

DRAYTON SOUTH COAL PROJECT

Biodiversity Offset Strategy

For:

Hansen Bailey Pty Ltd

April 2015

Final



**PO Box 2474
Carlingford Court 2118**

Report No. 9080RP12

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	18/03/2015	CP	Draft for review by Hansen Bailey
2	17/04/2015	CP	Finalised for adequacy review
3	27/04/2015	CP	Finalised for submission

Approved by: Dr. David Robertson

Position: Director

Signed: 

Date: 27 April, 2015

Table of Contents

1	INTRODUCTION	1
1.1	Purpose	1
1.2	Background	2
1.2.1	The Project	2
1.2.2	Impact Assessment	3
1.2.3	Offsetting Requirements	5
1.3	Report Structure	5
1.4	Related Studies	5
2	LEGISLATIVE FRAMEWORK	6
2.1	EPBC Act Environmental Offsets Policy (2012)	6
2.2	NSW Biodiversity Offsets Policy for Major Projects (2014)	7
3	THE BIODIVERSITY OFFSET PACKAGE	8
3.1	The BOP Components	9
3.1.1	Onsite Offsets	9
3.1.2	Offsite Offsets	10
3.2	Security of the Offset Properties	11
3.3	Cumulative Offsets	12
3.4	Biodiversity Values Assessed Using the BBAM	12
4	CONSERVATION MEASURES	16
4.1	Onsite Offsets	16
4.1.1	Restoration of Saddlers Creek	16
4.1.2	Onsite Conservation of Vegetation	20
4.2	Offsite Offsets	21
4.3	Monitoring and Reference Sites	21
4.3.1	Reference Sites	22
4.3.2	Monitoring	22
4.4	Biodiversity Offset Management Plan	23
4.5	Credit Assessment	25

Table of Contents *(Cont'd)*

5	MINE REHABILITATION OFFSETS	28
5.1	Rehabilitation Objectives	28
5.2	Plant Communities to be Revegetation on Mined Land	29
5.2.1	Completion Criteria	29
5.2.2	Ecosystem Credits to be Created	32
5.3	Likely Success of Rehabilitation	33
5.4	Rehabilitation Monitoring	33
5.5	Rehabilitation Management Plan	33
6	CONSERVATION MEASURES FOR THREATENED SPECIES	34
6.1	Introduction	34
6.2	Diuris tricolor (Pine Donkey Orchid)	34
6.2.1	Conserving an Existing Population within Drayton Wildlife Refuge	34
6.2.2	Protection and Enhancement of Habitat	35
6.2.3	Salvage of Genetic Material	35
6.3	Cymbidium canaliculatum (Tiger Orchid)	35
6.3.1	Conservation within the Offsite Offset	35
6.3.2	Translocating from the Project Disturbance Footprint	35
6.4	Acacia pendula (Weeping Myall)	36
6.4.1	Conservation within the Onsite Offset	36
6.4.2	Propagation Trials	36
6.5	Eucalyptus camaldulensis (River Red Gum)	37
6.6	Tylophora linearis	37
6.7	Large-eared Pied Bat (Chalinolobus dwyeri)	37
7	OFFSET SUMMARY	38
7.1	Native Vegetation	38
7.1.1	Credit Matching Rules for Native Vegetation	40
7.2	Threatened Species	42

Table of Contents *(Cont'd)*

7.3	Conclusion	44
REFERENCES		45
FIGURES		47

List of Appendices

A.	SUMMARY OF OFFSETS FOR MNES
B.	FIELD SURVEY METHODOLOGY
C.	DESCRIPTION OF THE OFFSITE OFFSET PROPERTY
D.	SADDLERS CREEK RESTORATION: HUNTER LOCAL LAND SERVICES AGREEMENT
E.	BIODIVERSITY CREDIT REPORTS

List of Tables

Table 1.1	Ecosystem Credits Required to offset impacts on Native Vegetation and Threatened Species Habitat
Table 1.2	Species Credits Required to offset impacts on Threatened Species
Table 3.1	Areas of Native Vegetation within the Biodiversity Offset Package
Table 4.1	Ecosystem Credits Generated by the Onsite and Offsite Conservation and Restoration Areas
Table 5.1	Plant Community Types to be established on Mine Rehabilitation
Table 5.2	Completion/Relinquishment Criteria for the Mine Rehabilitation
Table 5.3	Benchmark Values for Target PCTs
Table 7.1	Ecosystem Credit Summary
Table 7.2	Ecosystem Credits Applied to Address Project Impacts
Table 7.3	Assessment of Offset Vegetation Types Against Matching Criteria
Table 7.4	Threatened Species Credit Summary

List of Figures

Figure 1	Regional Locality
Figure 2	Conceptual Project Layout
Figure 3	Onsite Offset Areas
Figure 4	Drayton Mine Existing Biodiversity Offsets
Figure 5	Location of the Offsite Offset
Figure 6	Offsite Offset Area
Figure 7	Native Vegetation – Onsite Offset Areas
Figure 8	Native Vegetation – Offsite Offset Area
Figure 9	Threatened Species – Onsite Offset Areas
Figure 10	Threatened Species – Offsite Offset Area

Glossary of Terms

Anglo American	Anglo American Coal
BAP	Biodiversity Action Plan
BBAM	BioBanking Assessment Methodology
BioBanking	A metric approach to assessing the biodiversity values of offset sites.
Biodiversity Credit	A unit measure used in BioBanking and the FBA to quantify biodiversity loss or gain
BOP	Biodiversity Offset Package
Box-Gum Woodland	EPBC-listed CEEC and TSC-listed EEC <i>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i> . Note that this refers collectively to both the woodland and grassland forms of the community.
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
CHPP	Coal handling and preparation plant
DoE	Commonwealth Department of the Environment
DP&E	NSW Department of Planning and Environment (formerly the Department of Planning and Infrastructure)
Drayton Mine	Drayton Mine is an operating coal mine in Coal Lease 229 and is managed by Anglo American. The mine commenced production in 1983 and predominately produces steaming coal for the export market at a maximum of 8 Mtpa of ROM coal
Drayton South	Proposed area for active mining operations in Exploration Licence 5460, including proposed associated infrastructure
Ecosystem Credit	A type of biodiversity credit that uses Biometric Vegetation Types as a surrogate measure of biodiversity value
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i> (under which Development Consent for the Project is sought)
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FBA	Framework for Biodiversity Assessment. This is the metric approach to biodiversity assessment that underpins the NSW Major Projects Biodiversity Offsets Policy (2014)
FM Act	<i>Fisheries Management Act 1994</i>

GIS	Geographic Information System
GPS	Global Positioning System
Hunter LLS	Hunter Local Land Services, formerly the Hunter-Central Rivers Catchment Management Authority
KTP	Key threatening process
LGA	Local Government Area
Locality	Land within 20 km radius of the Project Boundary
Minor additional mining areas	Additional areas at Drayton Mine that will allow for additional mining through the existing industrial dam and to enable establishment of sustainable high walls in the East, North and South Pits
MNES	Matters of National Environmental Significance that are listed in the EPBC Act
Mtpa	Million tonnes per annum
MU	Map unit
North West LLS	North West Local Land Services, formerly the Namoi Catchment Management Authority
NP&W Act	<i>National Parks and Wildlife Act 1974</i>
NSW	New South Wales
OEH	NSW Office of Environment and Heritage, a division of the NSW Department of Premier and Cabinet (formerly the Department of Environment, Climate Change and Water)
PAC	NSW Planning Assessment Commission
PCT	Plant Community Type
PMST	EPBC Act Protected Matters Search Tool
Project Boundary	The Project Boundary encompasses all land required for the Project including the existing Drayton Mine, Drayton South and the transport corridor
Project Disturbance Footprint	The total area within the Study Area that will require clearing for mining and construction, and all infrastructure associated with the Project
ROM	Run of Mine. The raw coal extracted by methods of dragline and blasting
Species Credit	A type of biodiversity credit that represents threatened species values or their specific habitat
SSD	State Significant Development
Study Area	The Study Area comprises an overall area of approximately 4,572 ha and includes the proposed Drayton South disturbance footprint, the transport corridor, the Edderton Road realignment and water pipelines to the Hunter River. This area is the focus of the Biodiversity assessment report. The Study Area excludes the existing Drayton Mine as this area has been the focus of previous assessments
TEC	Threatened Ecological Community listed under the TSC Act and/or EPBC Act

the Project

The Drayton South Coal Project. This is the proposed extension of Drayton Mine and development of a 15 year open cut coal and highwall mining operation with associated infrastructure and services. Collectively encompasses Drayton Mine, Drayton South, the transport corridor which will link the two operational areas, the proposed Edderton Road realignment and water pipelines to the Hunter River. It also includes the minor additional mining areas at Drayton Mine

Threatened species	Flora and fauna listed under the TSC Act, EPBC Act and FM Act
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
VIS	Vegetation Information System

Chapter 1

Introduction

1.1 Purpose

Cumberland Ecology was commissioned by Hansen Bailey on behalf of Anglo American Coal (Anglo American) to complete a biodiversity offset strategy report as part of the Environmental Impact Statement (EIS) for the Drayton South Coal Project (the Project). The Project is classed as a State Significant Development (SSD) under Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This biodiversity offset strategy report aims to evaluate the Project's Biodiversity Offset Package (BOP) against the Project's predicted impacts on biodiversity. Of particular focus are threatened species, populations and ecological communities protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) and the NSW *Fisheries Management Act 1994* (FM Act).

This biodiversity offset strategy report is required to be submitted with the EIS and must apply the BioBanking Assessment Methodology (BBAM) in accordance with the Framework for Biodiversity Assessment (FBA) to quantify the biodiversity gains of the proposed BOP.

The scope of this biodiversity offset strategy report includes:

- Identifying offset lands comprising the proposed BOP;
- Identifying and describing vegetation communities and threatened species habitat occurring on the offset lands;
- Identifying and mapping occurrences of threatened species;
- Broadly describing the conservation measures that will be implemented as part of the BOP;
- Assessing the potential biodiversity gain that could be achieved by applying the BBAM; and
- Evaluating the BOP against the predicted Project impacts under the FBA; and
- Evaluating the BOP against the predicted Project impacts under the Commonwealth offsetting policy.

1.2 Background

1.2.1 The Project

Drayton Mine is located approximately 13 km south of the township of Muswellbrook in the Upper Hunter Valley of NSW (see **Figure 1**). Drayton Mine has been operating in the Muswellbrook community for over 30 years and runs out of coal in 2015.

The Project will allow for the continuation of the existing Drayton Mine for up to 15 years, by developing an open cut mining area within EL 5460. The Project will extract up to 7 Million tonnes per annum (Mtpa) of export quality thermal coal by utilising existing Drayton Mine assets and infrastructure.

The Project was previously submitted for Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) but was refused by the NSW Planning Assessment Commission (PAC).

The current Project addresses the reasons provided by the PAC for the refusal of the previous application. The mine plan is defined by ridgelines nominated in the 'Drayton South Coal Project PAC Review Report' for the previous application issued in December 2013. The Project will remain behind the ridgelines nominated by the PAC. Significantly, this at least doubles the buffer setback distance from the Coolmore and Woodlands thoroughbred horse studs and is at least 2 km from the horse stud operational areas.

The current Project features a Project Disturbance Footprint of 1,441 ha, which represents a 25% reduction in mine footprint compared with the previous application. The current Project Disturbance Footprint of 1,441 ha includes approximately 1,438 ha of vegetated land.

The Project generally includes:

- Continuation of operations at Drayton Mine as currently approved with minor additional mining within the existing East, North and South Mining Areas for a period of 15 years;
- Development of a new open cut mining area with EL 5460 mining up to 6.4 Mtpa Run-Of-Mine (ROM) coal;
- Ongoing employment of a workforce of up to 500 full time equivalent employees;
- Utilisation of the existing Drayton Mine equipment fleet;
- Storage of water, and emplacement of tailings and rejects generated by the Project in existing Drayton Mine voids;
- Utilisation of the existing Drayton Mine infrastructure including the CHPP, rail loop and associated infrastructure, workshops, bath houses and administration offices;
- Construction of a transport corridor to the new mining area;

- Continued utilisation of the Antiene Rail Spur off the Main Northern Railway Line to transport product coal to the Port of Newcastle for export;
- Realigning and upgrading a section of Edderton Road;
- Continuation of mutually beneficial arrangements with neighbours Macquarie Generation and Mt Arthur Coal Mine;
- Installation of further water management and power reticulation infrastructure to support the new mining areas; and
- Progressive rehabilitation of disturbed areas as mining operations are completed.

Figure 2 illustrates the conceptual layout of the Project.

1.2.2 Impact Assessment

The Project was assessed by applying the FBA. This assessment is presented in the EIS biodiversity assessment report in full. A biodiversity credit profile report was generated for the Project, which quantifies the impacts of the Project in terms of biodiversity credits.

The biodiversity credit profile for the Project is summarised in **Table 1.1** and **Table 1.2**. A number of the vegetation types shown in **Table 1.1** are threatened ecological communities (TECs) listed under the TSC Act and/or EPBC Act. Each vegetation type has been assigned a map unit number (MU) for ease of reference. Vegetation types are matched to an approved Plant Community Type (PCT) in the Vegetation Information System (VIS) Classification database, which is administered and maintained by the NSW Office of Environment and Heritage (OEH).

Table 1.1 Ecosystem Credits Required to offset impacts on Native Vegetation and Threatened Species Habitat

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	% Cleared*	Area of Impact (ha)	Ecosystem Credits Required
MU 1	Upper Hunter White Box-Ironbark Grassy Woodland (CEEC/EEC)	1606	HU820	29%	3.8	254
MU 2	Upper Hunter White Box-Ironbark Grassy Woodland Derived Native Grassland (CEEC/EEC)	1606	HU820	29%	2.7	69
MU 3	Hunter Floodplain Red Gum Woodland (CEEC/EEC)	42	HU599	95%	10.9	602
MU 4	Hunter Floodplain Red Gum Woodland Derived Native	42	HU599	95%	4.3	103

Table 1.1 Ecosystem Credits Required to offset impacts on Native Vegetation and Threatened Species Habitat

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	% Cleared*	Area of Impact (ha)	Ecosystem Credits Required
MU 5	Grassland (CEEC/EEC) Central Hunter Box-Ironbark Woodland (EEC)	1691	HU905	79%	150.9	7,961
MU 6	Narrabeen Foothills Slaty Box Woodland (EEC)	1176	HU618	40%	97.0	5,323
MU 7	Central Hunter Bullock Forest Regeneration	1692	HU906	53%	25.9	950
MU 8	Hunter Valley River Oak Forest	485	HU712	50%	2.2	71
MU 9	Cooba Scrub	1691	HU905	79%	0.0	n/a
MU 10	Planted Vegetation	n/a	n/a	n/a	0.0	n/a
MU 11	Other Grassland	1691	HU905	79%	981.0	0
MU 12	Other Grassland	1691	HU905	79%	159.4	0
	Total				1,438	15,333

*This is the percent cleared value of the PCT in the major catchment area

Abbreviations: CEEC = critically endangered ecological community; EEC = endangered ecological community

Table 1.2 Species Credits Required to offset impacts on Threatened Species

Common Name	Scientific Name	Number of Individuals impacted	Species Credits Required
Pine Donkey Orchid	<i>Diuris tricolor</i>	~ 30	390
Tiger Orchid population in the Hunter Catchment	<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	1	10
Weeping Myall population in the Hunter Catchment	<i>Acacia pendula</i> population in the Hunter Catchment	1 patch (15 individuals)	1,155
Total			1,555

1.2.3 Offsetting Requirements

Anglo American is committed to acquiring the required ecosystem and species credits or to implementing supplementary measures in accordance with the FBA (Appendix B, OEH, 2014c), to offset the impacts of the Project. The primary source of credits is intended to be generated from the BOP.

