 ha (1000m²) or greater.

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

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

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

Figure 6. Commonwealth flowchart for identification of the Box-Gum Woodland CEEC (DEH 2006). [Importantly, a ‘no’ answer at any of the first three steps excludes a patch from the EEC, whether or not the patch is greater than 2 ha in size and has a high density of trees or regeneration]

5 RESULTS

5.1 EXISTING OFFSET AREAS

5.1.1 Vegetation Communities

The PCTs described below are considered closest in floristic composition and site characteristics to those described in the OEH (2014b) Plant Community Types Database. In some cases there are relatively large differences between the OEH (2014b) community and that observed on the study areas. These discrepancies may arise because past clearing and intensive grazing have changed community composition, for example formerly shrubby areas may now lack shrubs and appear grassy. However, vegetation varies across the landscape and some less prominent variants may not be covered explicitly by OEH (2014b). [Note: PCTs in the following lists are given in italics by their title in OEH (2014b).]

Belubula River/Flyers Creek

Two natural vegetation communities and one anthropogenic community occurred in the existing Belubula River / Flyers Creek offset area (Table 3).

- River Oak Forest (Community 1);
- Yellow Box Woodland (Community 2); and
- Exotic Grassland (Community 6).

River Oak Forest was by far the dominant community since much of the area is within the riparian zones of the Belubula River and Flyers Creek (Figure 2). A very small remnant patch of Yellow Box Woodland was also present (Figure 2). However, most of the non-riparian lower slope areas were covered in exotic grasses and herbs.

Table 3
Vegetation Types in the Existing Offset Areas

Community No.*	Belubula River/Flyers Creek	Black Rock Range	PCT code	Short Name	Plant Community Type (OEH, 2014b)	Dominant Species on Study Areas
1	✓	-	85	River Oak Forest	<i>River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregions</i>	River Oak (<i>Casuarina cunninghamiana</i>), River Red Gum (<i>Eucalyptus camaldulensis</i>)
2	✓	-	277	Yellow Box Woodland (Box-Gum Woodland EEC)	<i>Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion</i>	Yellow Box (<i>Eucalyptus melliodora</i>), Apple Box (<i>Eucalyptus bridgesiana</i>)
3	-	✓	266	White Box Woodland (Box-Gum Woodland EEC)	<i>White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion</i>	White Box (<i>Eucalyptus albens</i>)
4	-	✓	1095	Red Stringybark Woodland	<i>Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion</i>	Red Stringybark (<i>Eucalyptus macrorhyncha</i>), Red Box (<i>Eucalyptus polyanthemus</i>)
6	✓	✓	N/A	Exotic Grassland	-	Great Brome (<i>Bromus diandrus</i>), Soft Brome (<i>Bromus hordeaceus</i>), <i>Vulpia muralis</i> , Wimmera Ryegrass (<i>Lolium rigidum</i>)

* Note: Community 5 does not occur in the existing offset area.

Black Rock Range

There were remnants of the following vegetation communities on the Black Rock Range study area (Figure 3, Table 3):

- White Box Woodland (Community 3);
- Red Stringybark Woodland (Community 4);
- Exotic grassland (Community 6).

The vegetation on the Black Rock Range offset area had a small area of Red Stringybark Woodland that was not found on the other areas (Figure 3, Table 3).

5.1.2 Flora Species

The flora species recorded on the two existing offset areas are given for each quadrat in Appendix 1. Table 4 summarises the total numbers of native and introduced flora species identified on three quadrats for Belubula River/Flyers Creek and two quadrats at Black Rock Range.

Table 4
Summary of Flora Species Numbers in the Existing Offset Areas

Area	Native Species	%	Introduced Species	%	Total
Belubula/Flyers	14	20.3	55	79.7	69
Black Rock Range	20	40.8	29	59.2	49

The results show that introduced species dominated on both areas and that relatively few native species were present (Table 4).

5.1.3 Noxious Weeds

The introduced species shown below are listed as Class 4 noxious weeds under the NSW *Noxious Weeds Act, 1993* (DPI, 2014) for the Upper Macquarie County Council Area and occurred on both existing offset areas (Appendix 1);

- Blackberry (*Rubus fruticosus* species aggregate; includes *R. anglocandicans*);
- St. John's Wort (*Hypericum perforatum*); and
- Sweet Briar (*Rosa rubiginosa*).

Blackberry and Sweet Briar occurred in only low numbers indicating they have been well controlled. However, moderate numbers of St. John's Wort were present in Exotic Grassland at Black Rock Range.

