



WAMBO

MONTROSE WATER STORAGE MODIFICATION ENVIRONMENTAL ASSESSMENT

MAIN REPORT

Attachment 1 Consolidated Development Consent DA 305-7-2003

Appendix A Aboriginal Cultural Heritage Assessment

Appendix B Flora Assessment

Appendix C Fauna Assessment

Appendix D Agricultural Resources Assessment

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ES-1	4.15	CONSIDERATION OF CUMULATIVE IMPACTS WITH OTHER NEARBY MINING OPERATIONS	36
1	INTRODUCTION	1		
	1.1 OVERVIEW – WAMBO	1	5	STATUTORY CONTEXT
	1.2 OVERVIEW – MONTROSE WATER STORAGE MODIFICATION	1	5.1	GENERAL STATUTORY REQUIREMENTS
	1.3 CONSULTATION	1	5.2	MANAGEMENT PLANS THAT REQUIRE REVISION
	1.4 STRUCTURE OF THIS DOCUMENT	5		
2	WAMBO – EXISTING OPERATIONS	5	6	REFERENCES
	2.1 APPROVALS HISTORY	5		
	2.2 OPEN CUT MINING	6		
	2.3 UNDERGROUND MINING	6		
	2.4 COAL HANDLING AND PREPARATION	6		
	2.5 PRODUCT COAL TRANSPORT	6		
	2.6 WASTE ROCK MANAGEMENT	6		
	2.7 COAL REJECT MANAGEMENT	6		
	2.8 INFRASTRUCTURE AND SERVICES	7		
	2.9 SITE WATER MANAGEMENT AND SUPPLY	7		
	2.10 WORKFORCE	8		
	2.11 REHABILITATION	8		
	2.12 ENVIRONMENTAL MONITORING AND MANAGEMENT	11		
	2.13 COMPLAINTS	11		
3	MONTROSE WATER STORAGE MODIFICATION	11		
	3.1 REQUIREMENT FOR THE MONTROSE WATER STORAGE	11		
	3.2 MONTROSE WATER STORAGE SITING AND DESIGN	14		
	3.3 SUPPORTING INFRASTRUCTURE	14		
	3.4 SITE WATER MANAGEMENT	16		
	3.5 WATER SUPPLY	16		
	3.6 CONSTRUCTION	16		
	3.7 DECOMMISSIONING AND REHABILITATION	17		
4	ENVIRONMENTAL ASSESSMENT	17		
	4.1 LAND RESOURCES	17		
	4.2 SURFACE WATER	20		
	4.3 GROUNDWATER	21		
	4.4 ABORIGINAL HERITAGE	22		
	4.5 FLORA	24		
	4.6 FAUNA	28		
	4.7 NOISE AND BLASTING	30		
	4.8 AIR QUALITY	32		
	4.9 GREENHOUSE GAS EMISSIONS	33		
	4.10 ROAD TRANSPORT	34		
	4.11 VISUAL	35		
	4.12 NON-ABORIGINAL HERITAGE	35		
	4.13 SOCIO-ECONOMICS	35		
	4.14 HAZARD AND RISK	35		

LIST OF TABLES	
Table 1	Comparative Summary of the Approved and Modified Wambo
Table 2	Vegetation Communities Recognised within the Montrose Water Storage Area
Table 3	Threatened Fauna Species Previously Recorded in the Vicinity of Wambo
Table 4	Terrestrial Fauna Species
Table 5	Threatened Fauna Species Located during the Surveys

LIST OF FIGURES	
Figure 1	Regional Location
Figure 2	Aerial Photograph of Wambo and Surrounds
Figure 3	Schematic of Water Management System
Figure 4	Locations of Air Quality, Noise and Blast Monitoring Sites
Figure 5	Locations of Surface Water and Groundwater Monitoring Sites
Figure 6	Aerial Photograph of Montrose Water Storage Area
Figure 7	Strategic Agricultural Land in the Vicinity of Wambo
Figure 8	Alluvial Mapping in the Vicinity of the Montrose Water Storage Area
Figure 9	Aboriginal Sites in the Vicinity of the Montrose Water Storage Area
Figure 10	Vegetation Communities in the Vicinity of the Montrose Water Storage Area
Figure 11	Threatened Fauna Recorded during the Modification Surveys

LIST OF ATTACHMENTS	
Attachment 1	Consolidated Development Consent DA 305-7-2003

LIST OF APPENDICES	
Appendix A	Aboriginal Cultural Heritage Assessment
Appendix B	Flora Assessment
Appendix C	Fauna Assessment
Appendix D	Agricultural Resources Assessment

EXECUTIVE SUMMARY

ES1.1 BACKGROUND

Wambo is an existing open cut and underground coal mining operation situated approximately 15 kilometres west of Singleton, near the village of Warkworth, New South Wales.

A range of open cut and underground mine operations have been conducted at Wambo since mining operations commenced in 1969. Mining under Development Consent DA 305-7-2003 commenced in 2004 and currently both open cut and underground operations are conducted. The approved run-of-mine coal production rate is 14.7 million tonnes per annum and product coal is transported from Wambo by rail.

Wambo is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited (75%) and Sumiseki Materials Co. Ltd (25%). This Environmental Assessment has been prepared by WCPL to support an application to modify Development Consent DA 305-7-2003 (the Montrose Water Storage Modification [the Modification]).

An aerial photograph of Wambo, illustrating the approved extent of the open cut and underground mine operations and key infrastructure is provided on Figure ES-1.

ES1.2 DESCRIPTION OF THE MODIFICATION

The Modification would comprise the construction and operation of the Montrose Water Storage and associated supporting infrastructure (i.e. pumps, pipelines and powerline) (Figures ES-1 and ES-2).

The Montrose Water Storage would be a “turkey’s nest” style dam located to the south-west of the approved open cut limit (Figure ES-2) and would have a nominal capacity of approximately 1,500 million litres (ML).

The Modification is required to ensure adequate water storage is available at Wambo while the existing South Wambo Dam (approximately 840 ML capacity) is subsided by the approved North Wambo Underground Mine (Longwall 8). Water stored in the South Wambo Dam will be transferred to other water storages at Wambo (e.g. the proposed Montrose Water Storage) prior to the South Wambo Dam being subsided.

ES1.3 ENVIRONMENTAL REVIEW

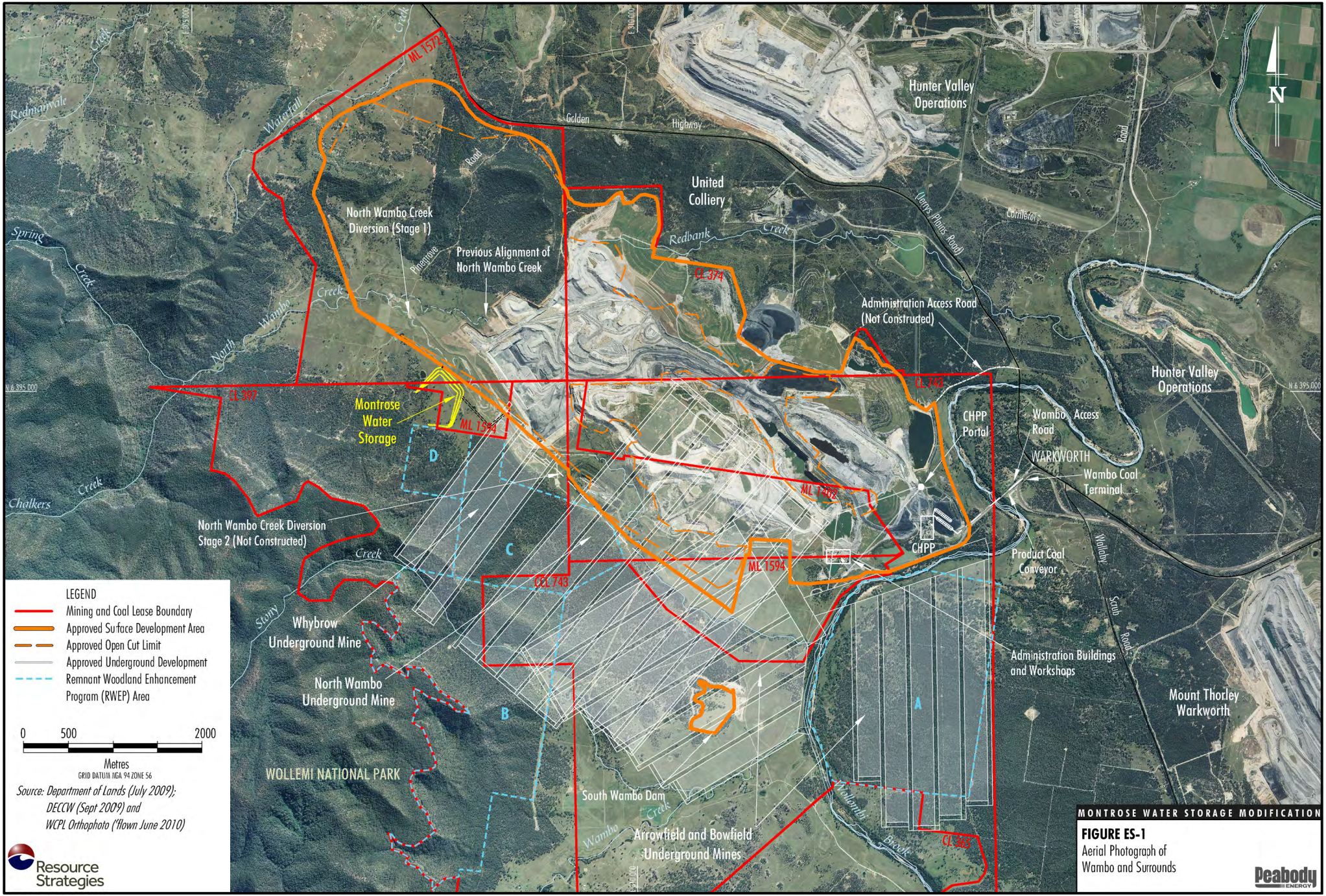
Potential environmental impacts of the Modification are largely restricted to the following key potential issues:

- Disturbance associated resulting in potential impacts on:
 - Aboriginal cultural heritage;
 - native flora;
 - native fauna; and
 - agricultural resources.

In order to assess the potential environmental impacts of the Modification, environmental reviews were completed for the above key issues. For Wambo incorporating the Modification, the environmental reviews have concluded that:

- There is no identified risk of harm to known Aboriginal cultural heritage sites.
- There would be no significant impact on threatened flora or fauna species as a result of the Modification.
- There would be no significant reduction in the quality of threatened ecological communities.
- There Montrose Water Storage area would not include highly productive soils, nor would it include areas of strategic agricultural lands.

WCPL would continue to implement existing environmental management and monitoring measures to minimise the potential impacts of Wambo incorporating the Modification on existing environmental values and the nearest private dwellings.



LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- Approved Open Cut Limit
- Approved Underground Development
- - - Remnant Woodland Enhancement Program (RWEPP) Area

0 500 2000
Metres
GRID DATUM: MGA 94 ZONE 56

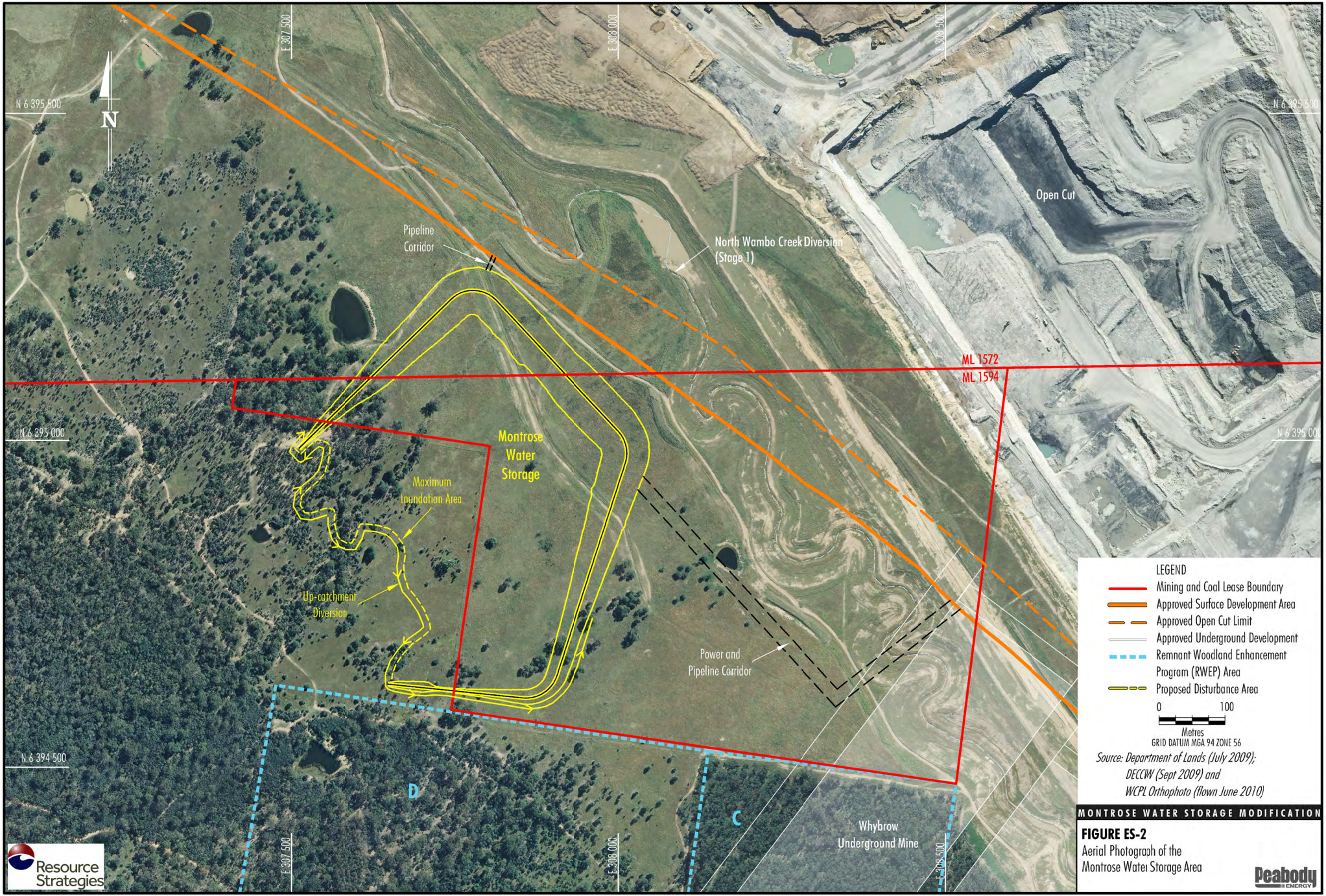
Source: Department of Lands (July 2009);
DECCW (Sept 2009) and
WCPL Orthophoto (flown June 2010)



MONTROSE WATER STORAGE MODIFICATION

FIGURE ES-1
Aerial Photograph of
Wambo and Surrounds





LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- Approved Open Cut Limit
- Approved Underground Development Program (RWEPP) Area
- Remnant Woodland Enhancement Program (RWEPP) Area
- Proposed Disturbance Area

0 100
Metres
GRID DATUM MGA 94 ZONE 56

Source: Department of Lands (July 2009);
DECCW (Sept 2009) and
WCPL Orthophoto (flown June 2010)

MONTROSE WATER STORAGE MODIFICATION

FIGURE ES-2
Aerial Photograph of the
Montrose Water Storage Area



1 INTRODUCTION

This document is an Environmental Assessment (EA) for a proposed modification to Wambo, an open cut and underground coal mining operation which operates in accordance with Development Consent DA 305-7-2003 (Attachment 1). Wambo is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited (75%) and Sumiseki Materials Co. Ltd (25%).