The BOP proposed for the current Project (and which is described in Chapter 3) has been directly applied from the previous Drayton South application. The BOP was accepted as being adequate for the previous application, which has an associated disturbance footprint that is 25% larger than the current Project application.

The BOP was previously assessed against the draft policy statement *Use of environmental offsets under the EPBC Act (2007)* and also under the *Principles for the Use of Biodiversity Offsets in NSW*. The offsetting policies that apply to the current Project application are now the EPBC Act Environmental Offsets Policy (2012) and the NSW Biodiversity Offsets Policy for Major Projects. These policies are briefly described in Chapter 2.

1.3 Report Structure

The remainder of this biodiversity offset strategy report is structured as follows:

- **Chapter 2** Legislative Framework;
- **Chapter 3** The Biodiversity Offset Package;
- **Chapter 4** Conservation Measures;
- **Chapter 5** Mine Rehabilitation;
- **Chapter 6** Conservation Measures for Threatened Species; and
- **Chapter 7** Offset Credit Summary.

1.4 Related Studies

This biodiversity offset strategy report should be read in conjunction with the EIS biodiversity assessment report.

Chapter 2

Legislative Framework

2.1 EPBC Act Environmental Offsets Policy (2012)

The Project was referred to the Commonwealth Minister for the Department of the Environment (DoE) in December 2014 and was subsequently declared a “controlled action” on 4 March 2015, for the following Matters of National Environmental Significance (MNES):

- Nationally threatened species and ecological communities; and
- A water resource, in relation to large coal mining development.

The Project will be assessed under the current assessment bilateral agreement with the NSW Government.

The EIS biodiversity assessment report indicates that there is likely to be residual impacts on MNES if compensatory measures (such as biodiversity offsetting) are not implemented.

To guide the assessment of biodiversity offsets, the Commonwealth Government adopted the EPBC Act Environmental Offsets Policy (the ‘EPBC Act offsets policy’) in October 2012, which replaces the draft policy statement *Use of environmental offsets under the EPBC Act (2007)*.

The EPBC Act offsets policy outlines the Commonwealth Government’s approach to the use of environmental offsets under the EPBC Act and relates to all MNES. The EPBC Act offsets policy applies to offsetting requirements in terrestrial and aquatic (including marine) environments and allows for 90% of offsetting requirements to be addressed by direct offsets (and the remaining 10% to be addressed by indirect offsets).

The evaluation of the BOP in relation to impacts on MNES is presented in **Appendix A** of this biodiversity offset strategy report.

2.2 NSW Biodiversity Offsets Policy for Major Projects (2014)

The NSW Biodiversity Offsets Policy for Major Projects (the 'NSW offsets policy') was adopted in September 2014 and applies to SSD and State Significant Infrastructure (SSI).

The NSW offsets policy is underpinned by the FBA, which is an assessment approach that standardises the methods and procedures for assessing biodiversity impacts on development sites and determining biodiversity offsets for those impacts.

The NSW offsets policy will be implemented for a transitional period of 12-18 months from the 1 October 2014. During this period, proponents and the consent authority will apply the NSW offsets policy to new major projects and certain existing projects in consultation with stakeholders. There will be some flexibility in the policy's application to address any technical or administrative issues.

After the transitional implementation period is lapsed, it is intended that legislative change will be made to formalise the approach to biodiversity assessment and offsetting in the planning approval process.

The FBA requires that the BioBanking Credit Calculator is used by an accredited assessor acting for the proponent, to assess and quantify the biodiversity values of an offset site. The BioBanking Credit Calculator is a web based decision tool that quantifies the biodiversity gain of an offset site using Biodiversity Credits as a unit measure. Since the FBA uses the Credit Calculator to quantify development impacts in terms of Biodiversity Credits, the value of the offsets can be directly compared with the impacts.

Chapter 3

The Biodiversity Offset Package

Anglo American is committed to delivering a substantial offsetting strategy that addresses the residual impacts of the Project. The Project adopts a “maintain or improve” approach to offsetting; this means that the offsetting strategy will aim to achieve no net loss of biodiversity values, including the area and condition of habitat for fauna, over the life of the Project.

The Project adopts a “maintain or improve” approach, which is defined as:

“...increasing the net area and condition of ecological communities within the locality of the proposed development in the medium to long term by permanently conserving and improving the condition of representative examples of vegetation communities and habitats for threatened species that are to be impacted by the proposed development.”

The offset strategy will be prepared in accordance with Anglo American’s internal Biodiversity Performance Standard (2011), which is consistent with the “maintain or improve” approach as it requires that:

- The target of no net biodiversity loss or net positive contribution to biodiversity is to be considered at the operational level based on the biodiversity risk and/or opportunity posed to the business;
- Operational biodiversity action plans should be aligned with National Biodiversity Frameworks and take cognisance of regional and/or local conservation planning frameworks where these exist; and
- Where there is the potential for significant adverse or positive impacts on biodiversity the implications of this risk and/or opportunity facing the operation needs to be assessed and the extent of the risk or opportunity translated into a business case for biodiversity management.

As aforementioned, the BOP proposed for the current Project has been directly applied from the previous Drayton South application, which has an associated disturbance footprint that is 25% larger than the current Project application. The BOP is comprised of a number of onsite conservation areas and also an offsite conservation area. The BOP is described in the following sections.

3.1 The BOP Components

The offset strategy will be focussed on the protection, restoration and maintenance of onsite and offsite conservation lands. These lands and the management of these lands for conservation comprise the Project's BOP.

The BOP has been designed to meet State and Commonwealth offsetting requirements and protect and improve biodiversity within the locality with the most efficient utilisation of resources.

3.1.1 Onsite Offsets

Anglo American is committed to meeting a significant portion of their offset requirements onsite to ensure that favourable biodiversity outcomes are achieved for the immediate region in which the Project is located. The main elements of the onsite offsets are listed below and are shown on **Figure 3**:

- Restoration of Saddlers Creek;
- Conservation of woodland and shrubland vegetation proposed for retention along the primary ridgeline of the Study Area;
- Conservation of remnant woodland in the north-eastern corner of the Drayton South area;
- Establishment of a buffer area around the Saddlers Creek restoration area, and the ridgeline and north-east conservation areas, as recommended by the Department of Planning and Environment (DP&E); and
- Rehabilitation of mined footprint.

The onsite offsets have been developed to maximise the opportunities for conservation *in situ* and will address a significant proportion of the Project's offsetting commitments. Notwithstanding this, the onsite offsets will not meet all of the Project's requirements and additional offsets are necessary to ensure that the Project will not result in a net loss in biodiversity.

Anglo American explored opportunities to expand on Drayton Mine's current offsets, which are proximate to the Study Area. Drayton Mine's current offsetting commitments include the Drayton Wildlife Refuge, which was established and gazetted the Drayton Wildlife Refuge in 1987 under Section 68 of the *National Parks and Wildlife Act 1974* (NP&W Act). The refuge designates specific areas for wildlife conservation whilst reserving other areas for mining and grazing purposes. Following the approval of MOD1 in 2009, two additional offset areas were created; the Modification (or Northern) Offset Area and the Southern Offset Area. Both areas have been incorporated into and managed in accordance with the Drayton Wildlife Refuge (see **Figure 4**).

Further areas of natural remnant vegetation, also referred to as the '*Natural Zone*', are also managed to improve the condition of native flora and fauna.

As such, there is little opportunity to expand on the Drayton Wildlife Refuge. Therefore, Anglo American has decided that offsite offsets should form a second component of the BOP to complement the onsite offsets proposed for the Study Area. Anglo American has acquired an offsite offset property for use as biodiversity offsets.

3.1.2 Offsite Offsets

i. Location

The offsite offset comprises approximately 79% of a 2,079 ha grazing property situated in the undulating hills near the township of Murrurundi in the Liverpool Plains local government area (LGA) (**Figure 5**). It is located approximately 75 km north of the Project Boundary along the New England Highway.

The majority of the offsite offset property is located in the Peel sub-bioregion of Nandewar Bioregion but a small proportion falls within the Hunter sub-bioregion of the Sydney Basin Bioregion. It is within the Liverpool Ranges close to the Pages River, and occurs largely within the Namoi River catchment.

Although the offsite offset property does not adjoin a conservation reserve, several are located within the locality. The closest conservation area is the Murrurundi Pass National Park (215 ha), located approximately 900 m to the south of the property. Towarri National Park (6,074 ha) and Wingen Maid Nature Reserve (1,096 ha) are approximately 10 km and 14 km to the south respectively; and Wallabadah Nature Reserve (1,132 ha) is located approximately 13 km to the north east of the offsite offset property.

ii. General Site Features

The property features relatively steep country that ranges from 500 to 900 metres in elevation and receives a high annual rainfall. The eastern half of the property occurs on soils derived from basalt whilst the western half occurs on soils derived from mudstone. The original woodland and forest vegetation on both the fertile basalt soils and the less fertile mudstone soils have been partially cleared or modified for livestock grazing, particularly sheep grazing.

Two semi-permanent creeks and their tributaries, Chilcotts Creek and Back Creek, flow through the property and contain water for the majority of the year. The property largely drains to the Namoi catchment, although a small proportion of the property is within the Hunter catchment. Dams have been established throughout the property to supply water for livestock.

The property contains over 1,100 hectares of remnant forest and woodland that are dominated by a mixture of box, gum and stringybark eucalypt species. The remainder of the property (approximately 900 hectares) consists of grassland areas. Of this, around 1,600 ha will be dedicated to biodiversity conservation. This vegetation provides large areas of habitat for fauna and support a natural or semi-natural understorey. The habitat values associated with mature remnant forest and woodland on the property include the provision of tree hollows, flowering food resources and shelter.

In addition to this, the property contains frontage to Chilcotts and Back Creeks, the riparian vegetation associated with these creeklines and other permanent watering points such as farm dams.

Large areas of native derived grassland dominated by large tussock grasses such as *Poa labillardieri* (Tussock Grass) also provide foraging habitat for ground-foraging fauna species. Nearby cliff lines and rock outcrops are also habitat attributes that add to value of the property for native fauna. The offsite offset is shown in **Figure 6**.

iii. *Land Use*

The property is currently used for stock grazing (sheep and cattle) and some areas have been improved, producing a mixture of native and improved pastures. Nevertheless, the property is well vegetated and continues to support extensive areas of diverse remnant woodland and open forest with a natural or semi-natural understorey. Natural regeneration of a number of tree species is prolific across the property and regular ringbarking to provide grazing pasture for livestock is evident. Overall, the property has a very good potential for habitat improvement if it becomes managed for conservation rather than farming.

iv. *Detailed Description of the Offsite Offset*

The offsite offset property was subject to baseline flora and fauna survey in 2012, 2013 and 2015. The survey methods are described in **Appendix B**. Detailed descriptions of the offsite offset property are provided in **Appendix C** and include native vegetation, habitat for native species and likelihood of occurrence of threatened species.

3.2 Security of the Offset Properties

The offset lands will be permanently protected by an appropriate mechanism. There are a number of options that are available to permanently protect land for conservation and these include:

- Conservation Agreements, which are a joint agreement between landowners and the Minister for the Environment under the *National Parks and Wildlife Act 1974*;
- Conservation covenants under Section 88 of the *Conveyancing Act 1919*; this is a joint agreement between the landowner and an authorised body;
- Application to change zoning regulation that dictates land use;
- Dedication of land to the National Parks reserve estates; and
- Land acquisition and management of the land under private ownership with conditions of commitment.

The final method of security will be decided on by Anglo American in consultation with OEH and other relevant agencies.

3.3 Cumulative Offsets

All of the mines in the area propose to rehabilitate mined areas and return them to forest and woodland. The mined landscaped will be progressively returned as flora and fauna habitat in the medium to long term.

Additionally, all of the mines have provisions for offsetting ecological impacts. All of the mines will or have purchased additional surrounding lands that contain forest, woodland and threatened derived native grasslands. These will collectively and significantly increase the total areas of native vegetation that exist in the locality in the future and will significantly increase the total area of native vegetation within conservation reserves in the locality.

3.4 Biodiversity Values Assessed Using the BBAM

The BBAM will assess the biodiversity gains in protecting, restoring and enhancing native vegetation types and habitat for native threatened species. There are approximately 15 vegetation types that have been identified in the offset areas. In the onsite offset areas, three remnant and one derived vegetation communities will be conserved in the onsite offsets, two remnant vegetation communities will be rehabilitated on mined lands and non-listed derived native grasslands will be restored or allowed to regenerate to woodland.

In the offsite offset, seven remnant vegetation communities will be conserved and grassland areas will be left to regenerate naturally to woodland and forest vegetation. The total area of each vegetation type has been summarised in **Table 3.1** and the corresponding Biometric Vegetation Type (BVT) shown. The native vegetation in the BOP is shown in **Figure 7** and **Figure 8**.

Threatened species that will be assessed using the BBAM include (**Figure 9** and **Figure 10**):

- One patch of *Acacia pendula* (Weeping Myall) comprising approximately 2 individuals. The exact number of individuals is not known because the species is clonal. The number of individuals has been estimated from the number of clumps recorded in a patch (see EIS biodiversity assessment report);
- One *Eucalyptus camaldulensis* (River Red Gum) on the onsite offset along Saddlers Creek;
- A population of *Diuris triolor* (Pine Donkey Orchid) within the Drayton Wildlife Refuge. The number of individuals is currently being determined; an Expert's Report has been requested and is in preparation;
- Approximately 37 ha of foraging habitat within 500m of breeding habitat of the Large-eared Pied Bat (*Chalinolobus dwyeri*) on the offsite offset;
- One *Cymbidium canaliculatum* (Tiger Orchid) in the offsite offset;

- Approximately five individuals of *Tylophora linearis* in the offsite offset. It is noted that there is likely to be a higher number of individuals present on the offset site that has not yet been detected.