5.1.4 Vegetation Condition

BioMetric data on vegetation condition for the two existing offset areas are presented in Tables 5 and 6. For the Belubula River/Flyers Creek area, the data show that the River Oak Forest and the small remnant of Yellow Box Woodland were both in poor condition with their ground cover in 'low' condition owing to a high dominance of exotic species; 68% exotic cover for River Oak Forest and 100% exotic cover for Yellow Box Woodland (Table 5). The River Oak Forest met or exceeded benchmark values only for native overstorey cover, other native groundcover and the number of trees with hollows. On all other measures River Oak Forest was well below the benchmarks. The Yellow Box Woodland also met or exceeded only three of the ten benchmarks; native overstorey cover, number of trees with hollows and length of fallen logs.

Table 5
Vegetation Condition Data – Belubula River/Flyers Creek Area

Vegetation Type	No. of Replicates	Recorded Values			Benchmarks	
		Lower	Upper	Average	Lower	Upper
Native plant species richness (number of species)						
River Oak Woodland	2	6	8	7	21	-
Yellow Box Woodland	1	6	-	6	23	-
Native overstorey cover (%)						
River Oak Woodland	2	26.5	63.0	44.8	15	43
Yellow Box Woodland	1	28.5	-	28.5	8	35
Native midstorey cover (%)						
River Oak Woodland	2	0	0	0	1	20
Yellow Box Woodland	1	0	-	0	1	20
Native groundcover – grasses (%)						
River Oak Woodland	2	0	0	0	1	35
Yellow Box Woodland	1	0	-	0	15	70
Native groundcover – shrubs (%)						
River Oak Woodland	2	0	0	0	0	5
Yellow Box Woodland	1	0	-	0	3	5
Native groundcover – other (%)						
River Oak Woodland	2	6	6	6.0	5	20
Yellow Box Woodland	1	0	-	0	3	20
Exotic plant cover (%)						
River Oak Woodland	2	68	72	70.0	-	-
Yellow Box Woodland	1	100	-	100.0	-	-
Number of trees with hollows						
River Oak Woodland	2	2	3	2.5	1	-
Yellow Box Woodland	1	2	-	2	0.8	-
Regeneration (proportion of tree species)						
River Oak Woodland	2	100	100	100.0	-	-
Yellow Box Woodland	1	0	-	0	-	-
Total length of fallen logs (m)						
River Oak Woodland	2	17.7	23.1	20.4	50	-
Yellow Box Woodland	1	100.6	-	100.6	66	-

Table 6
Vegetation Condition Data – Black Rock Range Area

Vegetation Type	No. of Replicates	Recorded Values			Benchmarks	
		Lower	Upper	Average	Lower	Upper
Native plant species richness (number of species)						
White Box Woodland	1	13	-	13	23	-
Exotic Grassland	2	8	-	8	23	-
Native overstorey cover (%)						
White Box Woodland	1	21.5	-	21.5	8	35
Exotic Grassland	2	0	-	0	8	35
Native midstorey cover (%)						
White Box Woodland	1	0	0	0	1	20
Exotic Grassland	2	0	-	0	1	20
Native groundcover – grasses (%)						
White Box Woodland	1	6	-	6	15	70
Exotic Grassland	2	2	-	2.0	15	70
Native groundcover – shrubs (%)						
White Box Woodland	1	0	-	0	3	5
Exotic Grassland	2	0	-	0	3	5
Native groundcover – other (%)						
White Box Woodland	1	0	-	0	3	20
Exotic Grassland	2	4	-	4.0	3	20
Exotic plant cover (%)						
White Box Woodland	1	72	-	72.0	-	-
Exotic Grassland	2	94	-	94.0	-	-
Number of trees with hollows						
White Box Woodland		0	-	0	0.8	-
Exotic Grassland	1	0	-	0	0.8	-
Regeneration (proportion of tree species)						
White Box Woodland	1	0	-	0	-	-
Exotic Grassland	2	0	-	0	-	-
Total length of fallen logs (m)						
White Box Woodland	1			35.0	66	-
Exotic Grassland	2	0	-	0	66	-

The data for the Black Rock Range area show the vegetation was in poor condition. The groundcover was in low condition with much greater than 50% cover by exotic species for the White Box Woodland (72%) and the Exotic Grassland (90%) (Table 6). White Box Woodland was in poor condition, meeting only one benchmark, native overstorey cover, and falling well short of all others (Table 6).

There are no benchmarks for Exotic Grassland in DECC (2008a) for the Lachlan Local Land Services (Lachlan LLS) region. It is considered the grassland is likely to have resulted from clearing Yellow Box or White Box Woodland and accordingly is compared with the benchmarks for Yellow Box Woodland here. Since it met only one of the Yellow Box Woodland benchmarks, other native groundcover, and its ground cover was in low condition, the Exotic Grassland is considered to be in very poor condition overall.