1.1 OVERVIEW – WAMBO

Wambo is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW) (Figure 1). Wambo adjoins grazing land to the south, other coal mining operations to the east and north, grazing land to the north-west and Wollemi National Park to the west and south-west (Figures 1 and 2).

A range of open cut and underground mine operations have been conducted at Wambo since mining operations commenced in 1969. Mining under Development Consent DA 305-7-2003 commenced in 2004 and currently both open cut and underground operations are conducted. The approved run-of-mine (ROM) coal production rate is 14.7 million tonnes per annum (Mtpa) and product coal is transported from Wambo by rail.

An aerial photograph of Wambo, illustrating the approved extent of the open cut and underground mine operations and locations of key infrastructure is provided on Figure 2.

1.2 OVERVIEW – MONTROSE WATER STORAGE MODIFICATION

The proposed Montrose Water Storage Modification (the Modification) would comprise the construction and operation of the Montrose Water Storage and associated supporting infrastructure (i.e. pumps, pipelines and powerline).

The Montrose Water Storage would be a “turkey’s nest” style dam located to the south-west of the approved open cut limit (Figure 2) and would have a nominal capacity of approximately 1,500 million litres (ML).

The Modification is required to ensure adequate water storage is available at Wambo while the existing South Wambo Dam (approximately 840 ML capacity) is subsided by the approved North Wambo Underground Mine (Longwall 8). Water stored in the South Wambo Dam will be transferred to other water storages at Wambo (e.g. the proposed Montrose Water Storage) prior to the South Wambo Dam being subsided.

Table 1 provides a comparative summary of the approved and proposed modified Wambo. A more detailed description of the Modification is provided in Section 3.

1.3 CONSULTATION

Consultation has been conducted with the local community, United Collieries, Singleton Shire Council (SSC), NSW Department of Planning and Infrastructure (DP&I) and the Dam Safety Committee during the preparation of this EA. A summary of this consultation is provided below.

It is anticipated that consultation between the local community, United Collieries and regulatory agencies will continue during the public exhibition of this EA and the assessment of the proposal by the NSW Government.

Local Community

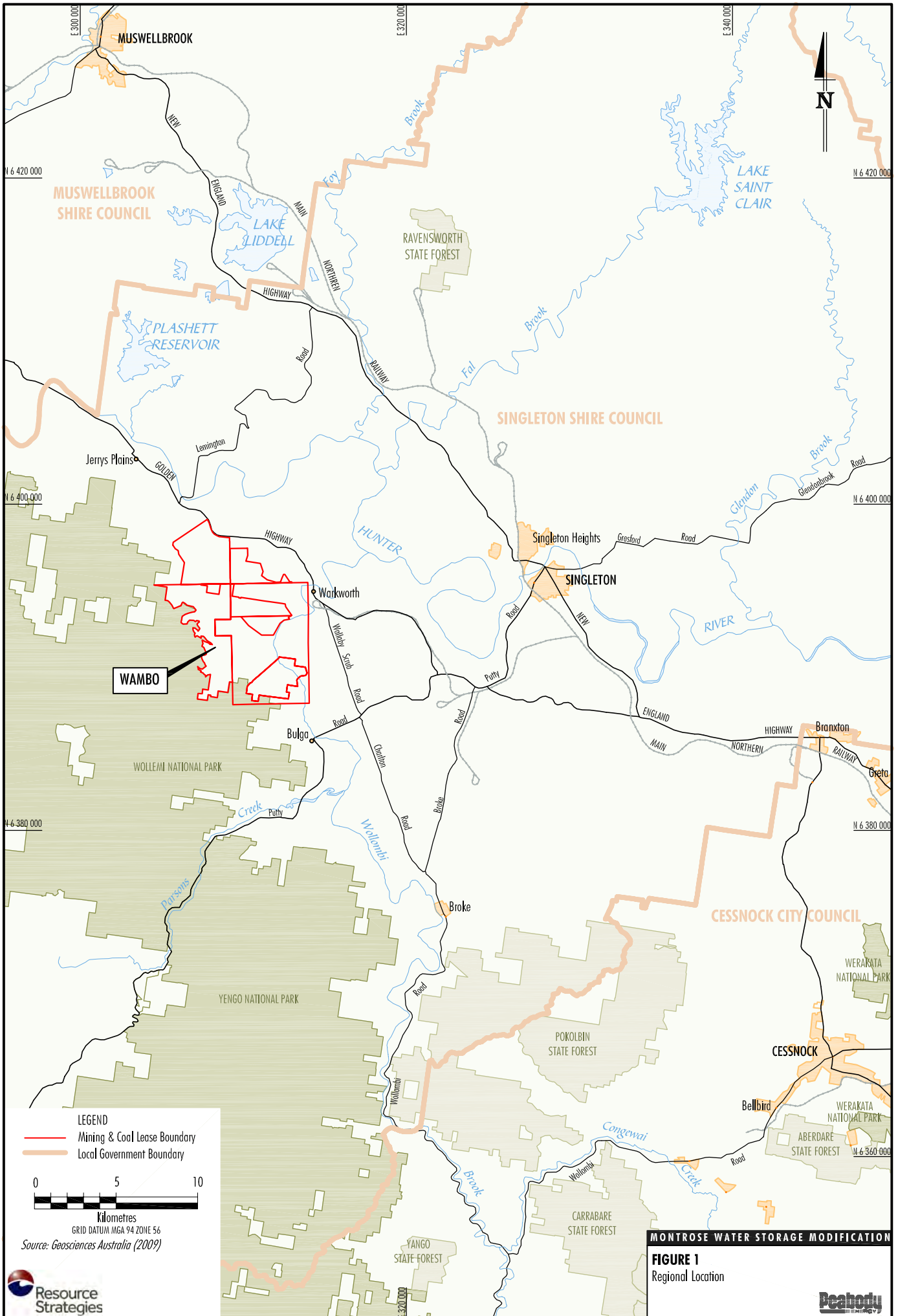
A Community Consultative Committee (CCC) for Wambo is in place and provides a mechanism for ongoing communication between WCPL and the local community. In May 2012 the CCC was notified of WCPL’s intention to lodge a modification application and WCPL provided an overview of the Modification.

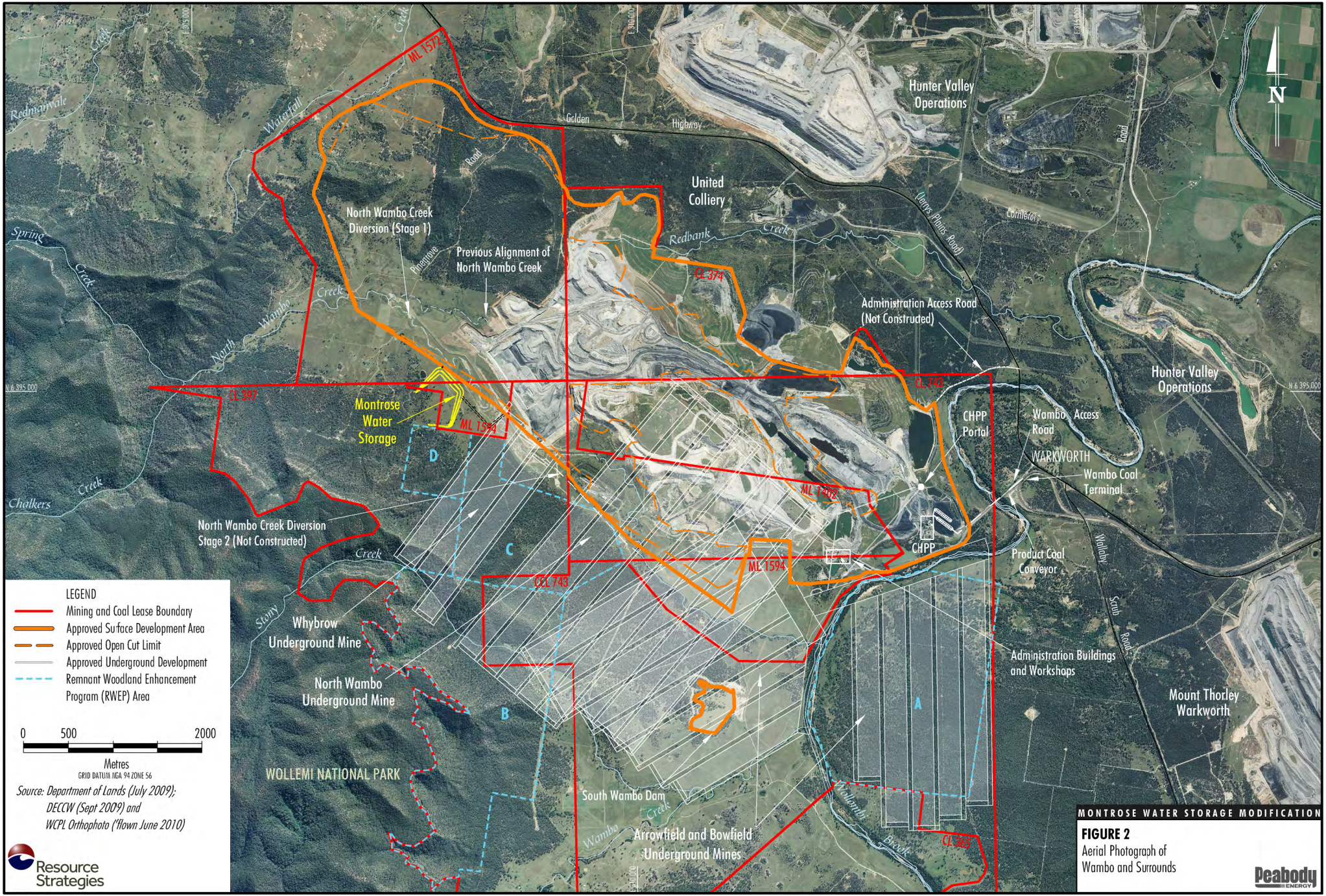
United Collieries

Consultation with United Collieries regarding the Modification was conducted in April 2012. During this consultation the Modification and potential impacts on existing and future United Collieries operations were discussed.

Local Government

Wambo is wholly located within the SSC Local Government Area (LGA) (Figure 1). SSC representatives were provided an overview of the Modification at the CCC meeting in May 2012.





LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- Approved Open Cut Limit
- Approved Underground Development
- Remnant Woodland Enhancement Program (RWEP) Area

0 500 2000
Metres
GRID DATUM: NGA 94 ZONE 56

Source: Department of Lands (July 2009);
DECCW (Sept 2009) and
WCPL Orthophoto (flown June 2010)



MONTROSE WATER STORAGE MODIFICATION

FIGURE 2
Aerial Photograph of
Wambo and Surrounds



Table 1
Comparative Summary of the Approved and Modified Wambo

Component	Approved Wambo¹	Modified Wambo
Open Cut Mining	<ul style="list-style-type: none"> Open cut mining at a rate of up to 8 Mtpa of ROM coal from the Whybrow, Redbank Creek, Wambo and Whynot Seams. An estimated total open cut ROM coal reserve of 98 million tonnes (Mt). Open cut mining operations until 2017. 	<ul style="list-style-type: none"> Unchanged.
Underground Mining	<ul style="list-style-type: none"> Underground mining of up to 7.5 Mtpa of ROM coal from the Whybrow, Wambo, Arrowfield and Bowfield Seams. Underground ROM coal reserves are estimated at 104 Mt. 	<ul style="list-style-type: none"> Unchanged.
ROM Coal Production Rate	<ul style="list-style-type: none"> Up to 14.7 Mtpa of ROM coal. 	<ul style="list-style-type: none"> Unchanged.
Total ROM Coal (Open Cut and Underground Mining)	<ul style="list-style-type: none"> 202 Mt. 	<ul style="list-style-type: none"> Unchanged.
Waste Rock Management	<ul style="list-style-type: none"> Waste rock deposited in open cut voids and in waste rock emplacements adjacent open cut operations. 	<ul style="list-style-type: none"> Unchanged.
Total Waste Rock	<ul style="list-style-type: none"> 640 million bank cubic metres (Mbcm). 	<ul style="list-style-type: none"> Unchanged.
Coal Washing	<ul style="list-style-type: none"> Coal handling and preparation plant (CHPP) capable of processing approximately 1,800 tonnes per hour (tph). 	<ul style="list-style-type: none"> Unchanged.
Product Coal	<ul style="list-style-type: none"> Production of up to 11.3 Mtpa of thermal coal predominantly for export. 	<ul style="list-style-type: none"> Unchanged.
CHPP Reject Management	<ul style="list-style-type: none"> Coarse rejects and tailings would be incorporated, encapsulated and/or capped within open cut voids in accordance with existing Wambo management practices. 	<ul style="list-style-type: none"> Unchanged.
Total CHPP Rejects	<ul style="list-style-type: none"> Approximately 27 Mt of coarse rejects and approximately 18 Mt of tailings. 	<ul style="list-style-type: none"> Unchanged.
Water Management System	<ul style="list-style-type: none"> A network of permanent and temporary structures including: <ul style="list-style-type: none"> – up-catchment diversions; – water storage dams; – sediment dams; – North Wambo Creek Diversion²; and – water transfer infrastructure (i.e. pumps and pipelines). 	<ul style="list-style-type: none"> Construction and operation of the Montrose Water Storage (approximately 1,500 ML capacity) and associated supporting infrastructure.
Water Supply	<ul style="list-style-type: none"> Make-up water demand to be met from runoff recovered from tailings storage areas, operational areas, dewatering, licensed extraction from Wollombi Brook and Hunter River. 	<ul style="list-style-type: none"> Unchanged.
Life of Mine	<ul style="list-style-type: none"> 21 years (from the date of the commencement of Development Consent DA 305-7-2003). 	<ul style="list-style-type: none"> Unchanged.