Table 3.1 Areas of Native Vegetation within the Biodiversity Offset Package

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Threatened Ecological Community (TEC)	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	% Cleared*	Condition	Offset Areas (ha)		
							Onsite Offset	Offsite Offset	Mine Rehabilitation
MU 1	Upper Hunter White Box-Ironbark Grassy Woodland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1606	HU820	29%	WL - Mod/Good			
MU 2	Upper Hunter White Box-Ironbark Grassy Woodland Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1606	HU820	29%	GL - Mod/Good - Poor			
MU 3	Hunter Floodplain Red Gum Woodland	- Listed TSC Act, E: Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions - Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	42	HU599	95%	WL - Mod/Good	20.20		
MU 4	Hunter Floodplain Red Gum Woodland Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	42	HU599	95%	GL - Mod/Good - Poor	61.99		
MU 5	Central Hunter Box-Ironbark Woodland	- Listed TSC Act, E: Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	1691	HU905	79%	WL - Mod/Good	112.21		471.12
MU 6	Narrabeen Foothills Slaty Box Woodland (EEC)	- Listed TSC Act, E: Hunter Valley Foothills Slaty Gum Woodland in the Sydney Basin Bioregion	1176	HU618	40%	WL - Mod/Good			655.75
MU 7	Central Hunter Bullock Forest Regeneration	Not listed	1692	HU906	53%	WL - Mod/Good			
MU 8	Hunter Valley River Oak Forest	Not listed	485	HU712	50%	WL - Mod/Good			
MU 9	Cooba Scrub	Not listed	1691	HU905	79%	WL - Mod/Good - Other - Shrubby	34.92		
MU 10	Planted Vegetation	Not listed	na	na	na	na			
MU 11	Other Grassland	Not listed	1691	HU905	79%	GL - Mod/Good - Poor	124.08		
MU 12	Other Grassland	Not listed	1691	HU905	79%	GL - Low	164.08		
MU 13	Silvertop Stringybark - gum open forest on basalts of the Liverpool Range, Brigalow Belt South and Nandewar	Not listed	565	NA353	45%	WL - Mod/Good		70.61	

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Threatened Ecological Community (TEC)	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	% Cleared*	Condition	Offset Areas (ha)		
							Onsite Offset	Offsite Offset	Mine Rehabilitation
MU 14	Silvertop Stringybark grassy open forests, eastern Nandewar and New England Tablelands	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	488	NA359	50%	WL - Mod/Good		243.75	
MU 15	Box - stringybark shrubby woodlands, Brigalow Belt South and Nandewar	Not listed	563	NA393	45%	WL - Mod/Good		268.04	
MU 16	Box - gum grassy woodlands, Brigalow Belt South and Nandewar	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	599	NA257	80%	WL - Mod/Good		54.25	
MU 17	White Box grassy woodland, Brigalow Belt South and Nandewar	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	496	NA414	60%	WL - Mod/Good		172.69	
MU 18	Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	544	NA342	65%	WL - Mod/Good		48.35	
MU 19	River Oak riparian woodland, eastern NSW	Not listed	84	NA191	60%	WL - Mod/Good		13.79	
MU 20	Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	496	NA414	60%	GL - Mod/Good - Poor		676.29	
MU 21	Low Diversity Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland	496	NA414	60%	GL - Low		97.22	
	TOTAL						517.48	1,644.99	1,126.87

*This is the percent cleared value of the PCT in the major catchment area

Chapter 4

Conservation Measures

This chapter broadly outlines the conservation approach for the onsite and offsite offsets and briefly describes the management measures that will be implemented.

The credit results from application of the BBAM to the native vegetation within the offsets are summarised at the end of the chapter. This chapter does not include assessment of the mine rehabilitation offsets; the latter is discussed in the next chapter.

Threatened species values are discussed separately later in this biodiversity offset strategy report.

4.1 Onsite Offsets

4.1.1 *Restoration of Saddlers Creek*

The restoration of Saddlers Creek will involve the retention and improvement of 20 ha of existing Hunter Floodplain Red Gum Woodland (MU 3) that is situated within the immediate vicinity of Saddlers Creek. In addition to this, there is an opportunity to restore an additional 62 ha of Hunter Floodplain Red Gum Woodland through the planting of native vegetation. This restoration work will be carried out in conjunction with the Hunter Local Land Services, or the Hunter LLS (see **Appendix D**). Various aspects of the proposed Saddlers Creek restoration program are discussed below.

i. Wildlife Corridor Values

Connectivity of new and existing offsets will be provided for in the long term through implementation of a connected system of corridors and habitat patches across the Project, and linkages to other wildlife reserves and areas of native habitat in the locality. Wildlife corridors connecting key areas of habitat increase the effective amount of habitat that is available for species and reduces the impacts of habitat fragmentation. This is especially important for migratory animals and those with large home ranges. Larger habitats support greater biodiversity, larger populations, and a wider range of food sources and shelter. Corridors also allow populations to interbreed, improving long-term genetic viability.

The key wildlife corridor being established by the Project is around Saddlers Creek, where the implementation of an intensive creek corridor restoration program will enhance its ability to act as a wildlife corridor. This strategy has been developed in consultation with the Hunter LLS and involves the rehabilitation of the lower reaches of Saddlers Creek to the west of

Edderton Road and restoration of riparian vegetation and Box-Gum Woodland around the core creekline. This will improve the area and condition of existing vegetation communities such as MU 5: Central Hunter Box-Ironbark Woodland and MU 3: Hunter Floodplain Red Gum Woodland in this area.

ii. *Improvement of Creekline Condition and Function*

Due to extensive agricultural practices and erosion, natural recruitment of native plant species along Saddlers Creek is low, and continues to be suppressed by grazing cattle and feral animals. A wide, dense riparian zone comprised of local provenance species will be regenerated along the length of Saddlers Creek to provide habitat for native fauna and flora, stabilise the channel banks and link with already existing communities to form broader habitat corridors. To minimise erosion, the upper banks and flats of Saddlers Creek will be stabilised with rapid growing native groundcover.

The exclusion of stock will be critical for the rehabilitation of vegetation around Saddlers Creek as cattle exacerbate soil erosion by direct soil disturbance from their hooves, and by removing ground cover vegetation that stabilises the soil. Therefore fencing will be installed to exclude stock, but allow native animals to utilise the revegetated areas for forage and nesting habitat and as a movement corridor.

These efforts will collectively enhance the ecological function of Saddlers Creek by:

- Extending riparian communities along the extent of Saddlers Creek and its tributaries that lie within the Study Area. This will improve the habitat and water quality of Saddlers Creek and stabilise highly eroded creek banks;
- Establishing fully viable and self-sustaining ecological communities, such as Central Hunter Box-Ironbark Woodland and Hunter Floodplain Red Gum Woodland, in cleared agricultural areas within the corridor by excluding cattle, implementing assisted natural regeneration methods and supplementary planting from tube stock to create and/or increase structural complexity;
- Building on wildlife movement and offset corridors along Saddlers Creek by linking other parts of the catchment that are already being managed and restored for conservation within land owned by Mt Arthur Coal and Drayton Mine. Extending green corridors from these sites in the north, through the Study Area to the Hunter River in the south, will secure a substantial area of high quality habitat for native fauna that will be conserved in the long-term; and
- Reducing the extent of invasive weed species and feral animal abundance within the Saddlers Creek corridor to both remove pressures from regenerating species and improve native biodiversity in the locality.

Adjacent gullies and watercourses to Saddlers Creek that also are within the Study Area will also be rehabilitated. There may be some potential to return the creeks to close to their natural condition by rehabilitating the incised channels and stabilising 'chains of ponds' where possible.

Some sections of Saddlers Creek still show evidence of this morphology in deep, permanent pools separated by sediment, however most are lacking native vegetation to stabilise the channels and are subject to further degradation by cattle.

Actions to be taken in the restoration of Saddlers Creek and adjacent gullies include:

- Protecting existing ponds from damage by excluding livestock and fencing riparian areas;
- Densely vegetating the instream within phragmites and other aquatic vegetation to trap sediment and prevent erosion;
- Creating pools and sediment bars by creating rock weirs;
- Soil conservation earthworks; and
- Reinstating snags and woody debris to provide habitat complexity for aquatic fauna.

Soil conservation earthworks are required in the proposed Saddlers Creek rehabilitation area to ensure the stability of soils and long term viability of the land. A number of soil conservation measures for Class IV to VII soils, as recommended by the Hunter LLS, will be implemented including graded contour banks and contour ripping. Existing contour banks will be reshaped and extended, or removed if they are no longer functionally viable. Additional low gradient contour banks will be constructed across creek and tributary slopes with the aim of increasing the amount of water retained in the Saddlers Creek catchment. These banks will intercept and slow runoff, spread water across grassed floodplain areas, and will divert flows from degraded areas to minimise channel flow velocity and limit further gully and bank erosion. Graded banks can also help prevent contamination of the waterways by filtering and trapping sediment brought from overland flow, particularly from rills and old gully lines (Department of Environment and Resource Management, 2004).

To enhance the effectiveness of the contour banks, native groundcover plants will be sown between contour banks to reduce run off velocities of water and trap sediment and help reduce their maintenance costs (Department of Environment and Resource Management, 2004). Groundcover species will be locally endemic and suitable for the soil type.

iii. Augmentation of Adjacent Conservation Works

The restoration of the Saddlers Creek corridor and improving the condition of existing vegetation within the immediate vicinity is a valuable compensatory measure as it represents “like for like” or better as an outcome.

Anglo American in association with the Hunter LLS, has established credentials for previous project work with *Eucalyptus camaldulensis* (River Red Gum) restoration along the Hunter River and Dart Brook at the Dartbrook Mine, and has the necessary expertise to conduct this work (see **Section 4.1.1iv** below). Furthermore, there is potential to create a catchment-based offset, which is the Hunter LLS’s approach to land management. This will build on

and complement existing offsets along Saddlers Creek managed by Mt Arthur Coal, and Hunter LLS works in other tributaries of Saddlers Creek.

Mt Arthur Coal's proposed Saddlers Creek Conservation Area is approximately 295 ha in size, and includes the main channel of Saddlers Creek, running along the southern and south eastern boundaries of the Mt Arthur Coal Boundary. By building on Mt Arthur Coal's biodiversity offset areas, the Project will add value and help create a substantial conservation area in the locality that is of ecological significance as it contains:

- Known threatened species;
- Known regionally significant species;
- Presence of a substantial number of tree hollows;
- Known examples of the Tiger Orchid (*Cymbidium canaliculatum*) Endangered Population;
- Riparian corridor values along Saddlers Creek;
- Linkages to Drayton Mine's southern offset area over the offsite portion of Saddlers Creek and proximity to Drayton Wildlife Refuge; and
- Remnants of threatened vegetation communities including:
 - White Box Derived Native Grassland;
 - Hunter Floodplain Red Gum Woodland; and
 - Central Hunter Box - Ironbark Woodland.

iv. *Case Study - Success of Anglo American's Dartbrook River Restoration Project*

In 2005, a joint project between Anglo American and the Hunter LLS was established to improve the health of a 6.5 km section of the Hunter River and Dart Brook, both degraded watercourses in the region, at Dartbrook Mine north of Muswellbrook. The objectives of the 5 year project were various riverbank and stream bed rehabilitation and restoration works at 7 sites that aimed to:

- Protect and enhance a 12 ha area containing one of the largest remaining populations of River Red Gum (*Eucalyptus camaldulensis*), an endangered population in the Hunter Catchment;
- Promote natural regeneration within natural and artificial (through irrigation and bunds) flood areas in conjunction with the planting of 4000 seedlings amidst the remnant population, such that the River Red Gum community is self-sustaining;
- Increase native vegetation density and diversity;

- Provide habitat and a habitat corridor for native fauna, particularly birds, by planting dense patches of habitat species in all strata;
- Minimise further riparian and stream biodiversity loss;
- Manage introduced species and weed infestations;
- Prevent further bank instability and erosion by excluding stock and planting along the riparian corridor; and
- Improve channel bed stability, water quality and flow regimes, protect upstream Chain-of-Ponds streams and restore fish habitat (fish 'hotels') and native fish stocks through the strategic in-stream placement of large logs (with I&I (NSW) and Hunter LLS).

Ongoing management, including periodic inspections by the Hunter LLS and monitoring undertaken by external consultants using methodology determined with the Hunter LLS, has determined that these works are progressing well. Further rehabilitation and restoration works were allowed in 2011, subsequent to completion of the project in 2010, with the renewal of a Scientific Licence issued under Section 132C of the *National Parks and Wildlife Act 1974*. As of the beginning of 2011, successfully completed activities included:

- River Red Gums (*Eucalyptus camaldulensis*) that had naturally regenerated during a 2007 flooding event were found to be thriving within the constructed bunds;
- Tree growth such that tree guards could be removed;
- Strategic removal of Weeping Willows (*Salix* sp.) and the ongoing management of noxious weeds including African Boxthorn, Bathurst Burr and Green Cestrum;
- Trapping of feral pigs, undertaken in conjunction with Livestock Health and Pest Authority (LH&PA);
- Placement of fish hotels;
- Ongoing maintenance including weed and pest control, as well as infill planting in areas that have a low survival rate of seedlings.

Thus, Anglo American has a proven track record for creekline restoration works. The Saddlers Creek Restoration Project will be undertaken by Anglo American in conjunction with the Hunter LLS in a similar partnership as that at Dartbrook Mine and is expected to be effective and deliver on the conservation objectives outlined for the BOP.

4.1.2 Onsite Conservation of Vegetation

In addition to the rehabilitation of native vegetation along Saddlers Creek, approximately 143 ha of existing vegetation along the primary ridgeline and in the north-eastern corner of the Study Area will be conserved, including MU 5: Central Hunter Box-Ironbark Woodland and MU 9: Cooba Scrub. These areas will have direct connectivity with adjacent revegetated

communities established as part of the mine rehabilitation. Areas of native vegetation that will be conserved in the Study Area will be managed for conservation including weed and feral animal control and other management actions as required for maintaining and enhancing their conservation value.

4.2 Offsite Offsets

Approximately 79% of the 2,079 ha grazing property will be dedicated as the offsite offset and be protected for conservation. There is high potential for the regeneration of native vegetation across the offsite offset and there is considerable evidence that grazing lands are actively maintained by such procedures as ringbarking.

Regeneration potential is high for all strata of vegetation including the canopy, subcanopy, understorey and ground stratum. Grasslands are generally dominated by native perennial grasses with various mixtures of native perennial and annual herbaceous plants.

The existing native vegetation within the offsite offset will be managed to allow native vegetation to naturally regenerate. Management measures include:

- Weed and feral animal control;
- Fence and track maintenance;
- Bushfire control;
- Cessation of ringbarking and clearing activities; and
- Removal of grazing.

The offsite offset is very well connected to adjacent blocks of vegetation. The offsite offset also contains frontage to two semi-permanent creeks (Chilcotts Creek and Back Creek) and so enables the protection of valuable riparian and habitat corridors in the catchment.