5.1.5 Threatened Flora

Belubula River /Flyers Creek

No threatened flora species were identified in the existing Belubula River/Flyers Creek offset area.

One PCT at the Belubula River/Flyers Creek offset area, *Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion*, is potentially part of the Box-Gum Woodland EEC/CEEC. Whether or not the remnant on the study area is considered part of the Box-Gum Woodland EEC/CEEC depends on whether it meets the relevant NSW (NPWS, undated) or Commonwealth (DEH, 2006) identification guidelines for acceptance. The guidelines are summarised in Table 7 and compared to the data obtained on the study area. The analysis indicates the Box-Gum Woodland remnants conform to the TSC Act EEC, but not the EPBC Act CEEC. In the latter case, the very poor condition of the ground cover excludes the remnant from the CEEC.

Table 7
Belubula River/Flyers Creek Area-
Conformance with Identification Criteria for the Box-Gum Woodland EEC/CEEC

Category	TSC Act		EPBC Act	
	Criterion	Conforms?	Criterion	Conforms?
Native understorey	Any native species present	Yes [Six native species on quadrat]	Predominantly native ground cover defined as 'at least 50% of the perennial vegetation cover in the ground layer is made up of native species'.	No [More exotic than native perennial species / cover]
Resilience	Site is 'likely to respond to assisted natural regeneration'	Yes [There is very limited potential for natural regeneration]	NA	-
Trees	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	Yes [Yellow Box present]	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	Yes [Yellow Box present]
Ground cover	Predominantly grassy	Yes [Introduced, not native grasses]	Native tussock grasses and herbs, and a sparse, scattered shrub layer.	No No native tussock grasses or shrubs]
Shrubs	'Shrubs are generally sparse or absent, though they may be locally common.'	Yes [No native shrubs recorded]	Patches with 'a continuous shrub layer of more than 30% cover' are excluded from the CEEC.	Yes [Native shrubs absent]
Important species	N/A	-	Twelve or more native (non-grass) understorey species present, including at least one 'important' species.	No [Only 4 native understorey species]
Disturbance	Natural soil and associated seed bank are still or at least partially intact.	Yes [Very limited potential]	Site is still the CEEC even if treeless, provided it has 'an intact native ground layer with a high diversity of native plant species'.	No [Native ground layer is depauperate]
Size	Not important	-	At least 0.1 ha with more than 12 native understorey species (not grasses) OR greater than 2 ha with an average of 20+ trees per ha, or active tree regeneration.	No [<12 non-grass native understorey species; <2 ha in area]

Black Rock Range

Two PCTs at Black Rock Range, *Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion*, and *White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion* are potentially part of the Box-Gum Woodland EEC/CEEC. An analysis (Table 8) indicates that the Box-Gum Woodland remnants conform to the TSC Act EEC (Figure 5) but not to the EPBC Act CEEC (Figure 6). No threatened flora species were identified in the existing Black Rock Range offset area.

Table 8
Black Rock Range Area-
Conformance with Identification Criteria for the Box-Gum Woodland EEC/CEEC

Category	TSC Act		EPBC Act	
	Criterion	Conforms?	Criterion	Conforms?
Native understorey	Any native species present	Yes [9 native species present]	Predominantly native ground cover defined as 'at least 50 percent of the perennial vegetation cover in the ground layer is made up of native species'.	Yes [Most exotic species are annuals, while most natives are perennials]
Resilience	Site is 'likely to respond to assisted natural regeneration'	Yes	NA	-
Trees	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	Yes [Yellow Box and White Box present]	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	Yes [Yellow Box and White Box present]
Ground cover	Predominantly grassy	Yes	Native tussock grasses and herbs, and a sparse, scattered shrub layer.	No [Ground layer dominated by exotic species]
Shrubs	'Shrubs are generally sparse or absent, though they may be locally common.'	Yes [Native shrubs are sparse]	Patches with 'a continuous shrub layer of more than 30 percent cover' are excluded from the CEEC.	Yes [Only a few tall native shrubs present]
Important species	NA	-	Twelve or more native (non grass) understorey species present, including at least one 'important' species.	No [9 present, 1 important]
Disturbance	Natural soil and associated seed bank are still or at least partially intact.	Yes [Seed bank likely to be partially intact, although considerably reduced]	Site is still the CEEC even if treeless, provided it has 'an intact native ground layer with a high diversity of native plant species'.	No [Native ground layer depauperate and dominated by exotic species]
Size	Not important	-	At least 0.1 ha with more than 12 native understorey species (not grasses) OR greater than 2 ha with an average of 20+ trees per ha, or active tree regeneration.	No No [Tree densities low, regeneration lacking]