¹ Development Consent DA 305-7-2003 (as modified).

² Denoted as 'water control system' in the *Wambo Development Project Environmental Impact Statement* (the EIS) (WCPL, 2003).

Department of Planning and Infrastructure

WCPL initiated consultation regarding the Modification with the DP&I in June 2012. An overview of the Modification was provided to the DP&I and key environmental assessment requirements and the proposed timing for EA lodgement were discussed.

Dam Safety Committee

WCPL initiated consultation regarding the Modification with the Dam Safety Committee in May 2012. An overview of the Modification will be provided to the Dam Safety Committee and key safety requirements for the design and operation of Montrose Water Storage in early July 2012.

1.4 STRUCTURE OF THIS DOCUMENT

Section 1	Provides an overview of Wambo, the Modification and the consultation undertaken in relation to the Modification.
Section 2	Provides a description of existing and approved operations at Wambo.
Section 3	Provides a description of the Modification.
Section 4	Provides an environmental assessment of the Modification and describes the environmental management systems and measures available to manage and monitor any potential impacts.
Section 5	Describes the general statutory context of the Modification.
Section 6	References.
Attachment 1 and Appendices A to D provide supporting information as follows:	
Attachment 1	Consolidated Development Consent DA 305-7-2003
Appendix A	Aboriginal Cultural Heritage Assessment
Appendix B	Flora Assessment
Appendix C	Fauna Assessment
Appendix D	Agricultural Resource Assessment

2 WAMBO – EXISTING OPERATIONS**2.1 APPROVALS HISTORY**

Wambo was approved under Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) in February 2004. Nine modifications to Development Consent DA 305-7-2003 have been granted under the EP&A Act:

- 2004 under Section 96(1) – to facilitate the commencement of operations under Development Consent DA 305-7-2003;
- May 2005 under Section 96(2) – to facilitate alterations to the North Wambo Underground Mine;
- January 2006 under Section 96(1A) – to facilitate the construction of an open cut workshop extension and surface infrastructure for the North Wambo Underground Mine;
- April 2006 under Section 96(1A) – to facilitate the extraction of remnant coal from the existing Wollemi Underground Mine;
- October 2006 under Section 96(1A) – to facilitate the construction and operation of a temporary North Wambo Creek bypass around the open cut operations;
- January 2007 under Section 96(2) – to facilitate the staged construction of the North Wambo Creek Diversion, a temporary North Wambo Creek pipeline and construction of gas drainage and dewatering infrastructure for the North Wambo Underground Mine;
- June 2009 under Section 96(1A) – to facilitate the construction and operation of the Chitter Dump Dam;
- August 2009 under Section 96(2) – to facilitate the construction and operation of the South Wambo Dam; and
- February 2011 under Section 75W – to modify Development Consent DA 305-7-2003 to require WCPL to prepare an Extraction Plan for all underground operations at Wambo, rather than a Subsidence Management Plan.

The consolidated Development Consent DA 305-7-2003, incorporating these modifications, is provided in Attachment 1.

2.2 OPEN CUT MINING

Open cut mining operations at Wambo involve the extraction of coal from the Whybrow, Redbank Creek, Wambo and Whynot Seams. The open cut is bounded by the United Colliery and the Golden Highway to the north, Wollombi Brook to the east (Figure 2) and by uneconomic strip ratios to the south and west.

The open cut mining fleet includes excavators, dozers, front end loaders, haul trucks, water trucks, service trucks, graders and drills (WCPL, 2011a).

During the 2010/2011 financial year approximately 4 Mt of ROM coal was mined at the Wambo open cut operations (WCPL, 2011a).

2.3 UNDERGROUND MINING

The following underground mines at Wambo are approved (Figure 2):

- North Wambo Underground Mine;
- Whybrow Underground Mine;
- Arrowfield Underground Mine; and
- Bowfield Underground Mine.

Development of the North Wambo Underground Mine commenced in 2005 and production (using longwall mining methods) commenced in 2007 (WCPL, 2008a). During the 2010/2011 financial year approximately 4.7 Mt of ROM coal was mined at the North Wambo Underground Mine (WCPL, 2011a).

Underground mining equipment includes continuous miners, longwall mining equipment, electric shuttle cars, load haul dump machines and personnel transporters (WCPL, 2011a).

To date mining has not commenced at the approved Whybrow Underground Mine, Arrowfield Underground Mine, or the Bowfield Underground Mine.

2.4 COAL HANDLING AND PREPARATION

ROM coal from the mining operations is hauled to the CHPP for processing. The majority of ROM coal is placed directly into the 400 t ROM bin and the remainder is placed onto the 250,000 t capacity ROM coal stockpile (WCPL, 2011a). ROM coal is reclaimed from the ROM coal stockpile by front end loader as required.

ROM coal is crushed and washed in the CHPP which operates at a rate of up to approximately 1,800 tph of ROM coal feed. A product coal stockpile with an approximate capacity of 500,000 t is used to stockpile product coal, prior to reclaim and loading to trains for transport off-site (WCPL, 2011a).

The CHPP operates up to 24 hours per day, 7 days per week and during the 2010/2011 financial year approximately 8.7 Mt of ROM coal was processed at the CHPP producing approximately 5.7 Mt of product coal (WCPL, 2011a).

2.5 PRODUCT COAL TRANSPORT

The Wambo Coal Terminal is capable of loading product coal onto trains at a rate of 4,500 tph (WCPL, 2011a). Product coal is reclaimed from the product coal stockpile at three reclaim points and is transferred via conveyors to the train load-out bin.

The Wambo Coal Terminal operates up to 24 hours per day, 7 days per week. An average of four trains are loaded each day, with a maximum of six trains per day being loaded during peak coal transport periods.

2.6 WASTE ROCK MANAGEMENT

The open cut operations are expected to produce approximately 640 Mbcm of waste rock during the life of Wambo (WCPL, 2003). Only a limited amount of waste rock will be produced from the underground operations. The overburden and interburden waste rock materials comprise mudstones, siltstones, sandstone, shale and conglomerates (WCPL, 2003).

Overburden removal is carried out mostly by excavators and haul trucks with the waste rock material hauled to open cut voids or waste rock emplacements. Approximately 27.6 Mbcm of waste rock was excavated during the 2010/2011 financial year (WCPL, 2011a).

2.7 COAL REJECT MANAGEMENT

Approximately 27 Mt of coarse reject material is expected to be produced over the life of Wambo and will primarily comprise minor quantities of coal as well as sandstone, siltstones, shales, conglomerates and mudstone (WCPL, 2003). The coarse reject material is selectively handled and co-disposed of with waste rock in open cut voids (WCPL, 2011a).

Tailings produced at the CHPP primarily comprise carbonaceous shale, sands and clay materials (WCPL, 2003). The tailings are pumped as a slurry to open cut voids. Once the tailings have filled a void they are progressively covered with coarse rejects and/or waste rock material using a combination of encapsulation and incorporation. Approximately 18 Mt of tailings (dry basis) are expected to be produced over the life of Wambo (WCPL, 2003).

2.8 INFRASTRUCTURE AND SERVICES

2.8.1 Administration, Bathhouses and Workshops

The main administration building, bathhouse and workshops are located at the south-east corner of the open cut operations (Figure 2). An administration block, bathhouse and workshops are also located at the CHPP.

2.8.2 Access Roads

Access to Wambo is currently via the sealed Wambo Access Road which intersects the Golden Highway near Warkworth (Figure 2).

The extension of the open cut to the north-west will necessitate the de-gazettal and closure of Pinegrove Road.

2.8.3 Haul Roads

All ROM coal and waste rock is hauled via internal haul roads. The internal haul roads are progressively constructed between the open cut, waste rock emplacement areas and the CHPP. The internal haul roads are regularly watered to minimise dust generation (WCPL, 2011a).

2.8.4 Electricity Supply

Electrical power requirements for Wambo are provided via a 66 kilovolt transmission line from the electricity grid (WCPL, 2003).

2.8.5 Dangerous Goods/Wastes

Hydrocarbon Storages

Hydrocarbons used on-site include fuels (diesel and petrol), oils, greases, degreaser and kerosene.

Procedures have been developed at Wambo for the handling, storage, containment and disposal of workshop hydrocarbons (i.e. oils, greases, degreaser and kerosene). Hydrocarbon storage facilities at Wambo are constructed and operated in accordance with Australian Standard (AS) 1940-2004 *The Storage and Handling of Flammable and Combustible Liquids*.

Waste hydrocarbons are collected, stored and removed by licensed waste transporters on a periodic basis (WCPL, 2011a).

Liquid and Non-Liquid Wastes

All solid and hazardous waste generated at Wambo is removed from the site and disposed of by a licensed contractor.

Sewage is treated in four on-site sewage treatment systems which are serviced by a licensed contractor (WCPL, 2011a).

Explosives Storage

Explosives required for Wambo include initiating products and detonators, ammonium nitrate fuel oil and emulsion. The explosives are used in accordance with AS 2187.2:2006 *Explosives – Storage, Transport and Use – Use of Explosives*.

Material Safety Data Sheets

No chemical or hazardous material are permitted on-site unless a copy of the appropriate Material Safety Data Sheet (MSDS) is available on-site or, in the case of a new product, it is accompanied by a MSDS.

2.9 SITE WATER MANAGEMENT AND SUPPLY

2.9.1 Site Water Management Strategy

The site water management strategy for Wambo is based on the containment and re-use of mine water and on the control of sediment that may be potentially carried with runoff from disturbed areas such as the waste rock emplacements.

The key components of the strategy are:

- Separation of undisturbed area runoff from disturbed area runoff.
- Collection and re-use of surface runoff from disturbed areas (including mining pre-strip areas, waste rock emplacements surfaces, etc.).

- Capture and on-site containment of mine water, comprising groundwater and/or surface water inflows to the open cut.
- Re-use of contained mine water for dust suppression over active surfaces (haul roads, waste rock emplacement surfaces, etc.).
- Consumption of contained waters in the site water supply system.
- Controlled release of excess site water in accordance with the Hunter River Salinity Trading Scheme.

2.9.2 Site Water Management System

The Wambo water management system (Figure 3) controls waters generated from development and operational areas while diverting upstream water around such areas. It includes both permanent structures that will continue to operate post-closure and temporary structures that will only be required until the completion of rehabilitation works. This system includes:

- up-catchment diversion structures;
- water storage dams;
- sediment dams;
- water transfer infrastructure (i.e. pumps and pipelines); and
- the North Wambo Creek Diversion.

The site water management system operates predominately as a closed self-contained system. The water balance of the system fluctuates with climatic conditions and as the extent of the mining operations evolves over time.

In accordance with Condition 25, Schedule 4 of Development Consent DA 305-7-2003, WCPL annually reviews the site water balance for Wambo and reports the results of this review in the Annual Review (previously reported in the Annual Environmental Management Report).

A section of North Wambo Creek has been diverted to avoid the Wambo open cut. The North Wambo Creek Diversion was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007b).

2.9.3 Water Supply

Water is predominately required at Wambo for the operation of the CHPP, for wash down of mobile plant, for dust suppression on haul roads and hardstand areas and for dust emission control sprays in the ROM and product coal stockpile areas. Water is also used in underground mines to control dust emissions in active mine areas. Some water is also used for watering vegetation establishment areas, fire fighting and other non-potable uses.

The site water supply priorities of Wambo are as follows (WCPL, 2003):

1. Recovery of supernatant waters and seepage from tailings storage areas.
2. Capture of incident rainfall and runoff across operational areas (i.e. open cut, infrastructure hardstands, CHPP and associated stockpiles).
3. Dewatering of underground mining operations.
4. Runoff captured from mine waste rock emplacement and pre-strip areas.
5. Trading of excess mine waters from surrounding mining operations.
6. Licensed extractions from the Hunter River.
7. Licensed extraction from Wollombi Brook.
8. Licensed capture of potential groundwater inflows from North Wambo Creek/Wollombi Brook alluvium.

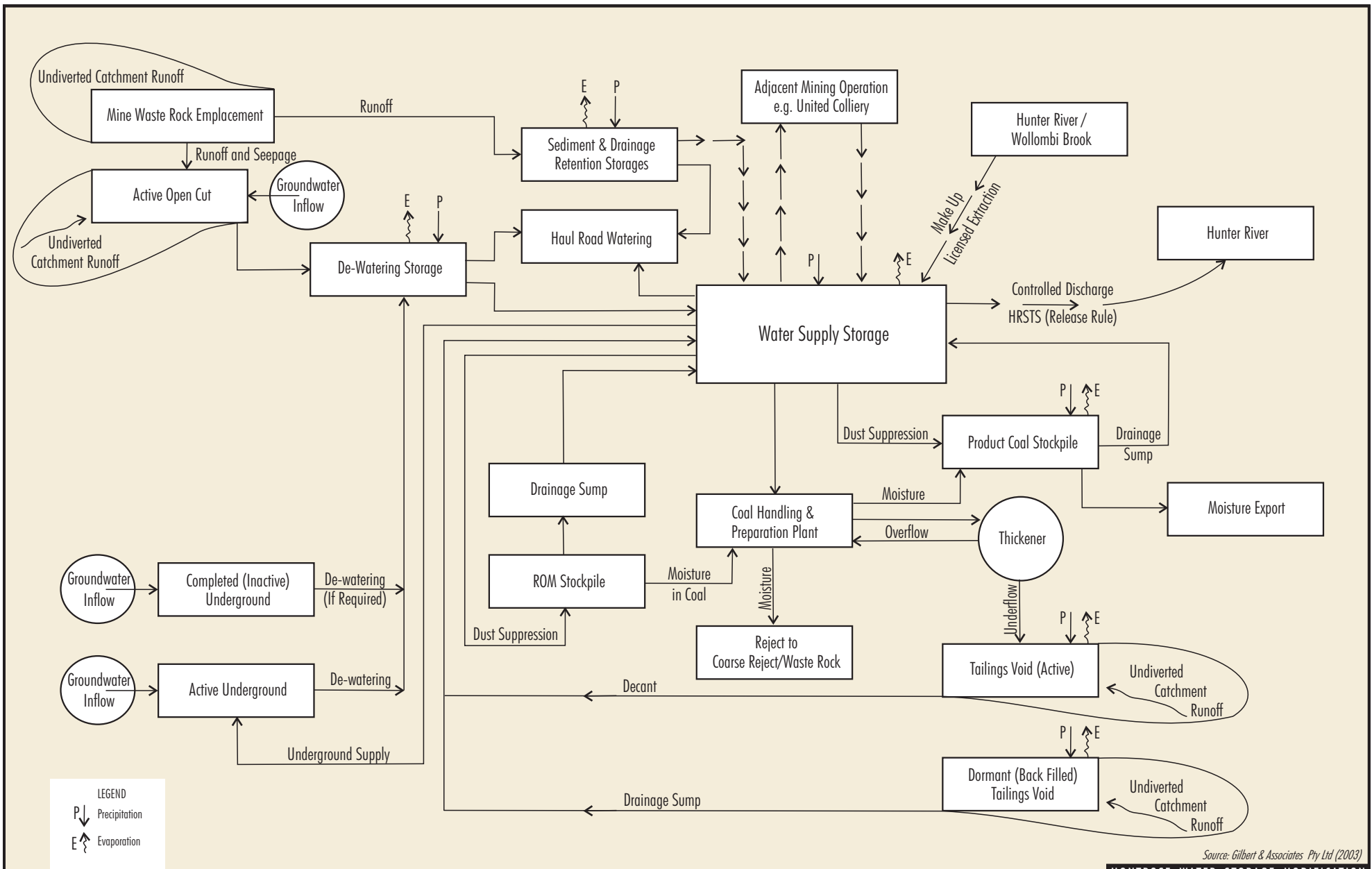
2.10 WORKFORCE

The Wambo workforce currently consists of approximately 842 employees and contractors (WCPL, 2011a).