4.3 Monitoring and Reference Sites

In order to ensure that the biodiversity objectives for the Project are achieved, an ecological monitoring program including the use of reference sites will be developed to record the ongoing status and health of flora and fauna that is to be retained on the Study Area and in the offsite offset areas. This will provide feedback data to determine the level of success of the mitigation and compensation measures implemented for the Project. Such monitoring is typically undertaken using appropriate reference sites that are located away from mining activities to use as a baseline against which to compare the status of habitats in close proximity to mining.

This section discusses these strategies and their applicability to the Project.

4.3.1 Reference Sites

The establishment of reference sites is recommended by the *ICMM Good Practice for Mining and Biodiversity guidelines* to enable impacts resulting from mining to be better understood and quantified (ICMM, 2006). Reference areas serve as a benchmark against which changes in biodiversity over time can be compared (for example, through the use of the BACI before-after/control-impact, approach). This approach collects and compares data from sites before and after the impact has occurred, and also from control (non-impacted) and impacted sites. Reference sites help to determine which changes are directly attributable to the mining operations and which are the results of unrelated outside factors. They are useful in rehabilitation, as they allow a desired endpoint to be set for rehabilitation efforts, and progress towards this endpoint through time can be quantified.

Reference sites for this Project will be selected before construction activities and mining commence. Ideally, locations suitable as reference sites should contain the same ecological community that is being impacted; be in a similar position in the landscape; have similar topography and disturbance history; and not be subject to impacts from the mine (ICMM, 2006). Appropriate locations for reference sites will be determined in consultation with relevant government agencies as part of the finalisation of relevant management plans.

i. Statistical Analysis of Monitoring Data

At each reference site, a range of data will be collected in order to allow comparisons to be made between impacted and non-impacted sites. This would provide an indication of the potential impacts occurring as a result of the Project. The full range of data to be collected at each reference site will be developed to enable statistical analysis of data.

Statistical analysis of data will be an important tool to compare the progress of rehabilitation and restoration works against reference sites. Data will be added to a database annually so that it will form a data matrix that is amenable to appropriate analysis, for example, using classification and ordination techniques, parametric statistics, or Analysis of Similarity.

4.3.2 Monitoring

Monitoring activities will include the monitoring of reference sites as well as monitoring of vegetation communities, populations of threatened flora and fauna on the Study Area and offsets. The monitoring program will track the progress of regeneration of native vegetation in the Study Area and offsets, and will identify problems that require active management, such as infestations of weeds and feral animals, or failure of some areas of plant species to regenerate.

This section considers the broad principles to be considered for ecological monitoring programs; more detailed specifications for ecological monitoring will be contained in the future management plans.

i. Vegetation Monitoring

A vegetation monitoring strategy will be established to determine the magnitude of the ecological impacts from mining activities on the various flora and fauna species known or likely to occur in the Study Area, and their habitats. The monitoring program would provide information to quantify the change in biodiversity over time within the Study Area. It is proposed that monitoring sites be established in areas of vegetation both inside and outside of the disturbance area and in designated reference sites. Regenerated areas are also proposed to be monitored in the long term to allow changes in species composition and structure over time to be quantified. Information should be used in adaptive management, in order to continually improve the outcomes of the rehabilitation and land management strategy. Appropriate data management procedures will be implemented to ensure that all data is collected using appropriate techniques and suitably analysed to allow meaningful spatial and temporal comparisons to be made.

ii. Threatened Species Monitoring

Monitoring will be undertaken on selected threatened species of flora and fauna, in order to determine whether populations are being adversely affected by the Project.

Threatened species monitoring will:

- Enable the identification of the impacts of the Project on threatened species;
- Identify changes in population numbers over time;
- Determine the success of impact mitigation and conservation measures; and
- Highlight areas for improvement if these measures are found to be inadequate.

Threatened species monitoring will involve conducting targeted threatened species surveys in areas of known habitat in order to record the abundance of selected species. This should include both flora and fauna species. The level of monitoring effort would be determined according to risk level and biology of the particular species in question (e.g. coordinating with breeding or movement times).

4.4 Biodiversity Offset Management Plan

Site-specific Biodiversity Offset Management Plans (BOMPs) will be prepared as part of the BOP to prescribe ongoing management actions for the onsite offsets and offsite offset property. This is a key component of the BOP to ensure that the biodiversity values of the Project's offsets can be maintained and improved.

Each BOMP will explain the key management approaches and expected gains of the onsite and offsite offsets and prescribe a suite of measures that will be implemented. The BOMP will contain a description and plan of conservation measures (long and short term) and will include measures to protect local biodiversity values and address specific values of significance such as the occurrence of threatened species. The BOMP will include details of

appropriate areas for rehabilitation and conservation, details of revegetation priorities and techniques, reference sites, monitoring methodology and key performance indicators against which to measure progress, and specify appropriate review periods where progress is reviewed and the BOMP updated as required.

The key objective of the BOMP will be to improve the condition of existing vegetation and to increase the area of Box-Gum Woodland and species habitat so that a gain in biodiversity value can be achieved. This includes the following specific aims:

- Maintenance and improvement of the condition of existing forest and woodland within all offset areas, specifically to improve conditions for threatened flora and fauna;
- Maintenance and improvement of derived native grassland areas to promote, through management of grazing pressure, natural succession towards woodland and or open forest;
- Rehabilitation of selected areas of low diversity native grassland by replanting trees and shrubs to promote a more rapid regeneration towards forest or woodland; and
- Improvement of habitat connectivity across offset lands, and from offset lands to adjacent native vegetation and mine rehabilitation in order to improve wildlife movement in the long term.

The BOMP will also be designed in accordance with the latest offset management guidelines made available by DoE. As such, the BOMP will include:

- A description of the threatened species and habitats within the offsite offset;
- A description of the freshwater habitats present;
- An assessment of the general condition and extent of the offset area and the identification of the key threats and risks;
- An assessment of the capacity of the offsite property for natural regeneration from soil seed banks and adjacent seed sources;
- A prescription of the most appropriate measures to restore forest, woodland and aquatic habitats;
- A prescription of an appropriate monitoring programme and adaptive management strategies;
- Details of appropriate timeframes and achievable completion criteria to allow Anglo American to effectively plan, cost, measure and monitor the progress of the management works; and
- Details of the auditing and reporting arrangements for the BOMP.

All restoration works will be conducted generally in accordance with any restoration and biodiversity enhancement guidelines that may be made available by DP&E and OEH. Some of the measures that will be employed to promote successful regeneration of woodland and forest will include weed and feral animal management, phased reduction of livestock management, track and trail management, active replanting and reseeding of vegetation within selected areas and monitoring; fire management; and ongoing monitoring. These will be guided by best practice guidelines and will be consistent with the desired outcomes of the National Recovery Plan for Box-Gum Woodland and Derived Native Grassland (DECCW, 2011) and incorporated as appropriate into the BOMP.

The offset properties contain extensive areas of existing woodland and open forest that will form nuclei for ongoing regeneration of trees and shrubs into grassland areas. Such habitats will provide immediate and ongoing habitats for native plants and animals. Existing forest and woodland areas are currently mature, functioning examples of natural ecosystems, but their condition is expected to improve with time as trees mature, tree hollows are generated and as regeneration of understorey takes place when livestock grazing techniques are implemented (McIntyre *et al.*, 2002).

Derived native grasslands conforming to Box-Gum Woodland within the offsite offsets exhibit significant floral diversity, including scattered trees and shrubs. It is intended that grazing management, combined with the management of weeds and feral animals will be able to accelerate regeneration of these grassland areas to forest and woodland areas. Such habitats are semi-natural and cannot currently be considered fully functional as they generally lack trees and shrubs. However, in the medium to long term, trees and shrubs are expected to regenerate into such areas if the condition of the land is improved through grazing and weed management (Lindenmayer *et al.*, 2010). It is expected that substantial regeneration will occur within the life of the Project and a mature, functional ecosystem will be established across much of these grassland areas within 50 years.

Low diversity native grasslands have low diversity of native ground covers and essentially no trees and shrubs. There are very few areas of low diversity native grasslands in the portion of the offsite offset property that will be reserved for conservation. Nevertheless, trees and shrubs will be planted into such areas to form nuclei of regenerating woody habitats that will then be able to progressively grow back into woodland or open forest. Replanting of such areas will take place early in the life of the Project (within the first five years) and it is expected that substantial regeneration of woody plants will occur within the life of the Project.

4.5 Credit Assessment

This section summarises the credit profile that can be generated for the conservation management of native vegetation and threatened species habitat on onsite and offsite offsets, excluding mine rehabilitation areas. The Biodiversity Credit Profile reports are provided with this biodiversity offset strategy report (**Appendix E**). Biometric plot and transect data, field data sheets, and spatial layers used in the Credit Calculator can be provided upon request.

Table 4.1 Ecosystem Credits Generated by the Onsite and Offsite Conservation and Restoration Areas

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Threatened Ecological Community (TEC)	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	% Cleared*	Condition	Onsite Offset		Offsite Offset		Total Ecosystem Credits
							Area (ha)	Ecosystem Credits	Area (ha)	Ecosystem Credits	
MU 1	Upper Hunter White Box-Ironbark Grassy Woodland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1606	HU820	29%	WL - Mod/Good					
MU 2	Upper Hunter White Box-Ironbark Grassy Woodland Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1606	HU820	29%	GL - Mod/Good - Poor					
MU 3	Hunter Floodplain Red Gum Woodland	- Listed TSC Act, E: Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions - Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	42	HU599	95%	WL - Mod/Good	20.20	254			254
MU 4	Hunter Floodplain Red Gum Woodland Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	42	HU599	95%	GL - Mod/Good - Poor	61.99	456			456
MU 5	Central Hunter Box-Ironbark Woodland	- Listed TSC Act, E: Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	1691	HU905	79%	WL - Mod/Good	112.21	1,237			1,237
MU 6	Narrabeen Footslopes Slaty Box Woodland (IEEC)	- Listed TSC Act, E: Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	1176	HU618	40%	WL - Mod/Good					
MU 7	Central Hunter Bullock Forest Regeneration	Not listed	1692	HU906	53%	WL - Mod/Good					
MU 8	Hunter Valley River Oak Forest	Not listed	485	HU712	50%	WL - Mod/Good					
MU 9	Cooba Scrub	Not listed	1691	HU905	79%	WL - Mod/Good - Other - Shrubby	34.92	324			324
MU 10	Planted Vegetation	Not listed	na	na	na	na					
MU 11	Other Grassland	Not listed	1691	HU905	79%	GL - Mod/Good - Poor	124.08	973			973
MU 12	Other Grassland	Not listed	1691	HU905	79%	GL - Low	164.08	802			802
MU 13	Silvertop Stringybark - gum open forest on basalts of the Liverpool Range, Brigalow Belt South and Nandewar	Not listed	565	NA353	45%	WL - Mod/Good			70.61	628	628

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Threatened Ecological Community (TEC)	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	% Cleared*	Condition	Onsite Offset		Offsite Offset		Total Ecosystem Credits
							Area (ha)	Ecosystem Credits	Area (ha)	Ecosystem Credits	
MU 14	Silvertop Stringybark grassy open forests, eastern Nandewar and New England Tablelands	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	488	NA359	50%	WL - Mod/Good			243.75	2,420	2,420
MU 15	Box - stringybark shrubby woodlands, Brigalow Belt South and Nandewar	Not listed	563	NA393	45%	WL - Mod/Good			288.04	2,748	2,748
MU 16	Box - gum grassy woodlands, Brigalow Belt South and Nandewar	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	599	NA257	80%	WL - Mod/Good			54.25	488	488
MU 17	White Box grassy woodland, Brigalow Belt South and Nandewar	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	496	NA414	60%	WL - Mod/Good			172.69	1,748	1,748
MU 18	Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	544	NA342	65%	WL - Mod/Good			48.35	471	471
MU 19	River Oak riparian woodland, eastern NSW	Not listed	84	NA191	60%	WL - Mod/Good			13.79	128	128
MU 20	Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland - Listed EPBC Act, CE: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	496	NA414	60%	GL - Mod/Good - Poor			676.29	7,639	7,639
MU 21	Low Diversity Derived Native Grassland	- Listed TSC Act, E: White Box Yellow Box Blakely's Red Gum Woodland	496	NA414	60%	GL - Low			97.22	908	908
	TOTAL						517.48	4,046	1,644.99	17,178	21,224

*This is the percent cleared value of the PCT in the major catchment area

Chapter 5

Mine Rehabilitation Offsets

5.1 Rehabilitation Objectives

The Project Disturbance Footprint will be progressively rehabilitated over the life of the Project. Approximately 1,127 ha of the Project Disturbance Footprint will undergo ecological rehabilitation and be included in the BOP. The remaining areas of the Project Disturbance Footprint will be rehabilitated and returned to other land uses.

The principle objective of rehabilitating the mine footprint for inclusion in the BOP will be to establish to the extent possible, through revegetation and rehabilitation strategies, self-sustaining and recognisable vegetation types that will be lost from the Project Disturbance Footprint.

The rehabilitation offset will aim to establish native vegetation that is self-sustaining in the long term and is capable of supporting a diverse range of viable flora and fauna populations. The rehabilitation offset will also contribute to maintaining a vegetated landscape in the Study Area in the long term that provides a “stepping stone” corridor between larger remnant patches of vegetation in the locality (DSE (VIC), 2008).

The importance of maintaining treed habitats in disturbed landscapes as corridors for fauna movement and seed dispersal is well-known (Cooper *et al.*, 2002; Fischer and Lindenmayer, 2002; DSE (VIC), 2008; Goldingay and Taylor, 2009). “Stepping stones” have been shown to be important in maintaining landscape connectivity and maintaining gene flow between separate populations because it facilitates the movement of pollen and seed vectors such as animals and insects (Lindenmayer, 2006).

Rehabilitation trials of targeted vegetation communities are soon to commence at Drayton Mine to ensure efforts on the Drayton South disturbance footprint are successful.

5.2 Plant Communities to be Revegetation on Mined Land

The rehabilitation of mined land will involve the revegetation of approximately 471 ha of MU 5: Central Hunter Box-Ironbark Woodland and approximately 656 ha of MU 6: Narrabeen Foothills Slaty Box Woodland (**Table 5.1**). These vegetation types currently occur within the Project Disturbance Footprint and so the establishment of these vegetation types in the mine rehabilitation area is intended to address the loss of these communities from the Study Area.

Table 5.1 Plant Community Types to be established on Mine Rehabilitation

Map Unit (MU)	Vegetation Map Unit name, as referred to in this Biodiversity Offset Strategy report	Plant Community Type (PCT)	Biometric Vegetation Type (BVT)	Area (ha)
MU 5	Central Hunter Box-Ironbark Woodland	1691	HU905	471.1
MU 6	Narrabeen Foothills Slaty Box Woodland	1176	HU618	655.8
TOTAL				1,127

5.2.1 Completion Criteria

The completion criteria specified for the target vegetation types to be rehabilitated are detailed in **Table 5.2** below. The level of increase in the site attribute condition scores predicted for each completion criteria is also set out in **Table 5.2**. The site attribute benchmarks referred to in the completion criteria are detailed in **Table 5.3** for each vegetation type to be rehabilitated.