5.1.6 Fauna Habitat

Fauna habitat values for both existing offset areas are relatively low for the following reasons;

- The eucalypt canopy has been substantially thinned in both areas. Nevertheless, the remaining canopy provides habitat for a range of open woodland bird species and foraging opportunities for possums and gliders. In the case of the Belubula River/Flyers Creek area, the often dense River Oak canopy provides shelter for a variety of bird species, especially those associated with aquatic habitats.
- The open grassland areas dominated by exotic species have limited habitat value, except for macropods, granivorous birds such as finches and common insectivorous birds adapted to grasslands such as Yellow-tailed Thornbills and Magpies.
- There are limited opportunities for reptiles with few logs on the ground or surface rocks for habitat on both areas.
- Both areas have retained old growth trees with hollows suitable for a variety of wildlife, but they are scattered in a cleared landscape with limited habitat available to denning or nesting species that depend on woodlands and forests.
- Both areas lack dense shrub cover required by some bird species for nesting and foraging.

5.2 PROPOSED STRATTON VALE REPLACEMENT AREA

5.2.1 Vegetation Communities

The PCTs detailed below are considered closest in floristic composition and site characteristics to those described in the OEH (2014b) Plant Community Types Database.

The vegetation on the proposed Stratton Vale replacement area is fairly uniform (Figure 4, Table 9), and comprises four vegetation communities:

- Yellow Box Woodland (Community 2);
- White Box Woodland (Community 3);
- Derived Grassland (Community 5); and
- Exotic Grassland (Community 6).

The original woodland vegetation on Stratton Vale has been thinned historically and now comprises mostly widely spaced trees separated by grassland dominated by exotic grasses and legumes. The larger treeless areas have been mapped as Exotic Grassland on Figure 4. Some large areas of derived native grassland also occur. These are dominated by grazing-tolerant native species including Speargrass (*Austrostipa scabra*) on dry north-facing slopes and Red Grass (*Bothriochloa macra*) on south-facing slopes.

Table 9
Vegetation Types in the Proposed Stratton Vale Replacement Area

Community No.*	PCT Code	Short Name	Plant Community Type (OEH, 2012)	Dominant Species on Study Areas
2	277	Yellow Box Woodland (Box-Gum Woodland EEC)	<i>Blakely's Red Gum – Yellow Box grassy woodland of the NSW South Western Slopes Bioregion</i>	Yellow Box (<i>Eucalyptus melliodora</i>), Apple Box (<i>Eucalyptus bridgesiana</i>)
3	266	White Box Woodland (Box-Gum Woodland EEC)	<i>White Box grassy woodland on well drained podsolic clay soils on hills in the NSW South Western Slopes Bioregion</i>	White Box (<i>Eucalyptus albens</i>)
5	N/A	Derived Grassland	-	Speargrass (<i>Austrostipa scabra</i>), Red Grass (<i>Bothriochloa macra</i>)
6	N/A	Exotic Grassland	-	Phalaris (<i>Phalaris aquatica</i>), Madrid Brome (<i>Bromus madritensis</i>), Soft Brome (<i>Bromus hordeaceus</i>), Subterranean Clover (<i>Trifolium subterraneum</i>)

* Note: Communities 1 and 4 do not occur in the Stratton Vale investigation area.

5.1.1 Flora Species

The flora species recorded on the proposed Stratton Vale replacement area are given for each quadrat in Appendix 1. A total of 69 flora species was observed on four quadrats and through opportunistic observations. Twenty three native (33.3%) and 46 introduced (66.7%) flora species were identified. The results showed the presence of low numbers of native species and that introduced species greatly predominated.

5.1.2 Noxious Weeds

Three introduced species listed as Class 4 noxious weeds under the NSW *Noxious Weeds Act, 1993* (DPI, 2014) for the Upper Macquarie County Council Area occur on the study area (Appendix 1);

- Bathurst Burr (*Xanthium spinosum*);
- Blackberry (*Rubus anglocandicans*); and
- St. John's Wort (*Hypericum perforatum*).

All noxious weeds occurred only in low numbers indicating they have been well controlled.