2.11 REHABILITATION

Rehabilitation at Wambo occurs progressively as areas/landforms become available to minimise the area of disturbance at any one time. Approximately 264 hectares (ha) of final rehabilitation has been undertaken at Wambo (WCPL, 2011a).

A summary of the key elements of the rehabilitation programme at Wambo is provided below.



Source: Gilbert & Associates Pty Ltd (2003)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 3
 Schematic of Water Management System

2.11.1 Rehabilitation Principles and Objectives

The following rehabilitation principles form the basis for rehabilitation planning and design at Wambo (WCPL, 2003):

- Existing remnant vegetation to be preserved wherever possible.
- Integration of open cut mining and rehabilitation planning to minimise the area of disturbance at any one time.
- Progressive rehabilitation of disturbed areas, including partial rehabilitation of temporarily inactive waste rock emplacements.
- Creation of post-mining landforms that enhance the amenity of the local landscape and contribute to local and regional habitat corridors as presented in the *Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of New South Wales* (NSW Department of Mineral Resources, 1999).
- Consideration of issues of public safety in the design of final landforms.
- Consultation with the relevant state government authorities, SSC and the CCC during the final design and planning of rehabilitated landforms.
- Implementation of trials and design studies as necessary to maximise effectiveness of the rehabilitation programme.
- Routine monitoring in order to identify rehabilitated areas requiring maintenance works.

The rehabilitation objectives at Wambo include (WCPL, 2003):

- The creation of safe, stable, adequately drained post-mining landforms that are consistent with the local surrounding landscape.
- Establishment of woodland vegetation linking remnant vegetation to the north and east of Wambo with the eastern borders of Wollemi National Park.
- Preservation of existing beneficial use of water resources.
- Development of a sustainable post-mining land use plan towards the end of Wambo life.

2.11.2 Final Landform Concepts

The preferred final landform concepts for Wambo will be revised and refined throughout the life of Wambo, utilising the outcomes of ongoing consultation with relevant authorities, stakeholders and the results of rehabilitation trials.

Surface infrastructure with no ongoing beneficial use will be removed from the site at the completion of mining (WCPL, 2003). Some infrastructure (e.g. site access roads, water storages) may be retained for alternate post-mining uses (where agreed in consultation with the relevant landholders).

2.11.3 Revegetation Strategy

The Wambo revegetation programme will establish significant areas and a net increase in woodland vegetation over the long-term. The final distribution of woodland to be established on rehabilitated landforms will ultimately depend on the outcome of closure planning including the shape of final landforms and the agreed post-closure land use (WCPL, 2003).

In recognition of the importance of vegetation corridors to regional biodiversity, rehabilitation initiatives for Wambo will aim to increase the continuity of vegetation in the region through the establishment of woodland corridors. Accordingly, the rehabilitation programme has been designed to establish linkages between the rehabilitation areas, existing remnant vegetation and Wollemi National Park (WCPL, 2003).

The provisional revegetation strategy includes the revegetation of disturbance areas with areas of woodland (corridors), areas which contain a mixture of woodland and pasture, and riparian vegetation.

2.11.4 Remnant Woodland Enhancement Programme

Four Remnant Woodland Enhancement Programme (RWEPP) areas have been established at Wambo (Figure 2). The objective of the RWEPP areas is to help to conserve regional biodiversity, whilst enhancing the habitat available to flora and fauna (WCPL, 2010a). Conservation and enhancement of the RWEPP areas will strengthen the linkages to be developed between Wollemi National Park, existing remnant woodland and woodland rehabilitation areas (WCPL, 2010a).

Details of the management of the RWEPP areas are provided in the Flora and Fauna Management Plan (WCPL, 2010a).

2.11.5 Rehabilitation Trials and Audit

A number of capping studies have been undertaken on the North East Tailings Dam. The outcomes of these studies have been incorporated into the rehabilitation strategy currently being implemented at the North East Tailings Dam (WCPL, 2011a).

WCPL proposes to conduct the following rehabilitation trials during 2012 (WCPL, 2011a):

- Biosolids application on rehabilitated waste rock emplacements.
- Supplementary planting of native grass species seed mix, in areas of patchy tree establishment.
- Use of mobile tree mulchers during vegetation clearance so that mulch material can be placed on soil to be stripped. Potential benefits include dust suppression, erosion control and provision of organic matter in stripped topsoil.

2.12 ENVIRONMENTAL MONITORING AND MANAGEMENT

Environmental management at Wambo encompasses a range of management plans and monitoring programmes overseen by statutory planning provisions. Approved management plans/monitoring programmes include:

- Environmental Management Strategy (WCPL, 2010b).
- Environmental Monitoring Program (WCPL, 2010c).
- Flora and Fauna Management Plan (WCPL, 2010a).
- Air Quality Monitoring Program (WCPL, 2008b).
- Noise Monitoring Program (WCPL, 2007a).
- Blast Monitoring Program (WCPL, 2009).
- Site Water Management Plan incorporating the following:
 - North Wambo Creek Diversion Plan (WCPL, 2007b).
 - Groundwater Monitoring Program (WCPL, 2010d).
 - Surface Water Monitoring Program (WCPL, 2010e).
 - Erosion and Sediment Control Plan (WCPL, 2010f).
 - Surface and Groundwater Response Plan (WCPL, 2010g).

- North Wambo Underground Mine Subsidence Management Plan (WCPL, 2006).
- Surface and Subsurface Investigation Programme (Strata Engineering, 2005).
- Life of Mine Rejects Emplacement Strategy (WCPL, 2011b).
- Bushfire Management Plan (WCPL, 2008c).

WCPL maintains an extensive monitoring programme whereby data is collected, analysed and maintained for reporting, future examination and assessment. The locations of existing environmental monitoring sites at Wambo are shown on Figures 4 and 5.

2.13 COMPLAINTS

WCPL maintains a 24 hours a day, 7 days per week complaints line which is directed to the Environment and Community Manager.

WCPL received a total of 35 complaints during the 2010/2011 financial year. Approximately 70% of the complaints were received from two complainants. The complaints received were related to noise, dust, blasting and lighting (WCPL, 2011a).

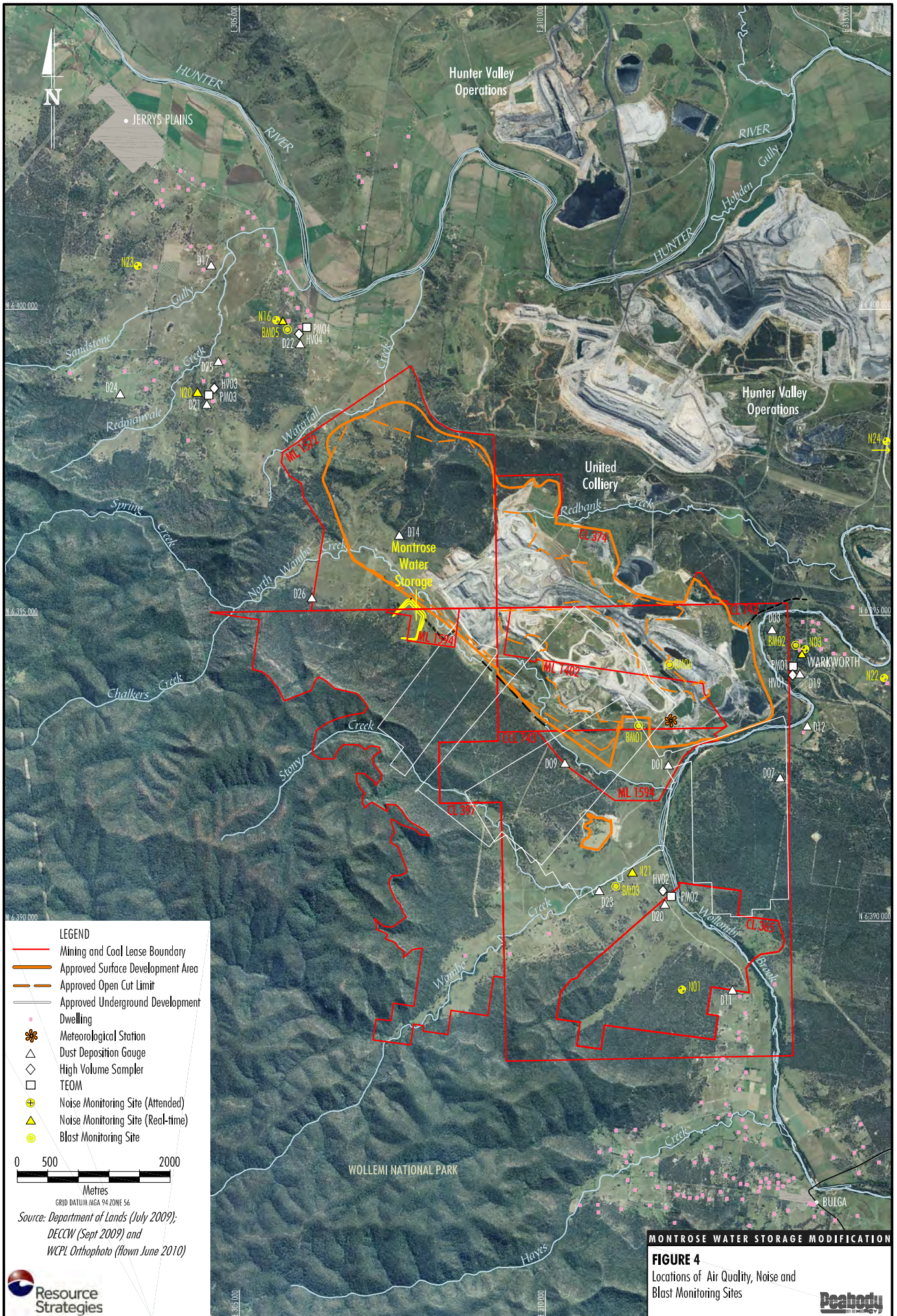
Mine-related complaints are managed in accordance with WCPL's Community Complaints Procedure.

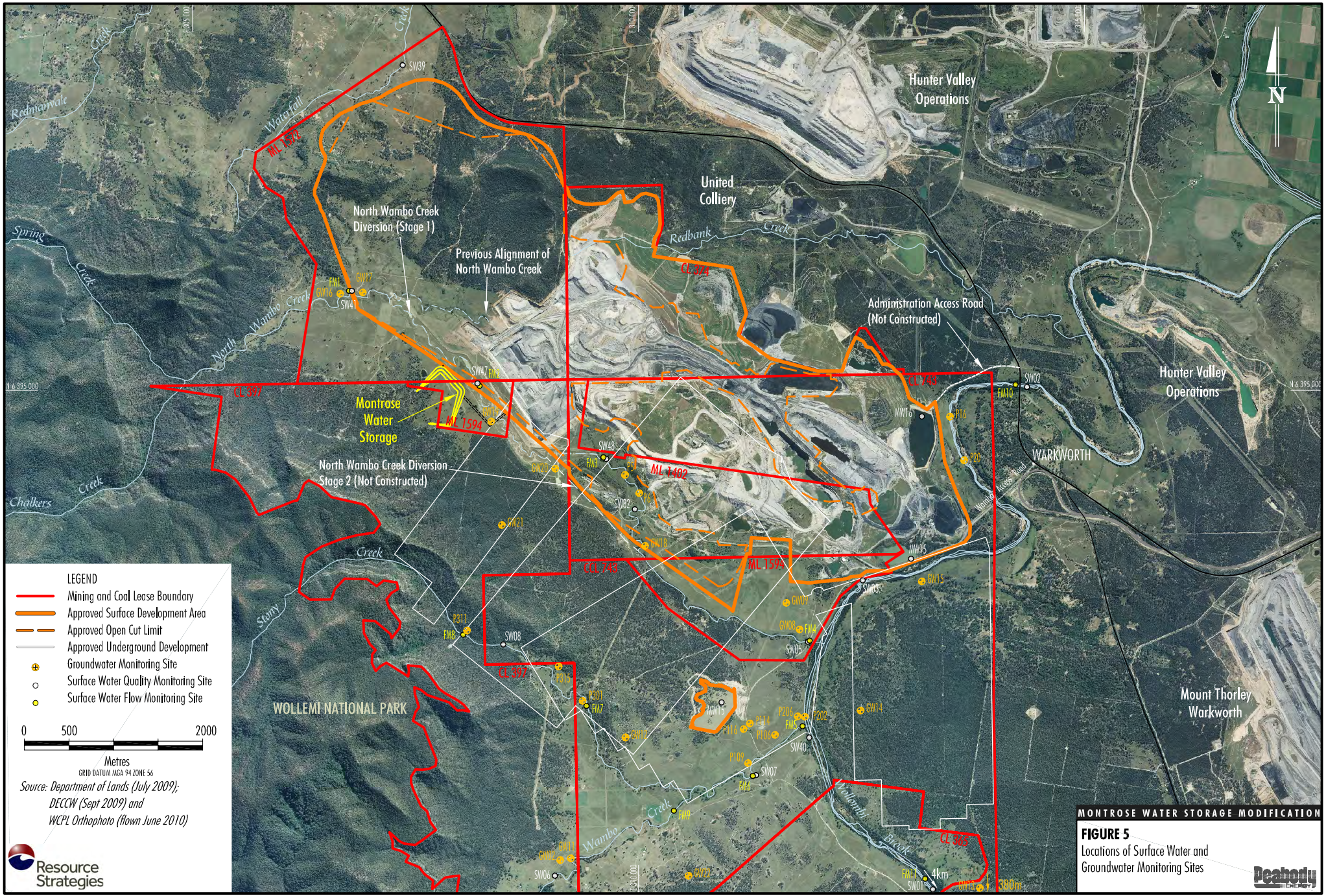
3 MONTROSE WATER STORAGE MODIFICATION

The Modification would not require any significant alteration to the approved Wambo operations and would not result in an alteration to the Wambo mining sequence.