Table 5.2 Completion/Relinquishment Criteria for the Mine Rehabilitation

Site Attribute	Calculated Increase in Site Attribute Condition Score	Required Completion/relinquishment Criteria
Native plant species richness	0.5	The rehabilitation will achieve >25% of the native plant species richness benchmark for the nominated PCT. Only plant species characteristic of the target PCT may be counted towards native plant species richness.
Over-storey cover	1	The rehabilitation will achieve >25% and <200% of the percent native over-storey cover benchmark for the nominated PCT. Only over-storey plant species characteristic of the target PCT may be counted towards percent native over-storey cover.

Table 5.2 Completion/Relinquishment Criteria for the Mine Rehabilitation

Site Attribute	Calculated Increase in Site Attribute Condition Score	Required Completion/relinquishment Criteria
Mid-storey cover	1	The rehabilitation will achieve >25% and <200% of the percent native mid-storey cover benchmark for the nominated PCT. Only mid-storey plant species characteristic of the target PCT may be counted towards percent native mid-storey cover.
Native ground cover (grasses)	1	The rehabilitation will achieve >25% and <200% of the percent native ground cover (grasses) benchmark for the nominated PCT. Only native ground cover (grasses) plant species characteristic of the target PCT may be counted towards percent native ground cover (grasses).
Native ground cover (shrubs)	1	The rehabilitation will achieve >25% and <200% of the percent native ground cover (shrubs) benchmark for the nominated PCT. Only native ground cover (shrubs) plant species characteristic of the target PCT may be counted towards percent native ground cover (shrubs).
Native ground cover (other)	1	The rehabilitation will achieve >25% and <200% of the percent native ground cover (other) benchmark for the nominated PCT. Only native ground cover (other) plant species characteristic of the target PCT may be counted towards percent native ground cover (other).
Exotic plant cover	0.5	No increase in site score has been awarded for management of exotic plant cover because of the recognised difficulty in managing ground cover from mine rehabilitation. However, rehabilitation must aim to maintain the exotic plant at <60%. Exotic plant cover must be calculated as a percentage of the total ground and mid-storey cover. Exotic plant cover is measured as total percent foliage cover of all exotics in all strata.
Number of trees with hollows	0	No natural formation of tree hollows is expected within 15 years (life of mine). However, stags brought onto the site from an adjoining development area already containing hollows and properly secured may be used as habitat augmentation for this attribute. The number of hollow bearing stags will be >25% of the number of hollow bearing trees benchmark for the nominated PCT.

Table 5.2 Completion/Relinquishment Criteria for the Mine Rehabilitation

Site Attribute	Calculated Increase in Site Attribute Condition Score	Required Completion/relinquishment Criteria
Over-storey regeneration	0.5	At least 25% of over-storey species for the nominated PCT are naturally regenerating. Over-storey regeneration is when a second generation of over-storey plants naturally regenerates on the site as a result of reproduction of established over-storey species. Over-storey regeneration does not include juvenile or young plants which have been planted or seeded. Over-storey regeneration must be present across the vegetation zone.
Total length of fallen logs	0	No development of woody ground debris from natural senescence of tree limbs is expected within 15 years (life of mine). However, active placement of logs that are brought onto the site from an adjoining development area and are placed in a configuration that reflects natural systems can be used as habitat augmentation. The length of coarse woody debris will be >25% of the total length of fallen logs benchmark for the nominated PCT.

Table 5.3 Benchmark Values for Target PCTs

	MU 5: Central Hunter Box-Ironbark Woodland (PCT 1691)	MU 6: Narrabeen Footslopes Slaty Box Woodland (PCT 1176)
Biometric Vegetation Type (BVT)	HU905	HU618
Native plant species	≥ 41	≥ 25
Native over-storey cover	15.0 to 40.0	20.0 to 50.0
Native mid-storey cover	5.0 to 20.0	10.0 to 60.0
Native ground cover (grass)	30.0 to 50.0	5.0 to 15.0
Native ground cover (shrubs)	5.0 to 10.0	5.0 to 10.0
Native ground cover (other)	20.0 to 40.0	5.0 to 15.0
Exotic plant cover	See Manual	See Manual
Number of trees with hollows	≥ 3	≥ 0
Over-storey regeneration	1	1
Total length of fallen logs	≥ 5	≥ 66

5.2.2 Ecosystem Credits to be Created

Mine rehabilitation offsets should generate less ecosystem credits than offsets containing existing vegetation in order to account for the uncertainty of ecological restoration on mined lands. The FBA requires that a scaling factor is applied to reduce the total credit output but this factor needs to be calculated manually because the BioBanking credit calculator does not include a function to do this.

Equation 7 of the FBA (OEH, 2014b) sets out how ecosystem credits are to be calculated for mine rehabilitated lands. A scaling factor of 0.25 is included in the equation.

Equation 7

$$\text{Number of Ecosystem credits created on post mined land} = \sum_{i=1}^n \{\Delta S_{rehab} \times A\} \times 0.25$$

Where

i is the i th vegetation zone to be managed on rehabilitated mining land

ΔS_{rehab} is the future site score for the PCT to be created on the rehabilitated mining land

A is the area of the land in hectares for the PCT that is to be created

MU 5 (HU905) and MU 6 (HU618) will be rehabilitated on post mined land. There is one vegetation zone per PCT. Site attribute values at the commencement of rehabilitation were assumed to be zero (except for exotic cover, which was assumed to be 3 or greater) and therefore the overall site value score at the commencement of rehabilitation was set at zero.

The calculated future site value score (also referred to as the gain in site value) was applied to the above equation to calculate the number of ecosystem credits to be generated by the mine rehabilitation offset.

The gain in site value (i.e. vegetation condition) that has been calculated from the predicted increase in site attribute scores under rehabilitation management is:

- MU 5 (HU905) = 11.20; and
- MU 6 (HU 618) = 14.33.

Thus, using Equation 7 of the FBA:

Ecosystem credits (HU905) = $\{11.20 \times 471.12\} \times 0.25 = \mathbf{1,319}$ (to nearest whole credit value)

Ecosystem credits (HU618) = $\{14.33 \times 655.75\} \times 0.25 = \mathbf{2,349}$ (to nearest whole credit value)

The ecosystem credits were calculated using Equation 7 of the FBA Operational Manual (OEH, 2014b) and therefore, the scaling factor of 0.25 for rehabilitation of mined land has been applied.

5.3 Likely Success of Rehabilitation

The proposed vegetation conservation and rehabilitation measures have been designed to produce measurable biodiversity outcomes and are based on recognised principles of rehabilitation and land management (McIntyre *et al.*, 2002). Despite this, it is difficult to predict how long it will take a given rehabilitation area to regenerate into a fully functioning ecosystem, as this is dependent on many factors including disturbance history, proximity of nearby remnant vegetation, condition of the soil and the management regime implemented. There are few areas of mature rehabilitation in Australia, which means that there is little information currently available on the long-term ecological development of rehabilitated communities (Nichols, 2005; Nichols *et al.*, 2005). Due to the inherent variability of ecological systems, the ability to predict long-term successional trends in rehabilitation is low, and it is difficult to accurately predict the composition and structure of vegetation beyond 10 years (Nichols, 2005). Nevertheless, it is clear that ceasing agricultural activities and the implementation of appropriate management techniques such as weed control and supplementary planting have the potential to substantially increase biodiversity.

5.4 Rehabilitation Monitoring

Monitoring of the condition of rehabilitated vegetation is generally covered under monitoring as described in **Section 4.3.2**. Monitoring of rehabilitation offsets will aim to track the progress of rehabilitation works against ecological completion criteria and to facilitate the early detection of factors that may be impeding successful establishment and development of revegetated ecological communities.

5.5 Rehabilitation Management Plan

Information regarding the preparation of rehabilitation sites, substrate and landform reconstruction, planting and species mixes, seed sourcing and scheduling, post establishment activities and reporting requirements should be detailed in a comprehensive rehabilitation management plan.

Chapter 6

Conservation Measures for Threatened Species

6.1 Introduction

This chapter examines conservation measures for threatened species that have potential to be impacted by the Project, or which have been recorded in the Project's offset areas. The chapter discusses measures including salvage of genetic material from areas that will be cleared, conservation of existing occurrences in offset areas, and translocation and propagation measures.

6.2 *Diuris tricolor* (Pine Donkey Orchid)

6.2.1 *Conserving an Existing Population within Drayton Wildlife Refuge*

A known population of *Diuris tricolor* occurs in the Drayton Wildlife Refuge. Since a wildlife refuge may be revoked at any time, Anglo American is willing to secure the area of the Drayton Wildlife Refuge supporting the *Diuris tricolor* population under an additional conservation mechanism, such as a Conservation Agreement under Part 4, Division 12 of the NP&W Act or a Biobanking Agreement under Part 7A, Division 2 of the TSC Act. It is recognised that in doing so, the local occurrence of the species will be protected in perpetuity. Anglo American plans to consult with OEH and other relevant agencies to progress the matter.

To ascertain the size of the population of *Diuris tricolor* within the wildlife refuge, it is necessary to conduct targeted surveys in September or early October. Surveys cannot be completed in time for inclusion in this biodiversity offset strategy report. For this reason, the size of the *Diuris tricolor* population within the Drayton Wildlife Refuge will be estimated from an expert's report in accordance with Section 6.6.2 of the BBAM Operational Manual (OEH, 2014b).

An Expert's Report has been requested and is in preparation to determine the number of individuals that are likely to be present in the Drayton Wildlife Refuge.

6.2.2 Protection and Enhancement of Habitat

To protect remaining areas of suitable habitat for *Diuris tricolor* in the Study Area, Anglo American is proposing to undertake substantial restoration work along Saddlers Creek as part of offsetting measures (see **Section 4.1.1**).

These measures will restore, increase and protect suitable *Diuris tricolor* habitat in the Study Area and contribute to the recovery of the species in the Hunter subregion.

6.2.3 Salvage of Genetic Material

The possibility of translocating *Diuris tricolor* from the Project Disturbance Boundary to conservation areas will be considered by Anglo American; however, it is noted that because translocation of ground orchids is difficult (Vallee *et al.*, 2004; Sommerville *et al.*, 2013) it is unlikely to be successful. Seed and tissue propagation trials will be conducted of the *Diuris tricolor* population within the Project Disturbance Footprint. This will utilise genetic material that will be collected prior to clearing, to ensure local genetic diversity is not lost.

6.3 Cymbidium canaliculatum (Tiger Orchid)

6.3.1 Conservation within the Offsite Offset

One individual *Cymbidium canaliculatum* (Tiger Orchid) will be conserved in the Project's offsite offset area. The individual has been assessed using the BBAM.

The species credits generated from the conservation of this individual is seven species credits.

6.3.2 Translocating from the Project Disturbance Footprint

Translocation of *Cymbidium canaliculatum* in the Project Disturbance Footprint will be undertaken to address the Project impacts on the species, as recommended by OEH. Epiphytic orchids typically have a high chance of successful translocation (Vallee *et al.*, 2004; Tremblay, 2008). Mangoola Coal, working with experts in the field, is in the process of developing best practice procedures for the salvage and translocation of a large number of *Cymbidium canaliculatum* from their approved disturbance area to suitable host trees in nominated Biodiversity Offset Areas. Monitoring of already translocated individuals indicates they are in good health (Umwelt, 2013).

Although translocation of *Cymbidium canaliculatum* has been successful to date, Mangoola Coal also experimented with propagation techniques for *Cymbidium canaliculatum* to ensure that the population is maintained in the event that the translocated individuals fail. In 2013, tubers from one *Cymbidium canaliculatum* were subdivided into 12 individual plants using a variety of growth mediums including woody debris, potting mix and wood chips. Ten out of the 12 plants have survived and healthy plants were relocated into the Mangoola Coal offset area in 2014 during the cooler months (SLR, March 2014). Subdivision using tubers may present a potential propagation process that can be utilised for individual plants that may not be salvageable.

Considering the above, Anglo American is committed to the translocation of the *Cymbidium canaliculatum* individual from the Project Disturbance Footprint to a suitable conservation area. Translocation would be to suitable remnant woody vegetation in a recipient site as close as possible to the location where the plant naturally occurs. Options include the proximate Drayton Wildlife Refuge or primary ridgeline, subject to the availability of a suitable mature host tree.

Anglo American will consult with Mangoola Coal and appropriate experts regarding best practice for the translocation and possible propagation of *Cymbidium canaliculatum*. Translocation will be conducted according to the ANPC best practice guidelines, 'Guidelines for the Translocation of Threatened Plants in Australia' (Vallee *et al.*, 2004) to ensure successful translocation of the species. Translocation of this species will ensure the individual and local occurrence of the species still remains within the Hunter catchment, and will be subject to protection mechanisms to be applied to the Project's offset lands.

6.4 *Acacia pendula* (Weeping Myall)

6.4.1 *Conservation within the Onsite Offset*

One extant patch of *Acacia pendula* comprising two individuals will be retained near the Saddlers Creek restoration area and will not be cleared by the Project. It will be included within the Saddlers Creek restoration area and be permanently protected as part of that offset area.

The species credits generated from the conservation of this patch is 71 species credits.

6.4.2 *Propagation Trials*

Anglo American has considered options to translocate individuals of *Acacia pendula* (Weeping Myall) within the Project Disturbance Footprint. However, translocation is not considered to be a viable option for this species as it is known to be very difficult and is unlikely to succeed.

It is proposed that propagation trials be undertaken for *Acacia pendula* (Weeping Myall) found within the Project Disturbance Footprint. For many *Acacia* species, propagation from seed is a reliable method (ANPS, 2006; ANPS, 2010; Simmons, 2012) and such trials would increase our knowledge of the biology of the species and retain the local genetic diversity of this disjunct population. However, it is acknowledged that the endemic form of *Acacia pendula* (Weeping Myall) is commonly known to be poor seeders (Bell *et al.*, 2007) and the likelihood of success under the current available information appears to be uncertain.

It is therefore proposed that propagation trials include use of rootstock material and top soil. Since *Acacia pendula* (Weeping Myall) is known to principally reproduce colonially via suckering from rootstock, there is an opportunity to introduce the species to offset areas using root material. Propagation from root stock and top soil of other *Acacia* species, such as *Acacia ausfeldii*, has been successfully undertaken at Ulan Coal Mine. Both the removal and translocation of 100-150mm of top soil and the stripping of 150-300mm of sub-soil root

zone has stimulated the establishment of 28 new *Acacia ausfeldii* plants (Ulan Coal Mines Limited, March 2013). The general disturbance from translocation is also thought to have promoted propagation (Eco Logical, 2014). The viability of this propagation process at recipient sites would be subject to monitoring and adaptive management.