5.1.3 Vegetation Condition

'BioMetric' vegetation condition data show that the vegetation was in relatively poor condition (Table 10). The groundcover was in low condition with greater than 50% cover by exotic species for both Yellow Box Woodland (62%) and White Box Woodland (80%) (Table 10). The Yellow Box Woodland met or exceeded only one of the ten benchmarks, native overstorey cover. However, it was very close to the lower benchmarks for groundcover by native grasses, other native groundcover, number of trees with hollows and length of fallen logs. The White Box Woodland at Stratton Vale met or exceeded the benchmarks for native overstorey cover and number of trees with hollows. It was also very close to the benchmark for groundcover by native grasses, but fell well short of five other benchmarks (Table 10).

5.1.4 Threatened Flora

No threatened flora species were identified on the proposed Stratton Vale replacement area.

Two PCTs, Yellow Box Woodland and White Box Woodland are potentially part of the Box-Gum Woodland EEC/CEEC. Whether or not the remnants on the study area are considered part of the Box-Gum Woodland EEC/CEEC depends on whether any patches meet the NSW (NPWS, undated) or Commonwealth (DEH, 2006) identification guidelines for acceptance. The analysis indicates that all Box-Gum Woodland remnants conform to the TSC Act EEC guidelines (Figure 5), but none conform to the EPBC Act CEEC guidelines (Figure 6) owing to the very poor condition of the ground cover (Table 11).

5.1.5 Fauna Habitat

The proposed Stratton Vale replacement area has relatively high fauna habitat values for the following reasons;

- Many of the remnant trees at Stratton Vale are very large and clearly pre-date European settlement. One tree hosts the nest of a Little Eagle (*Hieraetus morphnoides*), listed as Vulnerable under the TSC Act. In addition, many of the White Box trees have hollows suitable for parrots and a nesting population of the Vulnerable Superb Parrot (*Polytelis swainsonii*) is present on and around the investigation area.
- While the groundcover is generally dominated by exotic species, there is a good representation of native perennial grasses, potentially providing habitat for granivorous birds favouring native grass seed, such as finches and the Superb Parrot.
- However, Stratton Vale is lacking in tall and low shrubs that would provide cover and nesting habitat for many birds including finches, babbler, thornbills and others.
- There are limited opportunities for most reptiles owing to very dense exotic grass cover over much of the area and relatively few logs on the ground. However, areas of surface rock on ridges and rock outcrops along Swallow Creek provide reptile habitat.
- Swallow Creek provides water for wildlife and habitat for aquatic fauna.

Table 10
Vegetation Condition Data – Proposed Stratton Vale Replacement Area

Vegetation Type	No. of Replicates	Recorded Values			Benchmarks	
		Lower	Upper	Average	Lower	Upper
Native plant species richness (number of species)						
Yellow Box Woodland	2	8	9	8.5	23	-
White Box Woodland	2	7	8	7.5	23	-
Native overstorey cover (%)						
Yellow Box Woodland	2	39.0	56.5	47.8	8	35
White Box Woodland	2	21.5	48.5	35.0	8	35
Native midstorey cover (%)						
Yellow Box Woodland	2	0	0	0	1	20
White Box Woodland	2	0	0	0	1	20
Native groundcover – grasses (%)						
Yellow Box Woodland	2	10.0	18.0	14.0	15	70
White Box Woodland	2	4.0	24.0	14.0	15	70
Native groundcover – shrubs (%)						
Yellow Box Woodland	2	0	0	0	3	5
White Box Woodland	2	0	0	0	3	5
Native groundcover – other (%)						
Yellow Box Woodland	2	0	4.0	2.0	3	20
White Box Woodland	2	0	2.0	1.0	3	20
Exotic plant cover (%)						
Yellow Box Woodland	2	50.0	74.0	62.0	-	-
White Box Woodland	2	76.0	84.0	80.0	-	-
Number of trees with hollows						
Yellow Box Woodland	2	0	1	0.5	0.8	-
White Box Woodland	2	0	2	1.0	0.8	-
Regeneration (proportion of tree species)						
Yellow Box Woodland	2	0	33.0	16.5	-	-
White Box Woodland	2	0	0	0	-	-
Total length of fallen logs (m)						
Yellow Box Woodland	2	35.1	59.2	47.2	66	-
White Box Woodland	2	30.8	41.7	36.3	66	-

Table 11
Proposed Stratton Vale Replacement Area -
Conformance with Identification Criteria for the Box-Gum Woodland EEC/CEEC