3.1 REQUIREMENT FOR THE MONTROSE WATER STORAGE

The Modification is required to ensure adequate water storage is available at Wambo while the existing South Wambo Dam (approximately 840 ML capacity) is subsided by the approved North Wambo Underground Mine (Longwall 8). Water stored in the South Wambo Dam will be transferred to other water storages at Wambo (e.g. the proposed Montrose Water Storage) prior to the South Wambo Dam being subsided.





MONTROSE WATER STORAGE MODIFICATION

FIGURE 5
Locations of Surface Water and
Groundwater Monitoring Sites



The Montrose Water Storage (approximately 1,500 ML capacity) would temporarily replace the South Wambo Dam (approximately 840 ML capacity) while this dam is subsided by the North Wambo Underground Mine. Therefore the Modification would initially result in a net increase in site storage capacity of approximately 660 ML. Once mining at the North Wambo Underground Mine is complete and the South Wambo Dam is re-established the site storage capacity would increase by approximately 1,500 ML as a result of the Modification.

This additional storage capacity is required as a review of the site water balance indicated that additional contingent capacity is required as the frequency and duration of controlled releases under the Hunter River Salinity Scheme have been lower than previously anticipated resulting in on-site storage levels that have a higher risk of interruption to operations.

3.2 MONTROSE WATER STORAGE SITING AND DESIGN

3.2.1 Montrose Water Storage Siting

The Montrose Water Storage site was selected after a review of available water storage locations at Wambo taking into consideration physical constraints (i.e. topography, geological/soil conditions), ease of integration with the existing site water management system, cost of construction and the location of historical and future underground mine workings.

The final layout of the Montrose Water Storage at the selected site was designed to avoid known Aboriginal cultural heritage sites, minimise disturbance of remnant native woodland, and avoid the North Wambo Creek Diversion 1 in 100 year flood area.

3.2.2 Montrose Water Storage Design

The Montrose Water Storage would be a “turkey’s nest” style dam located to the south-west of the approved open cut limit (Figures 2 and 6) and would have a capacity of approximately 1,500 ML. The footprint of the Montrose Water Storage would be approximately 24 ha.

The design of the Montrose Water Storage would include aspects to minimise seepage, including constructing the embankments with a low permeability core and cut-off key that would be extended into competent basement material.

The Montrose Water Storage embankments would be constructed from material excavated from the Montrose Water Storage footprint.

Up-catchment diversions would be constructed on the southern side of the Montrose Water Storage to divert runoff around the Montrose Water Storage (i.e. no upslope surface water runoff would be collected). The up-catchment diversions would divert runoff into existing drainage lines which report to the North Wambo Creek Diversion.

The Montrose Water Storage would be operated to maintain freeboard to store a 1 in 100 year 72 hour rainfall event. In the event that the Montrose Water Storage was nearing capacity, measures (e.g. pumping water to other water storages) would be implemented to minimise the potential for release.

WCPL would obtain approval for the Montrose Water Storage from the Dam Safety Committee and would construct and operate it in accordance with the requirements of the approval. The Dam Safety Committee has indicated that the Montrose Water Storage would be a prescribed dam, and therefore WCPL would prepare and submit a Design Report that would include:

- detailed designs (including embankment and hydraulic design);
- construction methodology and quality control;
- details of water management; and
- details of operational monitoring requirements (e.g. regular inspections).

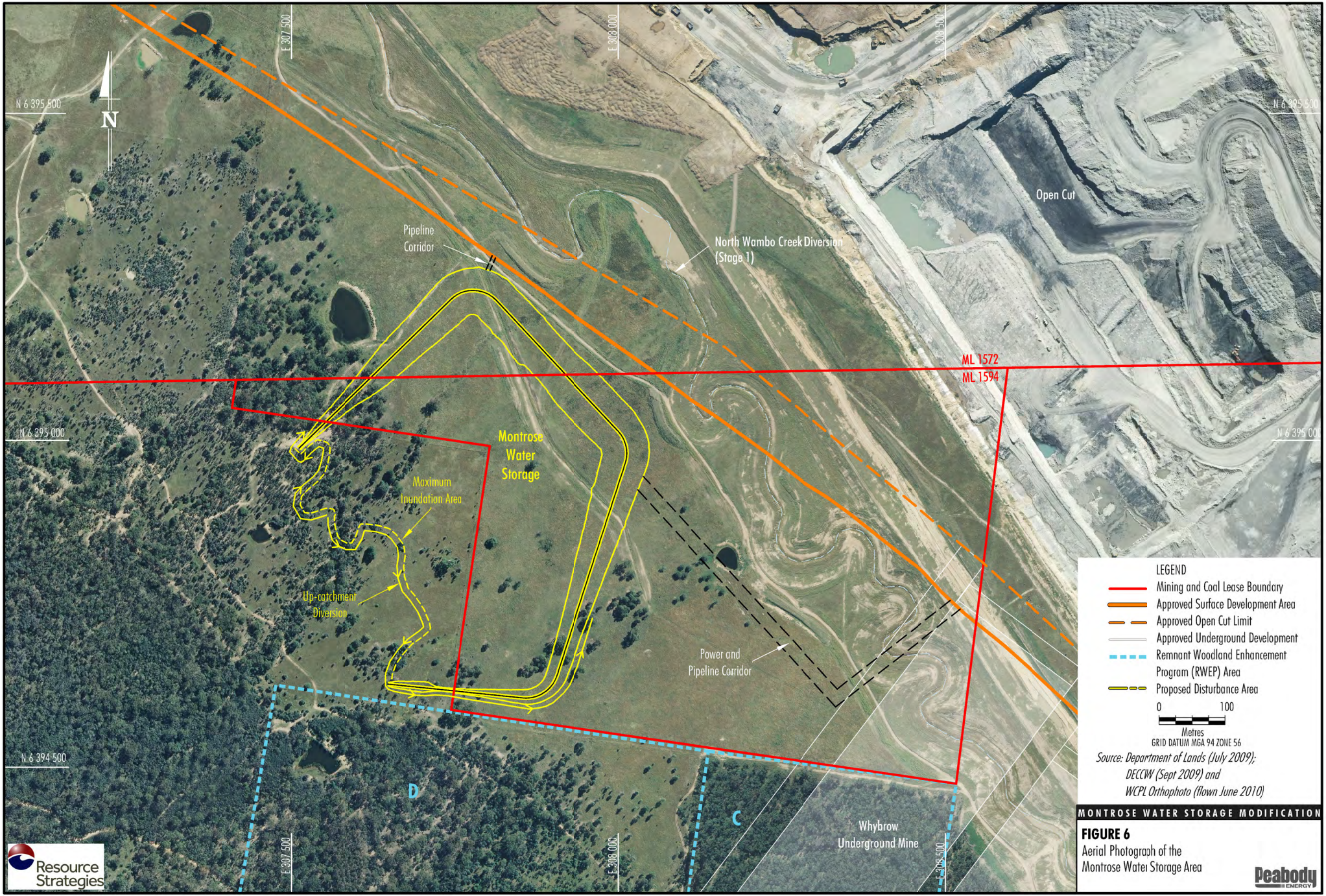
The Mining Operations Plan would be revised to include details of the operation of the Montrose Water Storage.

3.3 SUPPORTING INFRASTRUCTURE

Supporting infrastructure (i.e. pumps, pipelines and powerline) would be installed to transfer water between the Montrose Water Storage and other components of the site water management system.

Two service corridors would be required as part of the Modification. The pipeline corridor (approximately 6 m wide) would consist of a pipeline that would link the Montrose Water Storage to the open cut to the north (Figure 6).

The power and pipeline corridor (approximately 20 m wide) would consist of a pipeline and powerline that would link the Montrose Water Storage to existing infrastructure areas at Wambo to the north-east (Figure 6).



LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- - - Approved Open Cut Limit
- - - Approved Underground Development Program
- - - Remnant Woodland Enhancement Program (RWEPP) Area
- - - Proposed Disturbance Area

0 100
Metres
GRID DATUM MGA 94 ZONE 56

Source: Department of Lands (July 2009);
DECCW (Sept 2009) and
WCPL Orthophoto (flown June 2010)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 6
Aerial Photograph of the
Montrose Water Storage Area



The service corridors traverse grazing land and their locations have been selected to avoid known Aboriginal cultural heritage sites and remnant native woodland.

The pipelines would be poly pipe laid on the ground surface and would be located so that no material land disturbance works would be required.

Leak detection and shutdown systems would be installed in the pipelines to identify and respond to variations in flow rates (used to detect leaks in the pipeline or other malfunctions).

Crossing structures would be constructed to allow the pipelines to cross the North Wambo Creek Diversion without interrupting flow. At these crossings, the pipelines would be encased to contain leakage if the pipeline was to fracture before automatic cut-off valves were activated.

Where the pipelines cross the existing track (Figure 6) they would be buried to allow vehicles to continue to utilise the track. Disturbance would be restricted to the existing track disturbance areas.

The powerline would be located so that no material land disturbance works (apart from the installation of power poles) would be required. No material land disturbance works or disturbance of known Aboriginal cultural heritage sites would be required for the installation of the power poles.

Vehicular access to the Montrose Water Storage would be via existing tracks.

3.4 SITE WATER MANAGEMENT

A description of the existing site water management strategy is provided in Section 2.9.1. The site water management system (Section 2.9.2) would remain unchanged except for the addition of the Montrose Water Storage and the temporary loss of the South Wambo Dam while this dam is subsided by the North Wambo Underground Mine.

Water stored in the South Wambo Dam will be transferred to other water storages at Wambo (e.g. the proposed Montrose Water Storage) prior to the South Wambo Dam being subsided.

The South Wambo Dam will be re-established once mining in the North Wambo Underground Mine is complete so that it can continue to be used as a water storage.

As described in Section 3.1, the Modification would initially result in a net increase in site storage capacity of approximately 660 ML. Once mining at the North Wambo Underground Mine is complete and the South Wambo Dam is re-established the site storage capacity would increase by approximately 1,500 ML as a result of the Modification.

3.5 WATER SUPPLY

A description of the existing site water supply and their priorities is provided in Section 2.9.3. The water supply priorities would remain unchanged for the Modification. The Site Water Management Plan (including the Site Water Balance) would be revised to include the Montrose Water Storage (subject to Development Consent conditions).

3.6 CONSTRUCTION

The Montrose Water Storage would be constructed in accordance with the Design Report which is approved by the Dam Safety Committee.

Vegetation clearance required for the construction of the Montrose Water Storage would be conducted in accordance with the Vegetation Clearance Protocol included in the Flora and Fauna Management Plan (WCPL, 2010a).

Topsoil would be stripped and then temporarily stockpiled inside the Montrose Water Storage footprint. The topsoil would be reapplied to the embankment walls once they have been constructed.

The Montrose Water Storage embankments would be constructed from material excavated from the Montrose Water Storage footprint.

The fleet used to construct the Montrose Water Storage would include excavators, dump trucks, scrapers, graders and compactors.

No blasting would be required for the Modification.

Construction of the Montrose Water Storage and associated supporting infrastructure would take approximately 6 months and require approximately 12 additional employees/contractors. Construction works would generally be undertaken during daytime hours (7.00 am to 6.00 pm Monday to Friday and 7.00 am to 4.00 pm Saturday).

3.7 DECOMMISSIONING AND REHABILITATION

The Montrose Water Storage would ultimately be either retained for beneficial use by the relevant landholder (i.e. used to support agricultural activities) or decommissioned and the area rehabilitated in accordance with the Flora and Fauna Management Plan (WCPL, 2010a) and the Wambo rehabilitation principles and objectives (Section 2.11.1).

Revegetation of the proposed Montrose Water Storage site would include the:

- use of endemic plant species which are characteristic of the vegetation communities disturbed (Section 4.5);
- establishment of upper, mid and lower story native vegetation; and
- the use of regionally significant flora species.

4 ENVIRONMENTAL ASSESSMENT

4.1 LAND RESOURCES

4.1.1 Background

Landforms and Topography

Wambo is located in the Upper Hunter Valley region where landforms are characterised by gently sloping flood plains associated with the Hunter River and the undulating foothills, ridges and escarpments of the Mount Royal Range and Great Dividing Range.

Elevations in the vicinity of Wambo range from approximately 60 m Australian Height Datum (AHD) at Wollombi Brook to approximately 650 m AHD at Mount Wambo within the Wollemi National Park to the west of Wambo (WCPL, 2003). Elevations in the Montrose Water Storage area range from approximately 100 m AHD at the North Wambo Creek Diversion to approximately 130 m AHD in the south.

Land Use

Land use in the vicinity of Wambo is characterised by a combination of coal mining operations, agricultural land uses and the village of Warkworth. WCPL-owned lands that are not subject to mining operations are utilised for the agistment of stock (WCPL, 2003).

The Montrose Water Storage area is wholly located on WCPL-owned land and land use includes cleared grazing land (rain-fed unimproved pasture) (Appendix D) and patches of remnant native woodland.

Soils

An Agricultural Resource Assessment was undertaken for the Modification by McKenzie Soil Management (2012) and is included as Appendix D.

The soil types mapped in the Montrose Water Storage area comprise Grey Sodosol, Brown Sodosol, Red Kandosol, Brown Kandosol and Spolic Anthrosol. No alluvial soils were observed in the Montrose Water Storage area.

Soil Condition

A broad range of soil physical and chemical constraints for agricultural land use were identified in the Montrose Water Storage area including (Appendix D):

- soil acidity and associated aluminium toxicity;
- a lack of water holding capacity;
- dispersive subsoil;
- subsoil salinity; and
- nutrient deficiencies.