6.5 *Eucalyptus camaldulensis* (River Red Gum)

Eucalyptus camaldulensis comprises an endangered population within the Hunter catchment area. One individual has been recorded within the Saddlers Creek restoration area and will be conserved as part of that offset area. Additional individuals will be planted along Saddlers Creek as part of the restoration program for that offset area.

The BBAM assesses the biodiversity gain for the conservation of one existing individual. The species credits generated from the conservation of this individual is 7 credits.

6.6 *Tylophora linearis*

Tylophora linearis is twining herb that is Vulnerable under the TSC Act and Endangered under the EPBC Act. Recent survey of the offsite offset detected at least five individuals within grassy stringybark open forest vegetation (see **Appendix C**). There is likely to be more occurrences on the offsite offset that has not yet been detected.

The BBAM has been applied to assess the biodiversity gain from the protection of five known individuals. The species credits generated from the conservation of this individual is 36 credits.

6.7 Large-eared Pied Bat (*Chalinolobus dwyeri*)

Rock outcrops with minor cliffs and caves occur on several of the hilltop areas of the offsite offset property (see **Appendix C**). These features are considered likely to afford habitat to cave roosting bats and to other fauna. Species that can potentially find roosting habitat in these areas include threatened microchiropteran bats of the family Vespertilionidae.

The Large-eared Pied Bat (*Chalinolobus dwyeri*) was detected on the offsite offset property and is known to use caves as roost and breeding sites. Approximately 37 ha of foraging habitat (well timbered woodland and open forest vegetation with gully habitat) occur within 500 m of cliff line. The protection of such habitat on the offsite offset generates 262 species credits.

Chapter 7

Offset Summary

7.1 Native Vegetation

The total number of credits calculated for the estimated loss of native vegetation from the Project Disturbance Footprint is approximately 15,333 ecosystem credits. The BOP proposed for the current Project has been directly applied from the previous Drayton South application. For this reason, the BOP generates approximately 24,892 ecosystem credits from the onsite offset areas, offsite offset area and the future mine rehabilitation (**Table 7.1**). The total number of ecosystem credits generated by the BOP that can potentially be applied to offset the Project's impact requirement is 12,359 ecosystem credits. This represents approximately 81% of the required ecosystem credits and approximately 50% of the total credits that could be generated by the BOP.

Table 7.1 Ecosystem Credit Summary

Credits Required (Impacts)	Credits Generated (BOP)	Credits Applied	% of Impact Addressed	Additional Credits Needed	Unapplied Offset Credits
15,333	24,892 (162%)	12,359	81%	2,974	12,533

The types of ecosystem credits applied to the impacts are detailed in **Table 7.2**. For most vegetation types to be impacted, the BOP can fully address the credit requirement calculated for the Project. The BOP can address 44% of the credit requirement for MU 6: Narrabeen Footslopes Slaty Box Woodland (PCT 1176), through rehabilitation of the mining footprint. At least 2,974 ecosystem credits will need to be created in addition to the BOP to fully address the credit requirement for MU 6, or supplementary measures implemented in accordance with the FBA (Appendix B, OEH, 2014c).

Table 7.2 Ecosystem Credits Applied to Address Project Impacts

Map Unit	Impact Vegetation Type	Offset Vegetation Type	Keith Formation	Keith Class	Plant Community Type (PCT)	Biomatic Vegetation Type (BVT)	% Cleared in Catchment	Required (Impact) Ecosystem Credits	Offset Ecosystem Credits Applied	% of Impact Ecosystem Credits Addressed	Additional Credits Required
MU 1	Upper Hunter White Box-Ironbark Grassy Woodland (EEC, TSC Act, CEEC, EPBC Act)	White Box grassy woodland, Brigalow Belt South and Nandewar (EEC, TSC Act, CEEC, EPBC Act)	CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	New England Dry Sclerophyll Forests	1606	HU820	29%	254	254	100%	0
MU 17			CH3 Grassy Woodlands	New England Grassy Woodlands	496	NA414	60%		254		
MU 2	Upper Hunter White Box-Ironbark Grassy Woodland Derived Native Grassland (EEC, TSC Act, CEEC, EPBC Act)		CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	New England Dry Sclerophyll Forests	1606	HU820	29%	69	69	100%	0
MU 20		Derived Native Grassland (EEC, TSC Act, CEEC, EPBC Act)	CH3 Grassy Woodlands	New England Grassy Woodlands	496	NA414	60%		69		
MU 3	Hunter Floodplain Red Gum Woodland (EEC, TSC Act; CEEC, EPBC Act)		CH 9 Forested Wetlands	Eastern Riverine Forests	42	HU599	95%	602	602	100%	0
MU 3		Hunter Floodplain Red Gum Woodland (EEC, TSC Act; CEEC, EPBC Act)	CH 9 Forested Wetlands	Eastern Riverine Forests	42	HU599	95%		254		
MU 16		Box - gum grassy woodlands, Brigalow Belt South and Nandewar (EEC, TSC Act, CEEC, EPBC Act)	CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	599	NA257	80%		348		
MU 4	Hunter Floodplain Red Gum Woodland Derived Native Grassland (EEC, TSC Act, CEEC, EPBC Act)		CH 9 Forested Wetlands	Eastern Riverine Forests	42	HU599	95%	103	103	100%	0
MU 4		Hunter Floodplain Red Gum Woodland Derived Native Grassland (EEC, TSC Act, CEEC, EPBC Act)	CH 9 Forested Wetlands	Eastern Riverine Forests	42	HU599	95%		103		
MU 5	Central Hunter Box-Ironbark Woodland (EEC, TSC Act)		CH3 Grassy Woodlands	Coastal Valley Grassy Woodlands	1691	HU905	79%	7961	7961	100%	0
MU 5		Central Hunter Box-Ironbark Woodland (EEC, TSC Act)	CH3 Grassy Woodlands	Coastal Valley Grassy Woodlands	1691	HU905	79%		2556		
MU 9		Cooba Scrub	CH3 Grassy Woodlands	Coastal Valley Grassy Woodlands	1691	HU905	79%		324		
MU 11		Other Grassland - moderate/good condition	CH3 Grassy Woodlands	Coastal Valley Grassy Woodlands	1691	HU905	79%		973		
MU 12		Other Grassland - low condition	CH3 Grassy Woodlands	Coastal Valley Grassy Woodlands	1691	HU905	79%		802		
MU 16		Box - gum grassy woodlands, Brigalow Belt South and Nandewar (EEC, TSC Act, CEEC, EPBC Act)	CH3 Grassy Woodlands	Western Slopes Grassy Woodlands	599	NA257	80%		140		
MU 17		White Box grassy woodland, Brigalow Belt South and Nandewar (EEC, TSC Act, CEEC, EPBC Act)	CH3 Grassy Woodlands	New England Grassy Woodlands	496	NA414	60%		544		
MU 20		Derived Native Grassland (EEC, TSC Act, CEEC, EPBC Act)	CH3 Grassy Woodlands	New England Grassy Woodlands	496	NA414	60%		2622		
MU 6	Narrabeen Footslopes Slaty Box Woodland (EEC, TSC Act)		CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	1176	HU618	40%	5323	2349	44%	2974
MU 6		Narrabeen Footslopes Slaty Box Woodland (EEC, TSC Act)	CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	1176	HU618	40%		2349		
MU 7	Central Hunter Bullock Forest Regeneration		CH3 Grassy Woodlands	Coastal Valley Grassy Woodlands	1692	HU906	53%	950	950	100%	0
MU 17		White Box grassy woodland, Brigalow Belt South and Nandewar (EEC, TSC Act, CEEC, EPBC Act)	CH3 Grassy Woodlands	New England Grassy Woodlands	496	NA414	60%		950		
MU 8	Hunter Valley River Oak Forest		CH 9 Forested Wetlands	Eastern Riverine Forests	485	HU712	50%	71	71	100%	0
MU 19		River Oak riparian woodland, eastern NSW	CH 9 Forested Wetlands	Eastern Riverine Forests	84	NA191	60%		71		
TOTALS								15333	12359	81%	2974

7.1.1 Credit Matching Rules for Native Vegetation

The ecosystem credits created by the BOP have been matched to the required impact credits with due consideration of the FBA offsetting rules (Section 10.5, OEH, 2014b).

Broadly, the offset rules state that matching offset credits must:

- Be the same PCT as the required credits; and
- Be generated from the same or adjacent subregion to which the impact occurs.

These credit types will appear in the Credit Profile Report generated by the Credit Calculator.

A variation of the offset rules may apply if:

- Matching credits cannot be sourced; AND
- If the required ecosystem credit is not associated with a critically endangered community listed under the TSC Act or any TEC under the EPBC Act.

The variation offset rules can be applied (subject to approval by the consent authority) by allowing credits generated from a different PCT that:

- Has the same vegetation formation; AND
- Has an equal or greater percent cleared value; OR
- If the required credit is a TEC, then the created credit is also a TEC.

The rationale for the matching of impact and offset credits is outlined in **Table 7.3**.

Table 7.3 Assessment of Offset Vegetation Types Against Matching Criteria

Map Unit	Vegetation Type to be Impacted by the Project	Vegetation Type applied to offset the Impact Vegetation Type	Offsetting Criteria					
			Is the offset vegetation type listed as a matching PCT in the credit profile?	Is the offset vegetation type in the same or adjacent sub-region?	Is the impact vegetation type a critically endangered community (TSC Act) or an EPBC Act-listed community?	Is the vegetation formation of the offset vegetation type the same as for the impact vegetation type?	Is the % cleared value of offset vegetation type $\geq$ impact vegetation type?	Is the offset vegetation type a matching or higher value TEC?
MU 1	Upper Hunter White Box-Ironbark Grassy Woodland (EEC, TSC Act; CEEC, EPBC Act)	MU 17: White Box grassy woodland, Brigalow Belt South and Nandewar (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	Yes	No	Yes	Yes
MU 2	Upper Hunter White Box-Ironbark Grassy Woodland Derived Native Grassland (EEC, TSC Act; CEEC, EPBC Act)	MU 20: Derived Native Grassland (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	Yes	No	Yes	Yes
MU 3	Hunter Floodplain Red Gum Woodland (EEC, TSC Act; CEEC, EPBC Act)	MU 16: Box - gum grassy woodlands, Brigalow Belt South and Nandewar (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	Yes	No	No	Yes
MU 4	Hunter Floodplain Red Gum Woodland Derived Native Grassland (EEC)	MU 4: Hunter Floodplain Red Gum Woodland Derived Native Grassland (EEC)	Yes	Yes	Yes	Yes	Yes	Yes
MU 5	Central Hunter Box-Ironbark Woodland (EEC, TSC Act)	MU 5: Central Hunter Box-Ironbark Woodland (EEC, TSC Act)	Yes	Yes	No	Yes	Yes	Yes
		MU 16: Box - gum grassy woodlands, Brigalow Belt South and Nandewar (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	No	Yes	Yes	Yes
		MU 17: White Box grassy woodland, Brigalow Belt South and Nandewar (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	No	Yes	No	Yes
		MU 20: Derived Native Grassland (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	No	Yes	No	Yes
MU 6	Narrabeen Footslopes Slaty Box Woodland (EEC, TSC Act)	MU 6: Narrabeen Footslopes Slaty Box Woodland (EEC, TSC Act)	Yes	Yes	No	Yes	Yes	Yes
MU 7	Central Hunter Bullock Forest Regeneration	MU 17: White Box grassy woodland, Brigalow Belt South and Nandewar (EEC, TSC Act; CEEC, EPBC Act)	No	Yes	No	Yes	Yes	Yes
MU 8	Hunter Valley River Oak Forest	MU 19: River Oak riparian woodland, eastern NSW	No	Yes	No	Yes	Yes	No

7.2 Threatened Species

The total number of credits calculated for the estimated Project impacts to threatened species is approximately 1,555 species credits (**Table 7.4**). The BOP can generate approximately 326 species credits from the onsite and offsite offsets. No threatened species credits are proposed to be generated from mine rehabilitation.

Under the FBA offsetting rules, species credits calculated for impact species may only be offset with species credits created for the same species. There are currently 21 matching species credits that can be applied to address the Project impacts on threatened species, which is approximately 21% of the total species credits generated by the BOP.

The FBA makes provision for a variation of the FBA offsetting rules (Section 10.5.7, OEH, 2014b) by allowing credits created for a different species to be applied to the impact species (subject to approval by the consent authority). Different species credits may be applied to offset impact species if:

- The impact species to which the credit relates is not listed under the EPBC Act or listed as a critically endangered species under the TSC Act; and
- The species credit used as an offset is created in the same bioregion as the impact species credit calculated for the Project; and
- For flora, the alternative offset species credits is created from the same life-form as the flora species to be impacted; and
- Impact species listed under Schedule 1 of the TSC Act must be offset with credits generated from Schedule 1 or 1A species; and
- Impact species listed under Schedule 2 of the TSC Act must be offset with credits generated from Schedule 1, 1A or 2 species.

The remaining 79% of the species credits generated by the BOP do not meet the above criteria and cannot be applied under the variation of the offsetting rules. Approximately 1,534 additional species credits are needed to fully offset impacts to threatened species, or supplementary measures implemented in accordance with the FBA (Appendix B, OEH, 2014c).

Table 7.4 Threatened Species Credit Summary

Threatened Species	Impact number/ area of habitat	Offset number/ area of habitat	Impact Species credits	Offset Species credits	Additional Species Credits Needed
<i>Acacia pendula</i> population in the Hunter Catchment	15 ¹	2 ¹	1,155	14	1,141
<i>Chalinolobus dwyeri</i> (Foraging habitat within 500m of breeding habitat)	0	37 ha	0	262	0
<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	1	1	10	7	3
<i>Diuris tricolor</i> population in the Muswellbrook Local Government Area	30	TBA*	390	TBA*	390
<i>Eucalyptus camaldulensis</i> population in the Hunter Catchment	0	1	0	7	0
<i>Tylophora linearis</i>	0	5	0	36	0
Total Species Credits			1,555	326	1,534

¹Total numbers of individuals has been estimated from number of clumps recorded in a patch.

*Expert's Report for *Diuris tricolor* is in preparation.

7.3 Conclusion

The current Project application has a proposed Project Disturbance Footprint of 1,441 ha, of which 1,438 ha is vegetated. As the disturbance footprint associated with the previous application is 1,928 ha, the current Project represents a reduction of the mine footprint of 25%. The current Project has been assessed in accordance with the FBA and generates a credit requirement of 15,333 ecosystem credits and 1,555 species credits.

The BOP that was accepted for the previous application was directly applied to the current Project. Under the FBA, the BOP generates 24,892 ecosystem credits and 326 species credits from the combined onsite, offsite and mine rehabilitation offset areas. This represents 162% and 21% of the total offsetting requirements for native vegetation and threatened species respectively. However, when the FBA offsetting rules are applied, the Project's BOP is capable of meeting 81% of the offsetting requirements for impacts to native vegetation and 1% of the offsetting requirements for impacts to threatened species.