Category	TSC Act		EPBC Act	
	Criterion	Conforms?	Criterion	Conforms?
Native understorey	Any native species present	Yes [Low numbers of grazing tolerant native species are present]	Predominantly native ground cover defined as 'at least 50 percent of the perennial vegetation cover in the ground layer is made up of native species'.	No [Ground cover is dominated by exotics including perennial species]
Resilience	Site is 'likely to respond to assisted natural regeneration'	Yes There is limited potential for recovery of remaining resilient native species]	NA	-
Trees	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	Yes [Yellow Box and White Box present]	Site has, or is likely to have had prior to clearing, White Box, Yellow Box and/or Blakely's Red Gum.	Yes [Yellow Box and White Box present]
Ground cover	Predominantly grassy	Yes [Although mainly exotic species]	Native tussock grasses and herbs, and a sparse, scattered shrub layer.	No [Ground cover dominated by exotics (Table 12)]
Shrubs	'Shrubs are generally sparse or absent, though they may be locally common.'	Yes [Native shrubs absent]	Patches with 'a continuous shrub layer of more than 30 percent cover' are excluded from the CEEC.	Yes [Native shrubs absent]
Important species	NA	-	Twelve or more native (non grass) understorey species present, including at least one 'important' species.	No [Fewer than 12 native ground cover species present on all quadrats (Table 12)]
Disturbance	Natural soil and associated seed bank are still or at least partially intact.	Yes [Only a limited range of resilient species persists]	Site is still the CEEC even if treeless, provided it has 'an intact native ground layer with a high diversity of native plant species'.	No
Size	Not important	-	At least 0.1 ha with more than 12 native understorey species (not grasses) OR greater than 2 ha with an average of 20+ trees per ha, or active tree regeneration.	No No (Trees are sparse)

6 DISCUSSION AND CONCLUSIONS

Owing to similar histories of land use the three areas under investigation have many similarities in vegetation condition;

- All have had their original tree canopies heavily thinned and all have significant grassland expanses where most trees have been removed.
- All areas have virtually no extant tall or low shrubs owing to long histories of intensive livestock grazing and pasture improvement. Although Box-Gum Woodlands are predominantly grassy, they have a moderate shrub cover in their natural state, which provides habitat for a wide range of fauna species.
- Except for some small areas with northern and eastern aspects, the ground cover on all areas was heavily dominated by introduced annual and perennial grasses, and consequently is in 'low' condition as defined in the BioBanking assessment methodology (DECC, 2008b).
- The diversity of native flora was low on all areas.
- The proposed Stratton Vale replacement area has significant numbers of old growth Box trees with hollows suitable for a wide range of wildlife. Logs on the ground are present within patches of remnant woodland vegetation, but are generally absent from open grassland areas. Limited areas of rock outcrop and surface rock suitable for many reptiles are present at Stratton Vale. The Stratton Vale area is notable in having actual breeding habitat for two Vulnerable fauna species, the Little Eagle and the Superb Parrot.
- Owing to the very broad definition of the NSW Box-Gum Woodland EEC, all mapped occurrences of Yellow Box Woodland and White Box Woodland belong to the EEC. By contrast, the very strict Commonwealth Box-Gum Woodland CEEC guidelines mean that no areas investigated met the CEEC guidelines.

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**APPENDIX 1. Flora Species and Cover Abundance on Each Quadrat
[the community number heads each quadrat column]**

Scientific Name	Common Name	Belubula/Flyers			Black Rock		Stratton Vale					
		1	1	2	3	6	2	2	3	3	Opp.	
CLASS FILICOPSIDA												
Pteridaceae												
<i>Cheilanthes sieberi</i>	Poison Rock Fern				1							
CLASS MAGNOLIOPSIDA												
SUBCLASS MAGNOLIIDAE												
Amaranthaceae												
<i>Alternanthera</i> sp. A								1				
Apiaceae												
* <i>Conium maculatum</i>	Hemlock	4	5									
* <i>Torilis nodosa</i>	Knotted Hedge-parsley				1							
Asteraceae												
* <i>Arctotheca calendula</i>	Capeweed							5				
* <i>Carduus pycnocephalus</i>	Slender Thistle	2	3	•	1		•		3	4		
* <i>Carthamus lanatus</i>	Saffron Thistle				1	4				1		
* <i>Chondrilla juncea</i>	Skeleton Weed			•	2	3	•					
* <i>Cirsium vulgare</i>	Spear Thistle		2	•		1	•	2	2	3		
* <i>Conyza sumatrensis</i>	Tall Fleabane	2	2									
* <i>Hypochaeris radicata</i>	Flatweed	1	1			1						
* <i>Lactuca serriola</i>	Prickly Lettuce	1		•		1	•	1		1		
<i>Senecio quadridentatus</i>	Cotton Fireweed	1										
* <i>Silybum marianum</i>	Variegated Thistle	5	1	•		2	•	2	4	3		
* <i>Sonchus asper</i>	Prickly Sowthistle		2									
* <i>Sonchus oleraceus</i>	Common Sowthistle	2	3	•	1			2		2		
* <i>Xanthium spinosum</i>	Bathurst Burr						•			1		
Boraginaceae												
* <i>Echium plantagineum</i>	Paterson's Curse	2	2	•	5	1		1		1		
Brassicaceae												
* <i>Hirschfeldia incana</i>	Hairy Brassica	3	1									
* <i>Lepidium africanum</i>	African Peppergrass							2				
* <i>Raphanus raphanistrum</i>	Wild Radish				1							
* <i>Sisymbrium officinale</i>	Hedge Mustard	3	3	•			•	5	6	5		
Campanulaceae												
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell							1				
Caryophyllaceae												
* <i>Petrorhagia nanteuillii</i>		2			1	1						
* <i>Stellaria media</i>	Common Chickweed	1										
Casuarinaceae												
<i>Casuarina cunninghamiana</i>	River Sheoak	6	8									
Chenopodiaceae												
* <i>Chenopodium album</i>	Fat Hen				1							
* <i>Chenopodium murale</i>	Nettle-leaf Goosefoot									1		
<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Saltbush									2		
Clusiaceae												
* <i>Hypericum perforatum</i>	St. John's Wort	1				3	•					
Convolvulaceae												