Rural Land Capability and Agricultural Suitability

Regional Rural Land Capability mapping has been completed by the Soil Conservation Service of NSW (1985). Regional Agricultural Suitability mapping has been completed by NSW Agriculture (1983).

The regional Rural Land Capability and Agricultural Suitability mapping is documented in Appendix D.

Agricultural Activities and Productivity

Agricultural activities known to have been conducted in the Montrose Water Storage area include beef cattle production on rain-fed unimproved pasture. There was no evidence of crop production or vineyards in the Montrose Water Storage area (Appendix D).

The Montrose Water Storage area is not considered to be highly productive agriculture land given the soil limitations for plant growth and the nature of agricultural activities conducted (Appendix D).

Strategic Agricultural Lands

The *Draft Upper Hunter Strategic Regional Land Use Plan* (Upper Hunter DSRLUP) (NSW Government, 2012) includes mapping of lands identified as Biophysical Strategic Agricultural Land (BSAL). Figure 7 shows BSAL mapped in the vicinity of Wambo.

BSAL is classified as land with a soil fertility of 'high' or 'moderately high' (Draft Inherent General Fertility of NSW), Class II or III Land and Soil Capability, with reliable water of suitable quality and a minimum area of 20 ha (NSW Government, 2012).

The closest mapped BSAL in the Upper Hunter DSRLUP is associated with the Hunter River and is located approximately 3 km to the north of the Montrose Water Storage (Figure 7) (Appendix D).

The Upper Hunter DSRLUP also includes mapping of lands identified as Viticulture and Equine Critical Industry Clusters (Figure 7).

The closest Viticulture Critical Industry Cluster is located approximately 1 km to the south of the Montrose Water Storage (Figure 7). The closest Equine Critical Industry Cluster is located approximately 8 km to the north-west of the Montrose Water Storage (Figure 7) (Appendix D).

There was no evidence of viticulture in the Montrose Water Storage area (Appendix D).

McKenzie Soil Management completed an assessment of the Montrose Water Storage area and determined that the area did not meet the BSAL criteria outlined in the Upper Hunter DSRLUP (Appendix D).

4.1.2 Environmental Review

Landforms and Topography

The Modification would alter the landforms and topography within the Montrose Water Storage footprint. The topographic changes involved would be insignificant in the context of the existing approved mine landforms (Figure 2).

Soils

Potential impacts of the Modification on soils would relate primarily to:

- disturbance of in-situ soil resources within Montrose Water Storage area;

- increased erosion and sediment movement due to exposure of soils during construction; and
- alteration of physical and chemical soil properties (e.g. structure, fertility, permeability and microbial activity) due to soil stripping and stockpiling operations.

General soil resource management practices would include the stripping and stockpiling of soil resources for use in rehabilitation. The objectives of soil resource management for the Montrose Water Storage area would be to:

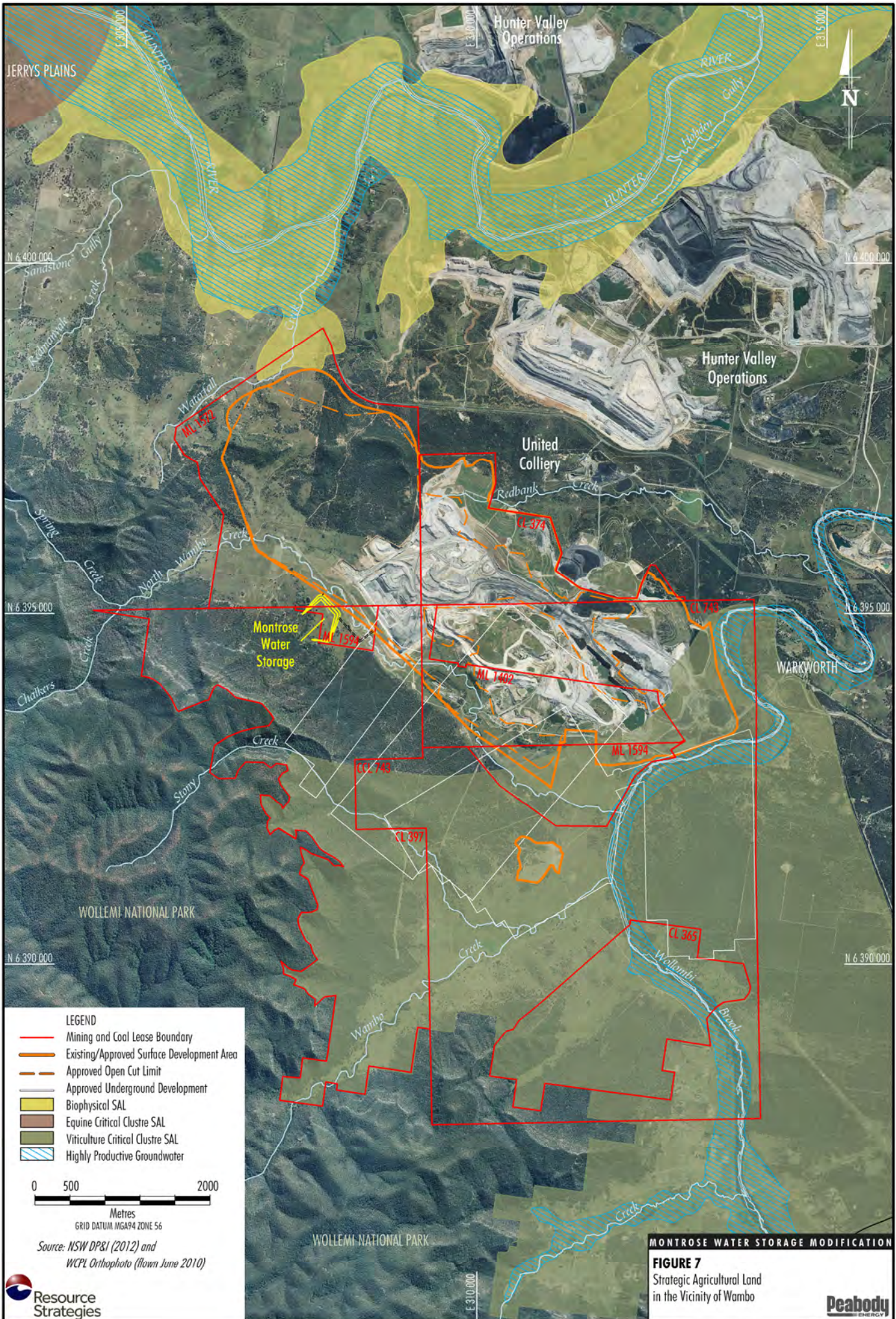
- identify and quantify potential soil resources for rehabilitation;
- optimise the recovery of useable soil reserves during soil stripping operations;
- manage soil reserves so as not to degrade the resource when stockpiled; and
- establish effective soil amelioration procedures to maximise the availability of soil reserves for future rehabilitation works.

The following management measures would be implemented during the stripping of soils in the Montrose Water Storage area:

- areas of disturbance requiring soil stripping would be clearly defined following vegetation clearing; and
- soil stripping during periods of high soil moisture content (i.e. following heavy rain) would be avoided to reduce the likelihood of damage to soil structure.

Any long-term soil stockpiles would be managed to maintain long-term soil viability through the implementation of relevant management practices as listed below:

- Soil stockpiles would be retained at a height of 3 m, with slopes no greater than 1:2 (vertical to horizontal [V:H]) and a slightly roughened surface to minimise erosion.
- Soil stockpiles would be constructed to minimise erosion, encourage drainage, and promote revegetation.
- Wherever practicable, soil would not be trafficked, deep ripped or removed in wet conditions to avoid breakdown in soil structure.



LEGEND

- Mining and Coal Lease Boundary
- Existing/Approved Surface Development Area
- - - Approved Open Cut Limit
- Approved Underground Development
- Biophysical SAL
- Equine Critical Clustre SAL
- Viticulture Critical Clustre SAL
- Highly Productive Groundwater

0 500 2000
Metres
GRID DATUM MGA94 ZONE 56
Source: NSW DP&I (2012) and
WCPL Orthophoto (flown June 2010)

Resource Strategies

MONTROSE WATER STORAGE MODIFICATION

FIGURE 7
Strategic Agricultural Land
in the Vicinity of Wambo

Peabody ENERGY

- All soil stockpiles would be seeded with a non-persistent cover crop to reduce erosion potential as soon as practicable after completion of stockpiling. Where seasonal conditions preclude adequate development of a cover crop, stockpiles would be treated with a straw/vegetative mulch to improve stability.
- Soil stockpiles would be located in positions to avoid surface water flows. Silt stop fencing would be placed immediately down-slope of stockpiles until stable vegetation cover is established.
- An inventory of soil resources (available and stripped) at Wambo would be maintained and reconciled annually with rehabilitation requirements.
- Weed control programmes would be implemented on soil stockpiles if required.

Land Use - Agricultural Activities and Productivity

The Modification would result in the disturbance or alteration of approximately 21 ha of existing agricultural lands (i.e. grazing land).

These potentially sterilised agricultural lands are not considered to be highly productive (Appendix D). It is therefore considered that the Modification has very little potential to materially affect regional agricultural production or demand for agricultural infrastructure, supplies and services at a local or regional level.

The Montrose Water Storage would ultimately be either retained for beneficial use by the relevant landholder (i.e. used to support agricultural activities) or decommissioned and the area rehabilitated in accordance with the Flora and Fauna Management Plan (WCPL, 2010a) and the Wambo rehabilitation principles and objectives (Section 3.7) (i.e. establishment of woodland vegetation).

WCPL-owned lands that adjoin Wambo would continue to be used for agricultural uses (e.g. via agistment of stock).

The potential impacts of the Project on the local amenity of adjoining privately-owned land, or water resources available for agricultural use, are considered where relevant in the surface water, groundwater, noise and blasting, air quality and visual sections (Sections 4.2, 4.3, 4.7, 4.8 and 4.11).

4.2 SURFACE WATER

4.2.1 Background

Gilbert and Associates prepared a surface water assessment for Wambo in 2003 (Gilbert and Associates, 2003).

Hydrology

Wambo is situated adjacent to Wollombi Brook, south-west of its confluence with the Hunter River (Figures 1 and 2). Wollombi Brook drains an area of approximately 1,950 square kilometres and joins the Hunter River some 5 km north-east of Wambo. The Wollombi Brook sub-catchment is bound by the Myall Range to the south-east, Doyles Range to the west, the Hunter Range to the south-west and Broken Back Range to the north-east (Hunter Catchment Management Trust, 2002).

The majority of lands within WCPL mining tenements drain via Wambo, Stony, North Wambo and Redbank Creeks to Wollombi Brook, while Waterfall Creek drains directly to the Hunter River (Figure 2).

A section of North Wambo Creek has been diverted to avoid the Wambo open cut (Figure 6). The North Wambo Creek Diversion was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007b).

Site Water Management and Monitoring

A description of the existing site water management strategy and system are provided in Sections 2.9.1 and 2.9.2, respectively.

A Surface and Groundwater Response Plan (WCPL, 2010g) for Wambo was established in 2005 and details measures to mitigate potential surface and groundwater impacts.

The Erosion and Sediment Control Plan (WCPL, 2010f) for Wambo was established in 2005 and identifies potential erosion and sediment sources, details design criteria, inspection and monitoring programmes, and reporting requirements.

A Surface Water Monitoring Program (WCPL, 2010e) for Wambo was established in 2005 and details surface water quality, stream flow and creek bed stability monitoring programs, water quality criteria, data review, and reporting requirements.

Surface water quality is generally monitored monthly at each of the surface water monitoring sites (Figure 5) and stream flow is measured at the surface water flow monitoring sites (Figure 5) during flow events.

4.2.2 Environmental Review

Hydrology and Flooding

The Montrose Water Storage would be a “turkey’s nest” style dam (Figure 6) and therefore only incident rainfall would be collected by the Montrose Water Storage.

The Montrose Water Storage footprint (i.e. the excised catchment area – 24 ha) represents approximately 0.49% and 0.01% of the total catchment area of North Wambo Creek and Wollombi Brook, respectively. The Modification is therefore not expected to significantly change flows in North Wambo Creek and Wollombi Brook.

The Montrose Water Storage site is located outside the North Wambo Creek Diversion 1 in 100 year flood area and therefore the Modification is not expected to significantly change flooding impacts along North Wambo Creek or Wollombi Brook.

Erosion and Sediment Control

The Modification is not expected to materially alter erosion and sediment control requirements.

Potential erosion and sedimentation impacts could potentially occur during the construction of the Montrose Water Storage.

Construction activities associated with the Modification would be undertaken in accordance with the Erosion and Sediment Control Plan (WCPL, 2010f).

The Erosion and Sediment Control Plan (WCPL, 2010f) applies the following general principles:

- Separation of runoff from disturbed and undisturbed areas where practicable.
- Construction of sediment dams or utilisation of existing mine water storages to contain runoff up to a specified design criterion.
- Construction of surface drains to facilitate the efficient transport of surface runoff. Drains will be designed using trapezoidal or parabolic cross-sections.
- Progressive rehabilitation/stabilisation of mine infrastructure areas.

The Erosion and Sediment Control Plan (WCPL, 2010g) would be reviewed, and if necessary, revised to include the Modification (subject to Development Consent conditions).

Water Supply

Water supply prioritisation at Wambo, as described in Section 2.9, would remain unchanged for the Modification.

Site Water Balance

The site water balance would be reviewed to incorporate the Modification. The results of the site water balance review would be reported in the Annual Review in accordance with Condition 25, Schedule 4 of the Development Consent DA-305-7-2003.

4.3 GROUNDWATER

4.3.1 Background

Australasian Groundwater and Environmental Consultants (AGE) assessed the potential hydrogeological impacts of Wambo in 2003 (AGE, 2003). The study included numerical modelling to assess the potential cumulative impacts of Wambo and surrounding mining operations on groundwater resources.

Hydrogeological Regime

The hydrogeological regime of the Wambo area comprises two main systems (AGE, 2003):

- Quaternary alluvial aquifer system of channel fill deposits associated with Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek.
- Underlying Permian strata of hydrogeologically “tight” and hence very low yielding to essentially dry sandstone and lesser siltstone and low to moderately permeable coal seams which are the prime water bearing strata within the Permian sequence.

Alluvial Aquifers

The alluvial flow in North Wambo Creek has been altered by the historical and existing mining operations including the removal of alluvium across the full width of the channel with consequent desaturation of the adjacent upstream and downstream alluvium.