All of the outstanding ecosystem credits required (2,974) are for impacts to MU 6: Narrabeen Foothills Slaty Box Woodland, which is an endangered ecological community listed under the TSC Act. Additional species credits (1,534) are required to offset impacts to *Diuris tricolor* (Pine Donkey Orchid), *Cymbidium canaliculatum* (Tiger Orchid) and *Acacia pendula* (Weeping Myall).

Anglo American will continue to identify (in consultation with DP&E and OEH) options that will address the residual credit requirement. Some options available for consideration include creating credits from other areas of offset-land owned by Anglo American, purchasing from other credit holders, and/or developing supplementary measures in accordance with the NSW offsets policy (OEH, 2014c).

References

- ANPS (2006). "Acacia - Propagation." Accessed: 2013, from <http://anpsa.org.au/acacia2.html>.
- ANPS (2010). "Plant Propagation from Seed." Accessed: 2013, from <http://asgap.org.au/seed.html>.
- Bell, S., Peake, T. and Driscoll, C. (2007). "Dealing with taxonomic uncertainty in Weeping Myall *Acacia pendula* from the Hunter Catchment." *Australian Plant Conservation* **16**: 14-15.
- Botanic Gardens Trust (2015). "PlantNET." Accessed: 2015, from http://www.rbgsyd.nsw.gov.au/search_plant_net.
- Braun-Blanquet, J. (1927). *Pflanzensoziologie Wien Springer*.
- Brooker, M. and Kleinig, D. (1990). *Field guide to eucalypts of south eastern Australia, Volume 2*. Inkata, Melbourne.
- DEC (NSW) (2004). *Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities. Working Draft*. Department of Environment and Conservation (NSW), Sydney.
- DECCW (2011). *National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland*. Department of Environment, Climate Change and Water, Sydney.
- DEH (2006). *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodland and derived grasslands*. Department of Environment and Heritage, Canberra, ACT.
- Department of Environment and Resource Management (2004). *Soil Conservation Measures - Design Manual for Queensland*. Department of Environment and Resource Management (QLD).
- Eco Logical (2014). *2013 Floristic Monitoring Report*. Prepared for Ulan Coal Mines Limited, Eco Logical Australia Pty Ltd.
- Hansen Bailey (2007). *Drayton Mine Extension Flora and Fauna Impact Assessment*. Prepared for Anglo Coal (Drayton Management) Pty Limited. Hansen Bailey, Brisbane, QLD.
- Harden, G. J. (1990-1993). *Flora of NSW Volumes 1-4*. New South Wales University Press, Kensington.
- ICMM (2006). *Good Practice Guidance for Mining and Biodiversity*. International Council on Mining and Metals.
- Lindenmayer, D., Bennett, A. and Hobbs, R. (2010). *Temperate Woodland Conservation and Management*. CSIRO Publishing, Collingwood.
- McIntyre, S., Mclvor, J. G. and Heard, K. M. (2002). *Managing and Conserving Grassy Woodlands*. CSIRO Publishing, Collingwood.
- Namoi Catchment Management Authority (2012). "Regional Vegetation Communities of the Namoi Catchment." 2012, from <http://www.namoi.cma.nsw.gov.au/416845.html>.

- Nichols, O. G. (2005). *Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on Coal Mines in the Hunter Valley. Final Report*. Australian Coal Association Research Program, Brisbane, QLD.
- Nichols, O. G., Grant, C. and Bell, L. C. (2005). *Developing ecological completion criteria to measure the success of forest and woodland establishment on rehabilitated mines in Australia*.
- NSW Scientific Committee (2002). *White box yellow box Blakely's red gum woodland - endangered ecological community listing*. Department of Environment and Conservation (NSW), Hurstville.
- OEH (2014a). *BioBanking Assessment Methodology 2014*. Office of Environment and Heritage, Sydney.
- OEH (2014b). *Framework for Biodiversity Assessment*. NSW Biodiversity Offsets Policy for Major Projects. Office of Environment and Heritage for the NSW Government, Sydney.
- OEH (2014c). *NSW Biodiversity Offsets Policy for Major Projects*. Office of Environment and Heritage for the NSW Government, Sydney.
- Richardson, F. J., Richardson, R. G. and Shepherd, R. C. H., Eds. (2006). *Weeds of the South-east: An identification guide for Australia*. R.G. and F.J. Richardson, Victoria.
- Simmons, M. (2012). "Cultivation of Acacias." from <http://www.worldwidewattle.com/>.
- SLR (March 2014). *Mangoola Coal Annual Environmental Management Report*. 1 January to 31 December 2013. SLR Consulting Australia Pty Ltd, Lambton.
- Sommerville, M., Siemon, J., Wood, C. and Offord, K. (2013). "Terrestrial Orchids." Accessed: 2013, from http://www.rbgsyd.nsw.gov.au/science/Horticultural_Research/orchids.
- Threatened Species Scientific Committee (2010). "Advice on the presence of hybrids in listed ecological communities ", from <http://www.environment.gov.au/epbc/publications/advice-hybrids.html>.
- Tremblay, R. L. (2008). "Ecological correlates and short-term effects of relocation of a rare epiphytic orchid after Hurricane Georges." *Endangered Species Research* 5: 83-90.
- Ulan Coal Mines Limited (March 2013). *Ulan Coal Mines Limited: Annual Environment Review*. 1 January 2012 - 31 December 2012. Ulan Coal Mines Limited, Mudgee.
- Umwelt (2013). *ETL Relocation Construction Translocation Plan*. Prepared for TransGrid and Xstrata Mangoola Pty Ltd. Umwelt (Australia) Pty Limited, Toronto.
- Vallee, L., Hogbin, T., Monks, L., Makinson, B., Matthes, M. and Rossetto, M. (2004). *Guidelines for the Translocation of Threatened Plants in Australia*. Australian Network for Plant Conservation, Canberra.

Figures

Figure 1	Regional Locality
Figure 2	Conceptual Project Layout
Figure 3	Onsite Offset Areas
Figure 4	Drayton Mine Existing Biodiversity Offsets
Figure 5	Location of the Offsite Offset
Figure 6	Offsite Offset Area
Figure 7	Native Vegetation – Onsite Offset Areas
Figure 8	Native Vegetation – Offsite Offset Area
Figure 9	Threatened Species – Onsite Offset Areas
Figure 10	Threatened Species – Offsite Offset Area

Coordinate System: MGA Zone 56 (GDA 94)

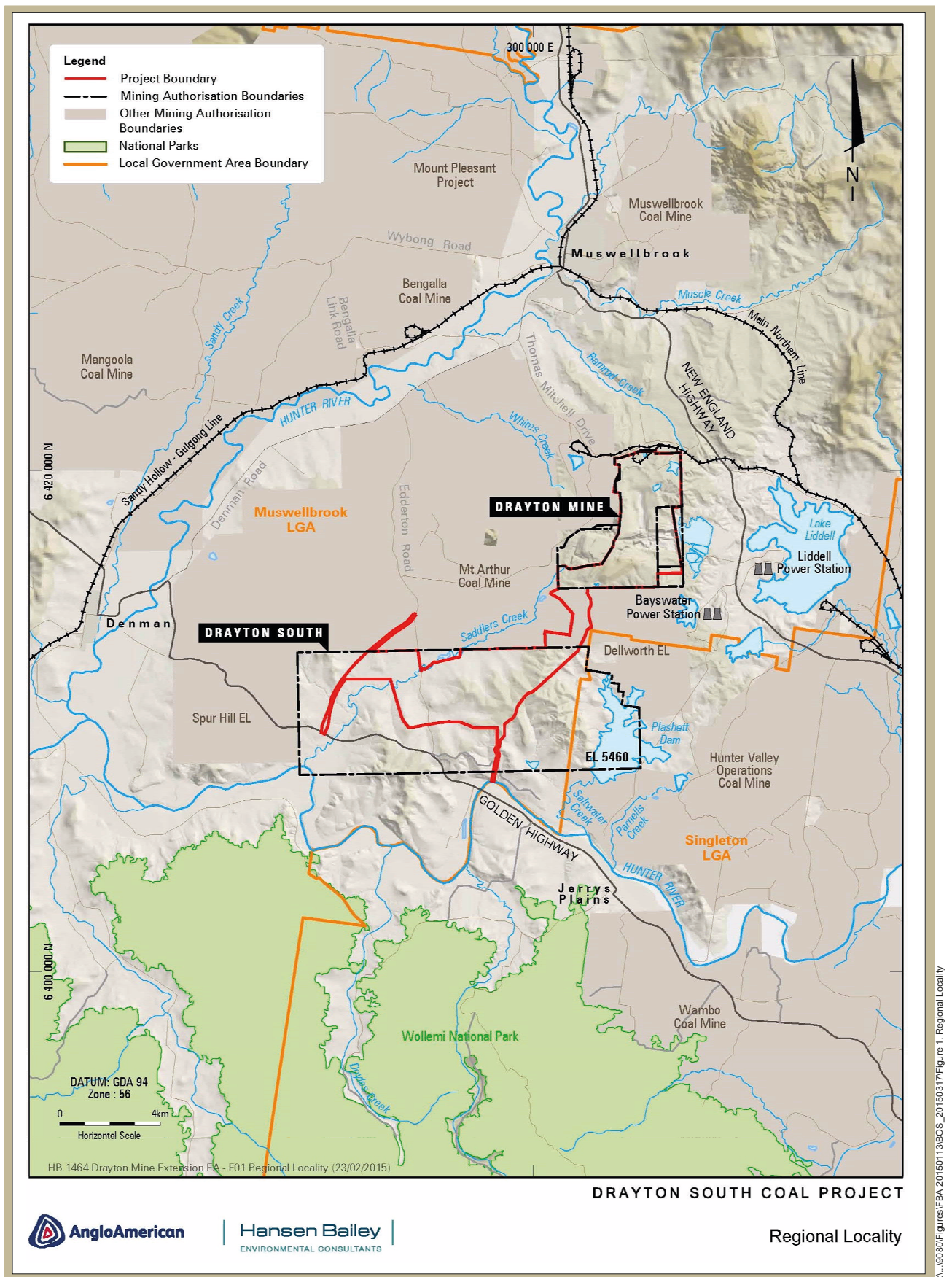


Figure 1. Regional Locality

Coordinate System: MGA Zone 56 (GDA 94)