Scientific Name	Common Name	Belubula/Flyers			Black Rock		Stratton Vale				
		1	1	2	3	6	2	2	3	3	Opp.
<i>Dichondra repens</i>	Kidney Weed		2	•			•			2	
Crassulaceae											
<i>Crassula sieberiana</i>	Australian Stonecrop							1			
Euphorbiaceae											
* <i>Euphorbia peplus</i>	Petty Spurge	1	1								
Fabaceae: Faboideae											
<i>Desmodium varians</i>	Slender Tick-trefoil				1						
* <i>Medicago polymorpha</i>	Burr Medic	3		•			•	1		3	
* <i>Medicago truncatula</i>	Barrel Medic								2		
* <i>Trifolium angustifolium</i>	Narrow-leaved Clover				1	3			2		
* <i>Trifolium arvense</i>	Haresfoot Clover	2			1			1	2		
* <i>Trifolium campestre</i>	Hop Clover							2	3		
* <i>Trifolium glomeratum</i>	Clustered Clover	1			3			3	2	3	
* <i>Trifolium repens</i>	White Clover		2								
* <i>Trifolium subterraneum</i>	Subterranean Clover	2		•			•	2	3	2	
* <i>Trifolium suffocatum</i>	Suffocated Clover				3	4	•	4	4	4	
Fabaceae: Mimosoideae											
<i>Acacia leucoxyla</i>					4						
Fumariaceae											
* <i>Fumaria capreolata</i>	Climbing Fumitory	4	6								
Geraniaceae											
* <i>Erodium cicutarium</i>	Common Storksbill							1			
* <i>Geranium molle</i>	Cranesbill Geranium						•				
<i>Geranium retrorsum</i>	Common Cranepsbill	3	5	•			•		3	2	
<i>Geranium solanderi</i>	Native Geranium				3						
Goodeniaceae											
<i>Goodenia pinnatifida</i>											•
Lamiaceae											
* <i>Marrubium vulgare</i>	White Horehound				1			2			
* <i>Mentha x piperita nothomorph citrata</i>			4								
* <i>Salvia verbenaca</i>	Vervain		1				•	4	2	1	
<i>Scutellaria humilis</i>	Dwarf Skullcap				2						
Loranthaceae											
<i>Amyema miquelii</i>					3						
Malvaceae											
<i>Brachychiton populneus</i>	Kurrajong				1						
* <i>Malva parviflora</i>	Small-flowered Mallow	3		•			•	4		4	
* <i>Modiola caroliniana</i>	Red-flowered Mallow	1	2	•		2	•	4	1	2	
Myrtaceae											
<i>Eucalyptus albens</i>	White Box				6				8	8	
<i>Eucalyptus bridgesiana</i>	Apple Box			•							
<i>Eucalyptus camaldulensis</i>	River Red Gum	6									
<i>Eucalyptus melliodora</i>	Yellow Box			•			•	6			
Myrsinaceae											
* <i>Anagallis arvensis</i>	Scarlet Pimpernel		2								
Nyctaginaceae											
<i>Boerhavia dominii</i>	Tarvine					2					
Onagraceae											