As described in Section 4.2.1, a section of North Wambo Creek has been diverted to avoid the Wambo open cut (Figure 6). The North Wambo Creek Diversion (Figure 6) was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007b).

Permian Aquifers

Historical and ongoing open cut and underground mining within the Wambo area (including adjoining mining operations) has created significant groundwater sinks. This has generated a regional zone of depressurisation within the Permian coal measures.

Groundwater Monitoring Program

The Groundwater Monitoring Program (WCPL, 2010d) for Wambo was established in 2005 and details a monitoring program, groundwater impact assessment criteria, data review and investigation processes, and reporting requirements.

Groundwater levels and quality are generally monitored bi-monthly at each of the groundwater monitoring sites (Figure 5) and results are reported in the Annual Review.

Surface and Groundwater Response Plan

The Surface and Groundwater Response Plan (WCPL, 2010g) for Wambo was established in 2005 and details measures to mitigate potential surface and groundwater impacts and includes the North Wambo Creek Subsidence Response Strategy (WCPL, 2010h).

4.3.2 Environmental Review

Alluvial Aquifers

The construction and operation of the Montrose Water Storage is not expected to have any significant impact on alluvial aquifer systems.

A geophysical investigation of the alluvium along North Wambo Creek in the vicinity of the Montrose Water Storage was undertaken by GHD (2007). Two methods were employed:

- multi-frequency electromagnetics, which is capable of distinguishing between sandy sediments, clayey materials and hard rock; and
- seismic refraction, which is capable of accurate depth to bedrock determinations.

The resulting mapping is shown on Figure 8.

The alluvium within the floodplain associated with North Wambo Creek merges gradually at the margins with colluvium (sand/clay) and regolith (clay/weathered bedrock material) (Figure 8).

The Montrose Water Storage would not be located in the North Wambo Creek alluvium (Figure 8). No alluvial soils were observed in the Montrose Water Storage area during the soil survey (Appendix D).

Notwithstanding, the design of the Montrose Water Storage would include aspects to minimise seepage, including constructing the embankments with a low permeability core and cut-off key that would be extended into competent basement material (Section 3.2). The potential for interaction (i.e. seepage) between the Montrose Water Storage and alluvial aquifer systems is therefore considered to be minimal.

In addition, the Groundwater Monitoring Program (WCPL, 2010d) would be revised to include a programme to investigate and monitor potential water loss (i.e. seepage) from the Montrose Water Storage to surrounding alluvial aquifers (subject to Development Consent conditions).

Permian Aquifers

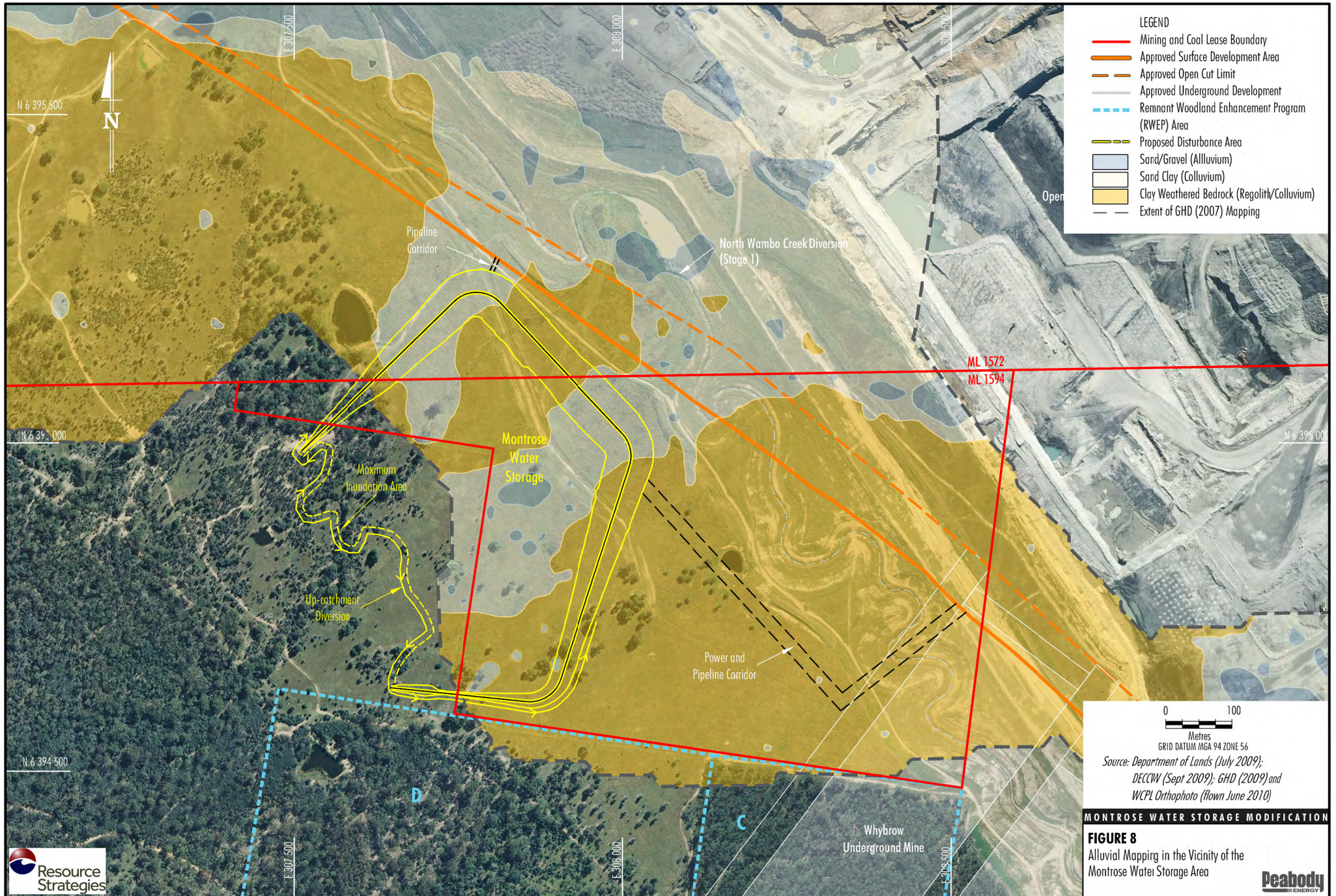
The construction and operation of the Montrose Water Storage is not expected to have a significant impact on the local groundwater systems.

Notwithstanding, groundwater levels and quality would continue to be monitored at Wambo in accordance with the Groundwater Monitoring Program (WCPL, 2010d) which would be revised to include a programme to investigate and monitor potential water loss (i.e. seepage) from the Montrose Water Storage as described above (subject to Development Consent conditions).

4.4 ABORIGINAL HERITAGE

4.4.1 Background

A number of Aboriginal cultural heritage surveys and assessments have previously been undertaken across Wambo and surrounding areas. The most recent large-scale survey and assessment was undertaken in 2002 by White (2003).



A total of 292 sites were identified across the study area, which included the Montrose Water Storage area. Sites identified included:

- a carved tree/ceremonial site;
- grinding groove sites;
- scarred trees;
- potential archaeological deposits (PADs); and
- isolated objects and object scatters (open sites).

In addition, RPS conducted an Aboriginal heritage survey and assessment in 2010 immediately adjacent to the Montrose Water Storage area on similar landforms. A total of four sites including an isolated artefact, an artefact scatter, a scarred tree and a PAD were identified during the 2010 surveys.

Aboriginal Cultural Heritage Management

Management of Aboriginal cultural heritage at Wambo is conducted in consultation with the Aboriginal community and in accordance with the requirements and conditions of Consent No. 2222 under section 90 of the *National Parks and Wildlife Act, 1974*.

4.4.2 Environmental Review

RPS (2012) prepared a due diligence assessment for the Modification (Appendix A). The assessment was undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects* (Department of Environment, Climate Change and Water, 2010) and the *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (Minerals Council, 2010). These codes require that reasonable and practicable steps be taken to identify whether or not Aboriginal objects are, or are likely to be, present in an area and determine whether or not the activities proposed are likely to harm Aboriginal objects.

A search of the Aboriginal Heritage Information Management System database and the Wambo Aboriginal heritage site register indicated that there were no recorded sites in the Montrose Water Storage area. In addition, RPS (2012) conducted a visual inspection of the Montrose Water Storage area.

Two Aboriginal heritage site (Sites 230 and 231) and three potential archaeological deposits (PADs) (PAD J, PAD K and PAD L) are located in the vicinity of the Montrose Water Storage area (Figure 9) (Appendix A). On the basis of these findings, the Montrose Water Storage and associated infrastructure were redesigned to avoid impact to these known sites.

Impact Assessment

No known Aboriginal sites or objects are located in the proposed disturbance area for the Modification (Appendix A).

Mitigation Measures

Aboriginal sites in the vicinity of the Montrose Water Storage area (Site 230, PAD J, PAD K and PAD L) would be fenced to avoid accidental damage by personnel or infrastructure works (Figure 9).

4.5 FLORA

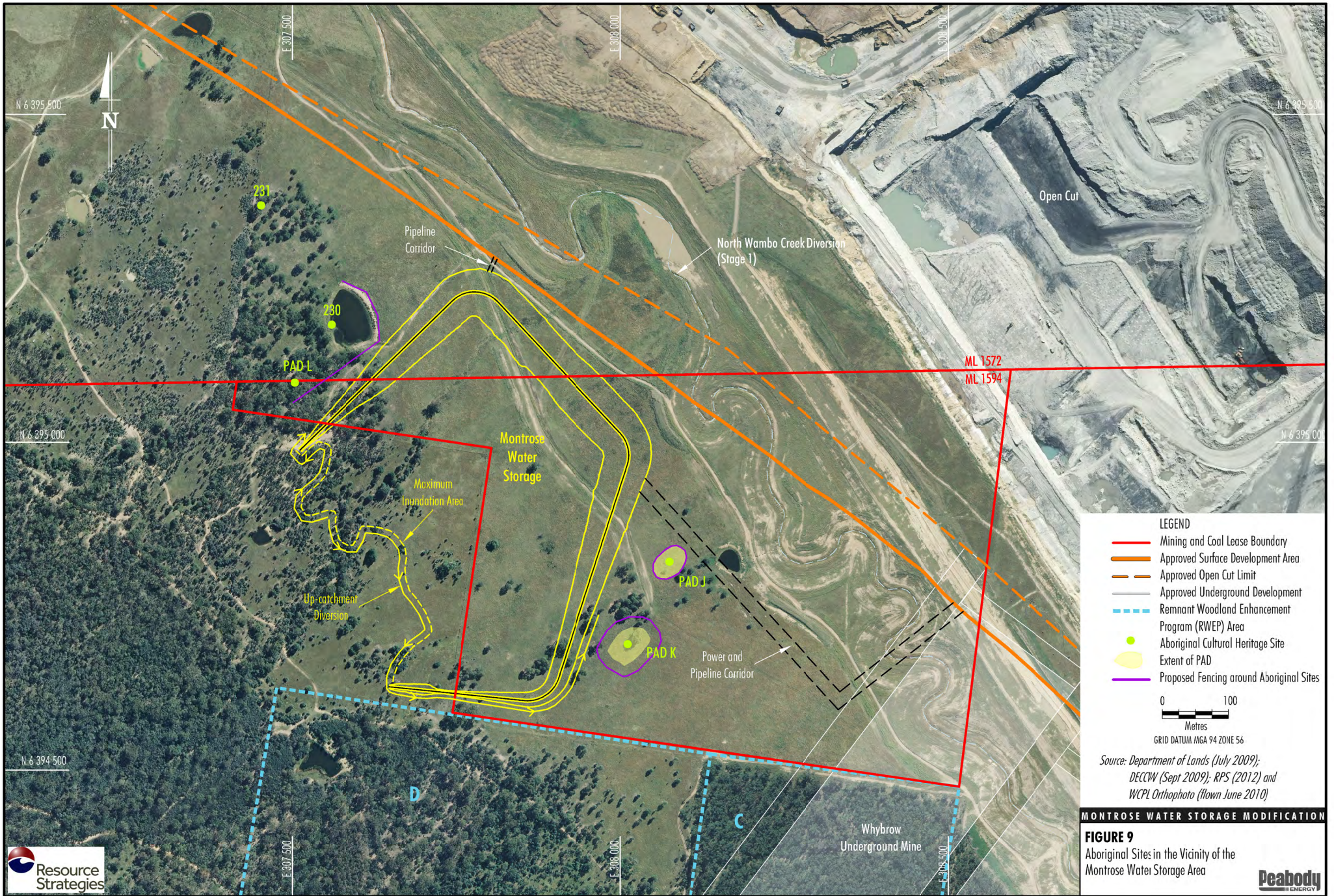
4.5.1 Background

A flora survey and assessment was conducted by Orchid Research (2003) for Wambo in 2003. Areas of remnant vegetation were systematically surveyed using quadrats and spot sampling sites to compile a comprehensive species list and to detect threatened species which may have been present.

Remnant vegetation was dominated by eucalypt forests and woodlands, however thin strips of River She-oak (*Casuarina cunninghamiana*) were reported to occur along North Wambo Creek, Wambo Creek, Stony Creek and Wollombi Brook and sand dune heathy woodlands were also reported to be present.

A number of tree species including Narrow-leaved Ironbark (*Eucalyptus crebra*), Grey Box (*E. moluccana*) and Bulloak (*Allocasuarina luehmannii*) were widespread and common and associate within many other species. Other dominant tree species include Spotted Gum (*Corymbia maculata*), Grey Gum (*E. punctata*), Blakely's Red Gum (*E. blakelyi*), Rough-barked Apple (*Angophora floribunda*) and Drooping She-oak (*Allocasuarina verticillata*).

No threatened flora species or populations listed under the *NSW Threatened Species Conservation Act, 1995* (TSC Act) or the *Commonwealth Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) were recorded at Wambo by Orchid Research (2003).



- LEGEND**
- Mining and Coal Lease Boundary
 - Approved Surface Development Area
 - Approved Open Cut Limit
 - Approved Underground Development
 - Remnant Woodland Enhancement Program (RWEP) Area
 - Aboriginal Cultural Heritage Site
 - Extent of PAD
 - Proposed Fencing around Aboriginal Sites

0 100
Metres
GRID DATUM MGA 94 ZONE 56

Source: Department of Lands (July 2009);
DECCW (Sept 2009); RPS (2012) and
WCPL Orthophoto (flown June 2010)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 9
Aboriginal Sites in the Vicinity of the
Montrose Water Storage Area



Orchid Research (2003) recorded two threatened ecological communities in the vicinity of Wambo, namely the Warkworth Sands Woodland Endangered Ecological Community (EEC) (listed in the TSC Act) and the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodlands EEC (listed in the TSC Act).