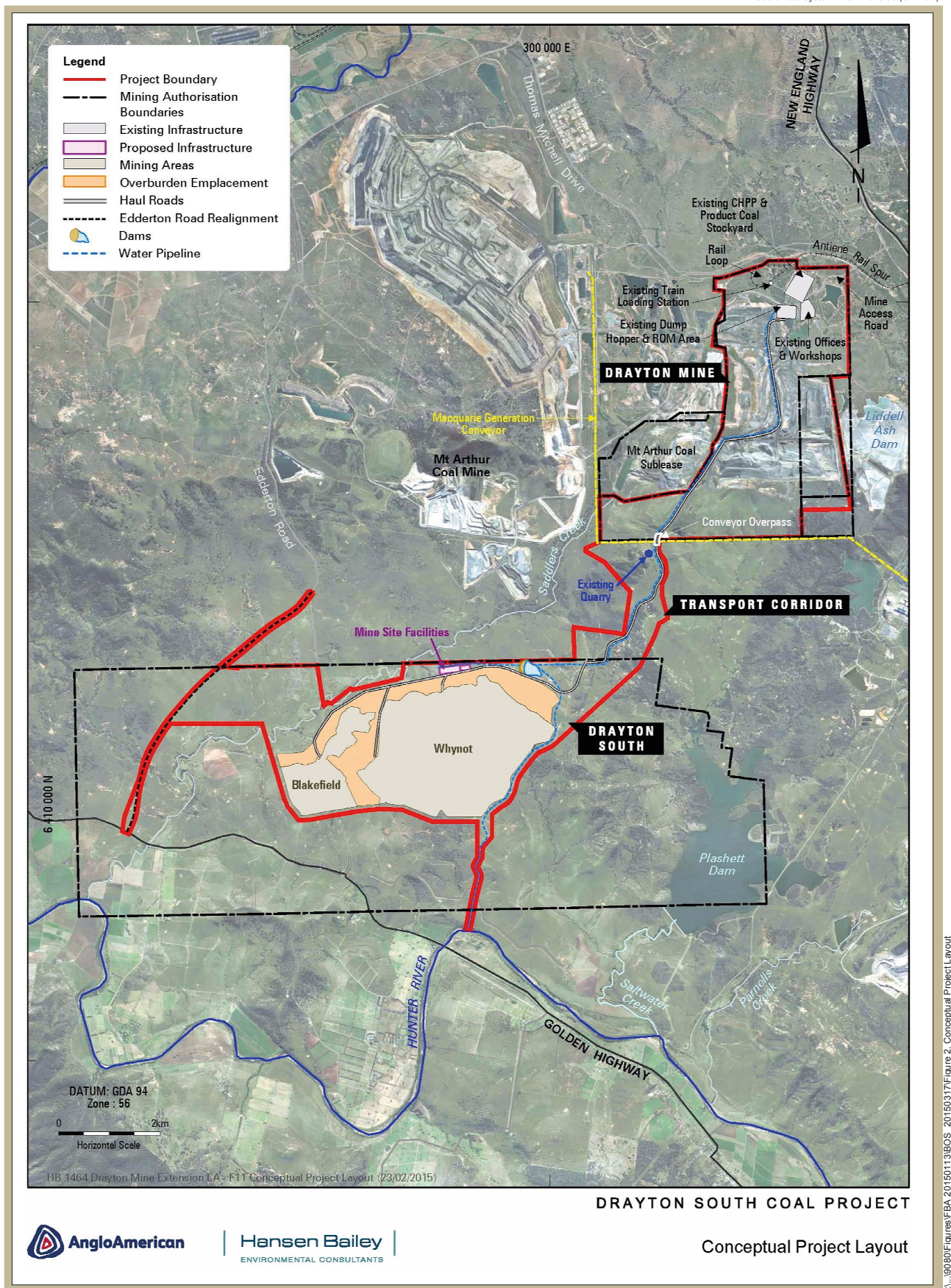


Figure 2. Conceptual Project Layout

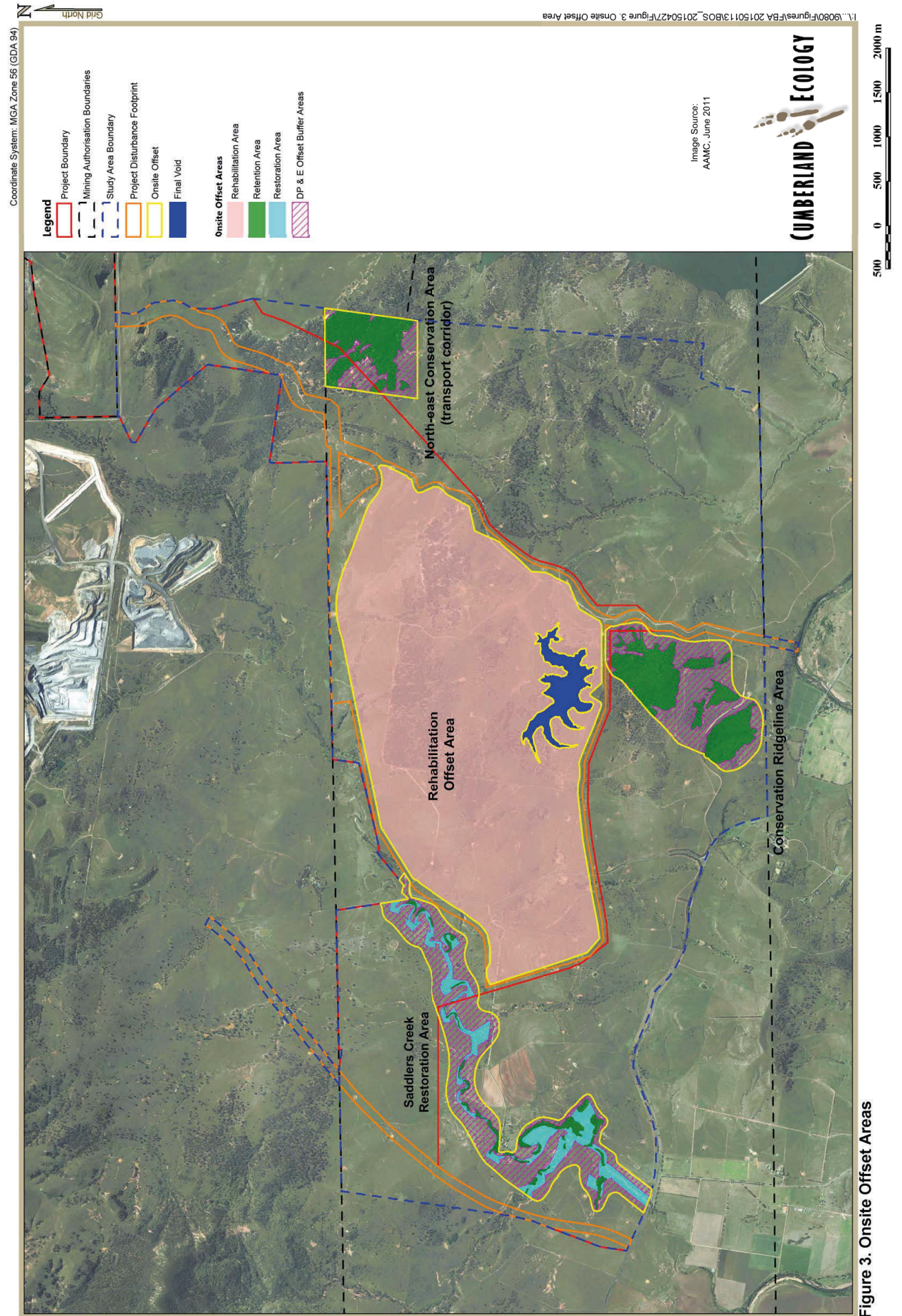
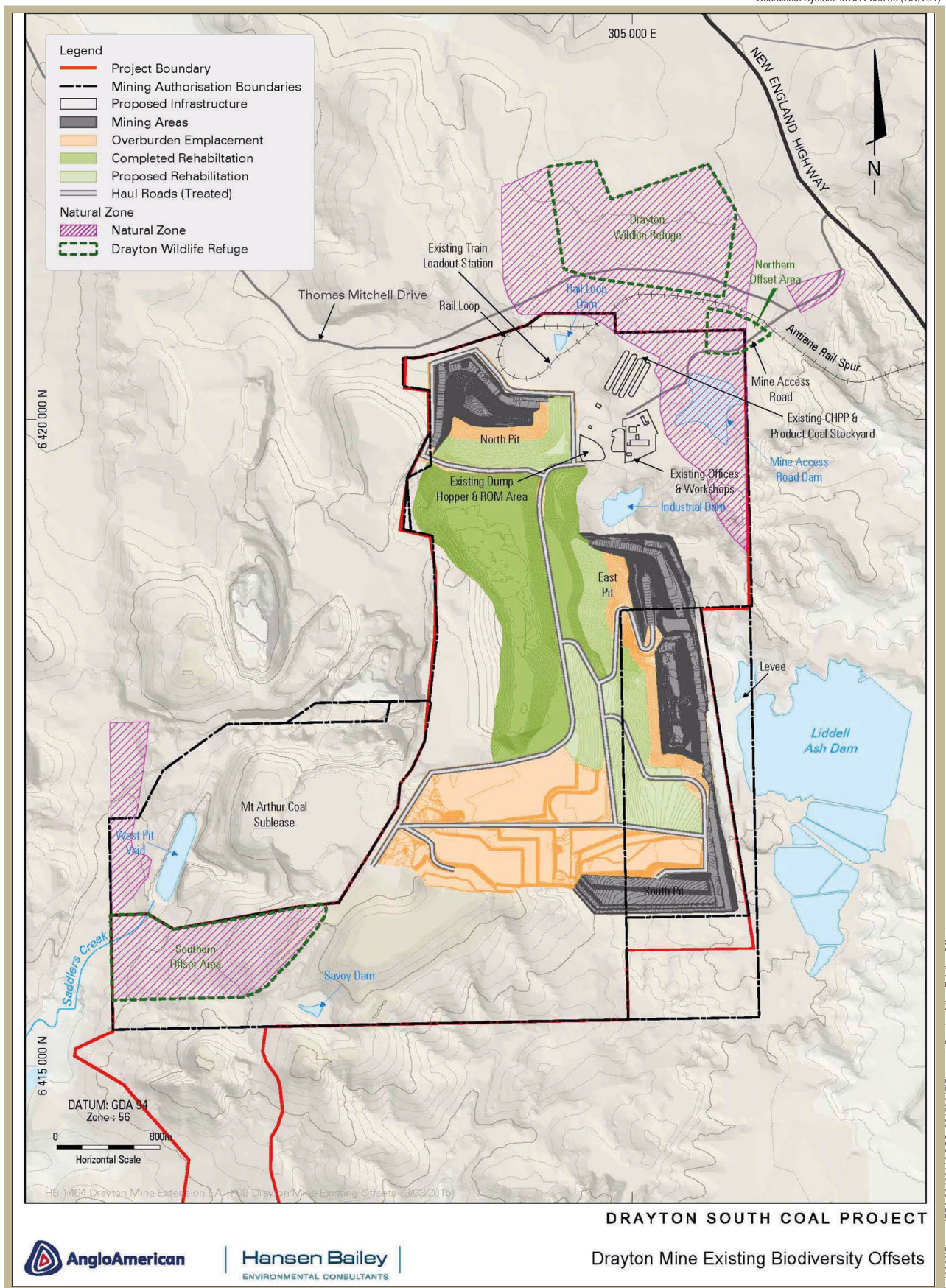


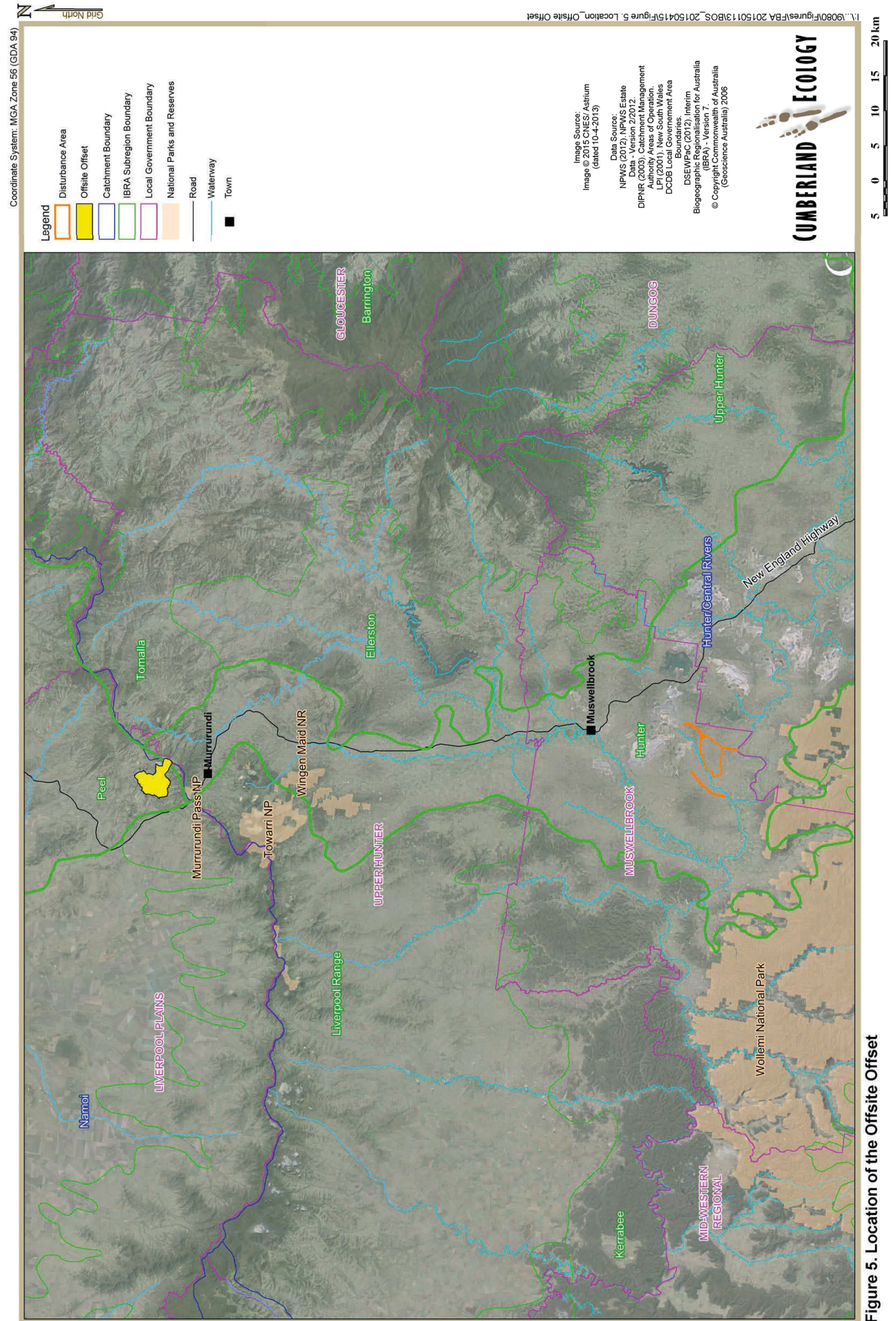
Figure 3. Onsite Offset Areas

Coordinate System: MGA Zone 56 (GDA 94)



L:\19080\Figures\FBA_20150317\Figure 4. Drayton Mine Existing Offsets

Figure 4. Drayton Mine Existing Biodiversity Offsets



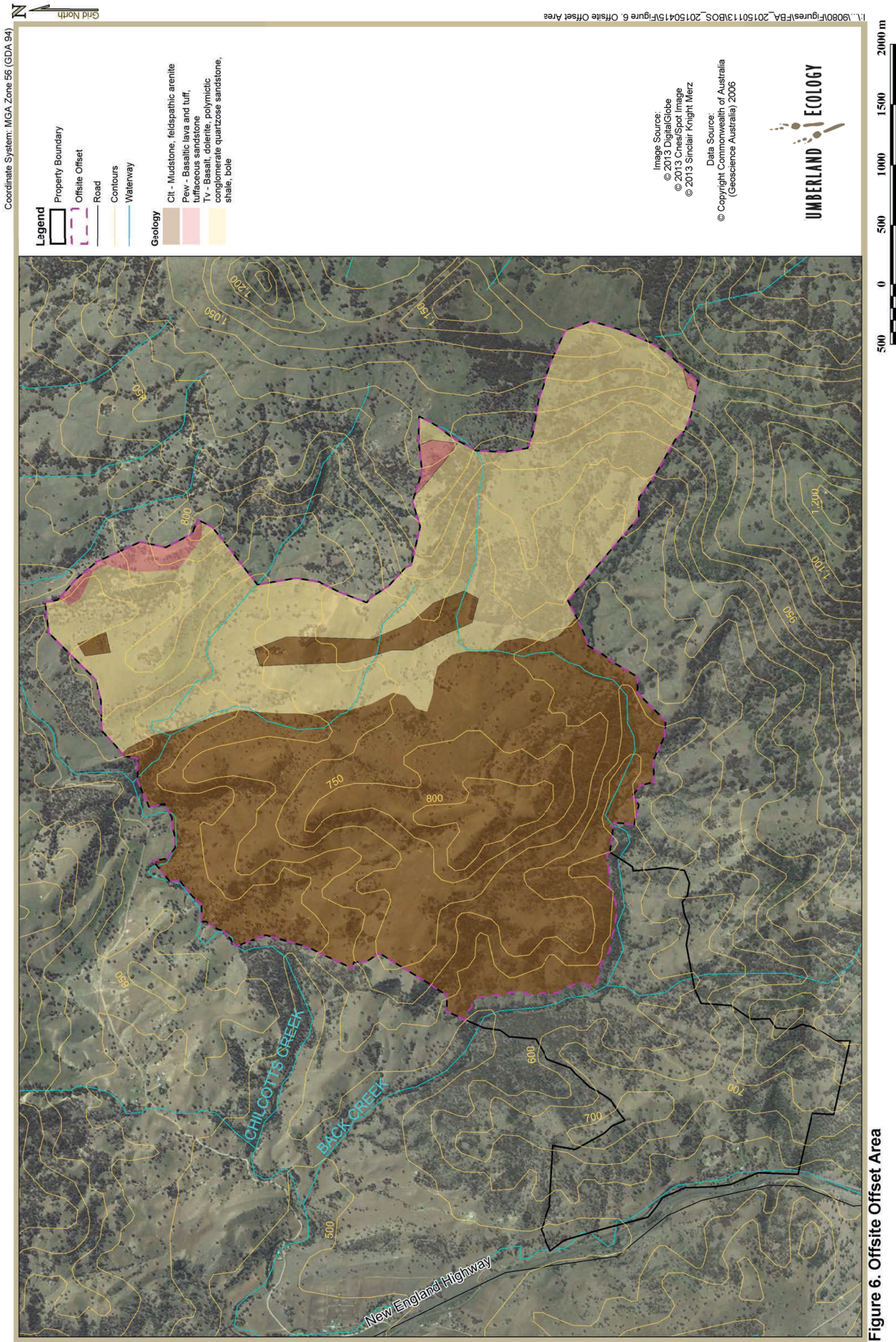


Figure 6. Offsite Offset Area