Scientific Name	Common Name	Belubula/Flyers			Black Rock		Stratton Vale					
		1	1	2	3	6	2	2	3	3	Opp.	
<i>Epilobium billardierianum</i> subsp. <i>cinereum</i>							•					
<i>Epilobium hirtigerum</i>			1									
Oxalidaceae												
<i>Oxalis perennans</i>	A Woodsorrel						•				1	
<i>Oxalis thompsoniae</i>				•		2						
Pittosporaceae												
<i>Bursaria spinosa</i>	Boxthorn											•
Plantaginaceae												
* <i>Plantago lanceolata</i>	Lamb's Tongues	2	2	•							2	
Polygonaceae												
<i>Rumex brownii</i>	Swamp Dock	2		•	1	1	•	1	3			
* <i>Rumex conglomeratus</i>	Clustered Dock		4									
Rosaceae												
<i>Acaena agnipila</i>					1				2			
* <i>Rosa rubiginosa</i>	Sweet Briar	1			1	1						
* <i>Rubus anglocandicans</i>	Blackberry	1	1				•	2				
* <i>Sanguisorba minor</i>	Salad Burnet	1										
Rubiaceae												
* <i>Galium aparine</i>	Goosegrass	1	5	•								
* <i>Sherardia arvensis</i>	Field Madder								1			
Salicaceae												
* <i>Salix viminalis</i>	Basket Willow		2									
Scrophulariaceae												
* <i>Orobanche minor</i>		1					•					
* <i>Verbascum virgatum</i>	Twiggy Mullein	1										
Solanaceae												
* <i>Solanum nigrum</i>	Black-berry Nightshade		1		1			1				
Urticaceae												
<i>Urtica incisa</i>	Stinging Nettle		3									
* <i>Urtica urens</i>	Small Nettle		5	•			•			3		
Verbenaceae												
* <i>Verbena incompta</i>	Purpletop		3									
* <i>Verbena officinalis</i>	Common Verbena	2										
SUBCLASS LILIIDAE												
Cyperaceae												
<i>Carex inversa</i>	Knob Sedge					5	•					
* <i>Cyperus eragrostis</i>	Umbrella Sedge	1	2									
<i>Isolepis hookeriana</i>			2									
Juncaceae												
* <i>Juncus articulatus</i>			2									
<i>Juncus usitatus</i>			1									
Lomandraceae												
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle mat-rush					1						
Poaceae												
<i>Austrostipa bigeniculata</i>												•
<i>Austrostipa scabra</i>	Speargrass							5				•
* <i>Avena barbata</i>	Bearded	2	2									

Scientific Name	Common Name	Belubula/Flyers			Black Rock		Stratton Vale				
		1	1	2	3	6	2	2	3	3	Opp.
<i>*Avena fatua</i>	Wild Oats				1			1			
<i>Bothriochloa macra</i>	Red Grass				1					1	●
<i>*Briza minor</i>	Small Shivery Grass					1					
<i>*Bromus catharticus</i>	Prairie Grass	3	3	●			●	6			
<i>*Bromus diandrus</i>	Great Brome	6	2	●	6	3				6	
<i>*Bromus hordeaceus</i>	Soft Brome	2		●	2	6	●	3	3	2	
<i>*Bromus madritensis</i>	Madrid Brome						●	3	4		
<i>Cynodon dactylon</i>	Couch	3	3								
<i>*Dactylis glomerata</i>	Cocksfoot	2	4					2	2		
<i>Elymus scaber</i>	Wheat Grass					2		1			
<i>*Holcus lanatus</i>	Yorkshire Fog		4								
<i>*Hordeum leporinum</i>	Barley Grass			●	1		●	6	3	6	
<i>*Lolium perenne</i>	Perennial Ryegrass	3		●			●	4	7	6	
<i>*Lolium rigidum</i>	Wimmera Ryegrass	5	3	●	2	2			4	1	
<i>Microlaena stipoides</i>	Weeping Grass					2	●	2	3	1	
<i>Panicum effusum</i>	Hairy Panic					4					
<i>*Paspalum dilatatum</i>	Paspalum	2		●			●				
<i>*Phalaris aquatica</i>	Phalaris	2	3	●		2	●			2	
<i>*Poa pratensis</i>	Kentucky Bluegrass		2								
<i>Poa sieberiana</i>	Snow Grass								2		
<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass				6		●	5	4	5	
<i>Rytidosperma racemosum</i>					1						
<i>*Vulpia muralis</i>						5					
<i>*Vulpia myuros</i>	Rat's Tail Fescue							2			
Total Native Species	43	14			20		23				
Total Introduced Species	76	55			29		46				
Total Species	119	69			49		69				

* = Introduced species; ● = Species present