Flora and Fauna Management Plan

A Flora and Fauna Management Plan (WCPL, 2010a) for Wambo was developed in 2005 and includes a vegetation clearance protocol, threatened species management protocol, RWEP management measures, rehabilitation programme and rehabilitation and RWEP monitoring programs.

4.5.2 Environmental Review

FloraSearch (2012) prepared a Flora Assessment for the Modification (Appendix B) and a summary is provided below. The Flora Assessment was prepared in consideration of the *Threatened Species Assessment Guidelines: The Assessment of Significance* (NSW Department of Environment and Climate Change [DECC], 2007).

Baseline Flora Surveys

Baseline flora surveys were conducted across the Montrose Water Storage area and wider surrounds in accordance Department of Environment and Conservation (DEC) (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* over 14 days during January 2010, February 2010 and July 2010. Flora was systematically surveyed using quadrats, spot sampling and random meanders. Targeted searches for threatened flora species and other plant species of conservation significance were conducted in areas of suitable habitat as part of the field surveys (Appendix B).

As a component of the baseline flora surveys, a number of reference sources including previous relevant flora surveys, database records (e.g. Office of Environment and Heritage Atlas of NSW Wildlife and Royal Gardens Trust, Sydney database records) and other scientific studies and literature were reviewed, and where appropriate, included in the assessment of existing vegetation (Appendix B).

Vegetation Communities

Three vegetation communities have been mapped within the Montrose Water Storage area and surrounds (Table 2 and Figure 10). A detailed description of these vegetation communities is provided in Appendix B.

Table 2
Vegetation Communities Recognised
within the Montrose Water Storage Area

Community Number	Common Names	Scientific Names
1	Central Hunter Box – Ironbark Woodland	<i>E. crebra</i> – <i>E. moluccana</i> – <i>Allocasuarina luehmannii</i>
2	Hunter Valley Footholes Slaty Box Woodland	<i>E. dawsonii</i> – <i>E. moluccana</i> – <i>Acacia salicina</i>
3	Secondary Native Grassland	<i>Panicum effusum</i> – <i>Sporobolus creber</i> – <i>Bothriochloa decipiens</i>

Source: after Appendix B.

Condition of Vegetation

The native vegetation within the Montrose Water Storage area is in relatively poor condition. The whole area has been highly disturbed historically by clearing, logging and grazing (Appendix B).

Flora Species Composition

A total 264 plant species were identified in the broader distribution of the three vegetation communities (Appendix B). The plant families with the highest numbers of species were the Grasses, Poaceae (57 species); Daisies, Asteraceae (25 species); the saltbushes and bluebushes, Chenopodiaceae (14 taxa); the Pea Flowers, subfamily Faboideae (13 species); the Wattles, subfamily Mimosoideae (9 species) and the Eucalypts and related genera in the family Myrtaceae (8 species) (Appendix B).

Introduced Flora Species and Noxious Weeds

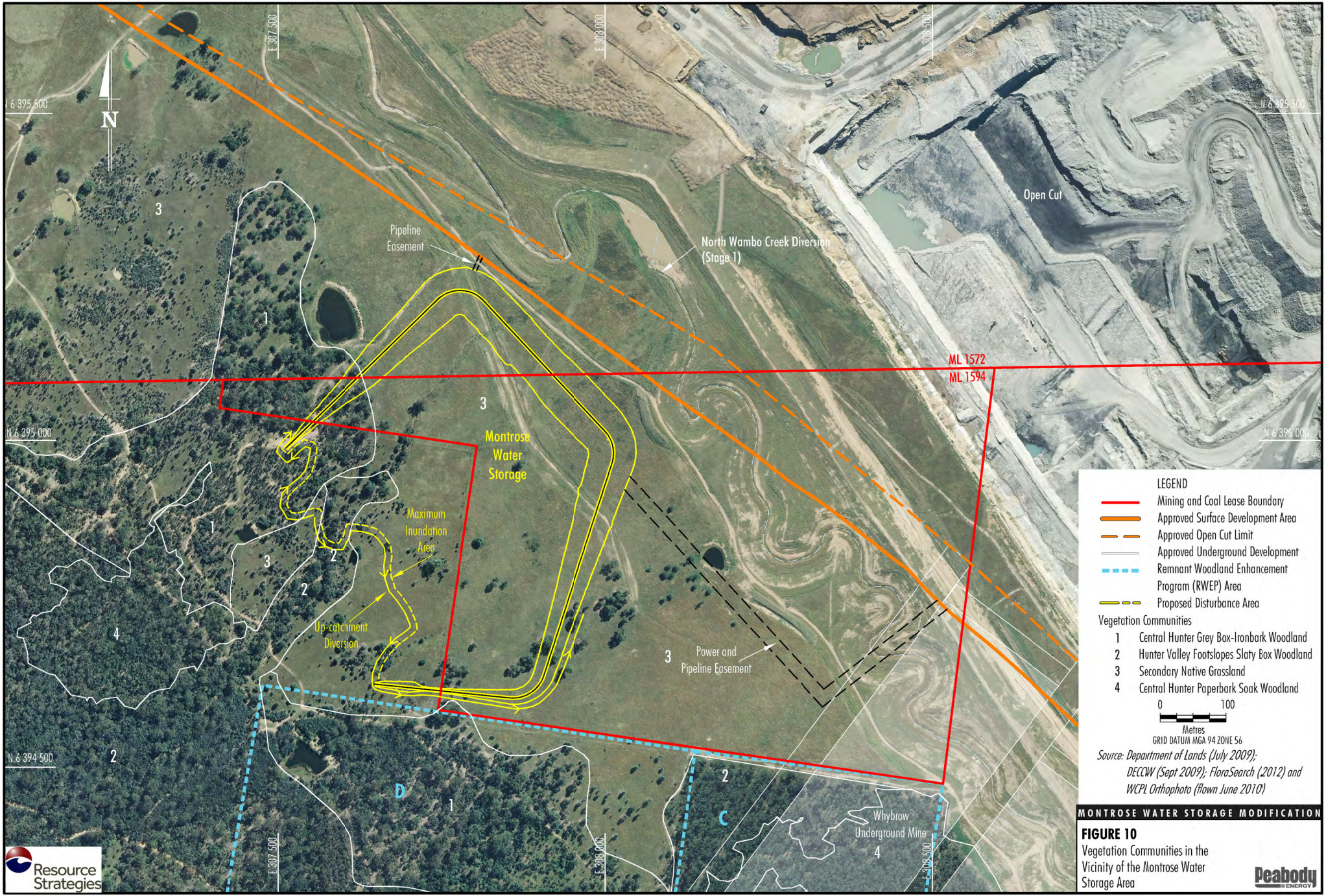
Thirty-one introduced species were recorded (11.7% of species). The highest proportion of introduced species (23.9%) was found in the secondary native grassland (Community 3).

Threatened Flora Species

No flora species listed in the schedules of the TSC Act or EPBC Act were found during targeted searches or other sampling conducted within the Montrose Water Storage area and surrounds (Appendix B).

Threatened Populations

No threatened populations were found in the targeted searches or other sampling in the wider survey area (Appendix B).



LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- - - Approved Open Cut Limit
- Approved Underground Development
- - - Remnant Woodland Enhancement Program (RWEP) Area
- - - Proposed Disturbance Area

Vegetation Communities

- 1 Central Hunter Grey Box-Ironbark Woodland
- 2 Hunter Valley Footholpes Slaty Box Woodland
- 3 Secondary Native Grassland
- 4 Central Hunter Paperbark Soak Woodland

0 100
Metres
GRID DATUM MGA 94 ZONE 56

Source: Department of Lands (July 2009);
DECCW (Sept 2009); FloraSearch (2012) and
WCPL Orthophoto (flown June 2010)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 10
Vegetation Communities in the Vicinity of the Montrose Water Storage Area



Threatened Ecological Communities

Two threatened ecological communities listed as threatened under the TSC Act were recorded during the recent survey within the Montrose Water Storage area, namely the:

- Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (mapped as Community 1 – Figure 10); and
- Hunter Valley Foothills Slaty Box Woodland in the Sydney Basin Bioregion Vulnerable Ecological Community (VEC) (mapped as Community 2 – Figure 10).

A detailed description of these threatened ecological communities is provided in Appendix B.

No threatened ecological communities listed under the EPBC Act occur in the Montrose Water Storage area.

Potential Impacts

Vegetation Clearance

The construction of the Montrose Water Storage would remove approximately 21 ha of secondary native grassland, 1.8 ha of Central Hunter Box – Ironbark Woodland (EEC) and 0.8 ha of Narrabeen Foothills Slaty Box Woodland (VEC).

The Modification would also involve the construction of a powerline and water pipelines. The powerline would be located so that no material land disturbance works (apart from the installation of power poles) would be required.

The pipelines would be poly pipe laid on the ground surface and would be located so that no material land disturbance works would be required.

Where the pipelines cross the existing track (Figure 6) they would be buried to allow vehicles to continue to utilise the track. Disturbance would be restricted to the existing track disturbance areas.

Threatened Flora

Evaluations have been conducted to assess the potential impacts of the Modification on threatened flora and their habitats. The evaluations were conducted in accordance with the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC, 2007) which require the application of a Seven Part Test of Significance.

Mitigation Measures, Management and Monitoring

Flora management at Wambo would continue to be conducted in accordance with the Flora and Fauna Management Plan (WCPL, 2010a). This would include limiting clearing to the minimum extent practical and minimising and mitigating potential soil erosion. The Flora and Fauna Management Plan (WCPL, 2010a) would be reviewed, and if necessary, revised to include the Modification (subject to Development Consent conditions). No specific additional flora mitigation or management measures are proposed for the Modification.

4.6 FAUNA

4.6.1 Background

Avifauna, mammals, reptiles and amphibians were surveyed at Wambo in 2003 (Mount King Ecological Surveys, 2003; Greg Richards and Associates, 2003), 2009 (RPS Harper Somers O'Sullivan [RPS HSO], 2009) and in 2010 (Biosphere Environmental Consultants, 2012).

Threatened Fauna

Thirteen threatened fauna species were recorded in the vicinity of Wambo, including eight birds and five mammals (Table 3) (Mount King Ecological Surveys, 2003; Greg Richards and Associates, 2003; RPS HSO, 2009).

Threatened Fauna Populations

No threatened fauna populations listed under the TSC Act have been recorded at Wambo (Mount King Ecological Surveys, 2003; Greg Richards and Associates, 2003; RPS HSO, 2009).

Table 3
Threatened Fauna Species Previously Recorded in the Vicinity of Wambo

Common Name	Scientific Name	Conservation Status ¹	
		TSC Act	EPBC Act
Birds			
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-
Diamond Firetail	<i>Stagonopleura guttata</i>	V	-
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>	V	-
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-
Hooded Robin	<i>Melanodryas cucullata cucullata</i>	V	-
Speckled Warbler	<i>Pyrrholaemus sagittatus</i>	V	-
Square-tailed Kite	<i>Lophoictinia isura</i>	V	-
Turquoise Parrot	<i>Neophema pulchella</i>	V	-
Mammals			
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	-
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V
Little Bentwing-bat	<i>Miniopterus australis</i>	V	-
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	-

Source: Mount King Ecological Surveys (2003), Greg Richards and Associates (2003) and RPS HSO (2009).

¹ Threatened species status under the TSC Act and EPBC Act (current as of June 2012).

V = Vulnerable

4.6.2 Environmental Review

Biosphere Environmental Consultants (2012) has prepared a Fauna Assessment for the Modification (Appendix C) and a summary is provided below. The fauna surveys and subsequent assessment have been conducted in consideration of the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC, 2007), *Draft Guidelines for Threatened Species Assessment* (DEC and Department of Primary Industries, 2005) and *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004).

Baseline Fauna Surveys

Baseline fauna surveys of a wider study area were conducted in spring 2010, including targeted surveys for threatened fauna species listed under the TSC Act and EPBC Act considered possible occurrences in the Montrose Water Storage area.

Four systematic sampling sites and 19 targeted sampling sites were surveyed using a variety of methods including ultra-sonic bat detectors and recorders (ANABAT™), harp traps, Elliott traps, cage traps, spotlighting, hair tubes, herpetofauna searches, bird surveys, call playback, identification of faunal traces and/or opportunistic observations (Appendix C). The locations of the fauna sampling sites are shown in Appendix C.

Major Habitat Types

Two broad habitat types were identified in the Montrose Water Storage area, namely: Open Pasture Land on Alluvial Plains and Low Regenerating Woodland on Alluvium.

A description of these habitat types is provided in Appendix C.

Native Fauna Species

During the 2010 survey of the wider surrounds, a total of 99 species were identified (including 93 native and six introduced species) (Appendix C). The number of fauna species identified during the 2010 baseline surveys is provided per fauna type in Table 4.

Table 4
Terrestrial Fauna Species

Fauna Type	Number of Fauna Species Identified
Amphibians	9
Reptiles	11
Birds	61
Mammals	18
Total	99

Source: Appendix C.

Introduced Fauna Species

One introduced bird and five introduced mammal species were located during the survey (Appendix C). The species included the Common Starling (*Sturnus vulgaris*), House Mouse (*Mus musculus*), Red Fox (*Vulpes vulpes*), Brown Hare (*Lepus capensis*), Rabbit (*Oryctolagus cuniculus*) and Cattle (*Bos taurus*) (Appendix C).

Threatened Fauna Species

Six threatened species listed under the TSC Act and/or the EPBC Act were recorded during the 2010 surveys (Table 5 and Figure 11).

Table 5
Threatened Fauna Species
Located during the Surveys

Common Name	Scientific Name	Conservation Status ¹	
		TSC Act	EPBC Act
Mammals			
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	-
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-
Birds			
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-
Speckled Warbler	<i>Pyrrholaemus sagittatus</i>	V	-
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-

Source: Appendix D.

¹ Threatened species status under the TSC Act and EPBC Act (current as of February 2011).

V = Vulnerable

Potential Impacts

The construction of the Montrose Water Storage would involve the removal of approximately 21 ha of Open Pasture Land on Alluvial Plains habitat and 2.6 ha of Low Regenerating Woodland on Alluvium habitat.

The powerline would be located so that no material land disturbance works (apart from the installation of power poles) would be required.

The Modification would not significantly affect threatened fauna species given (Appendix C):

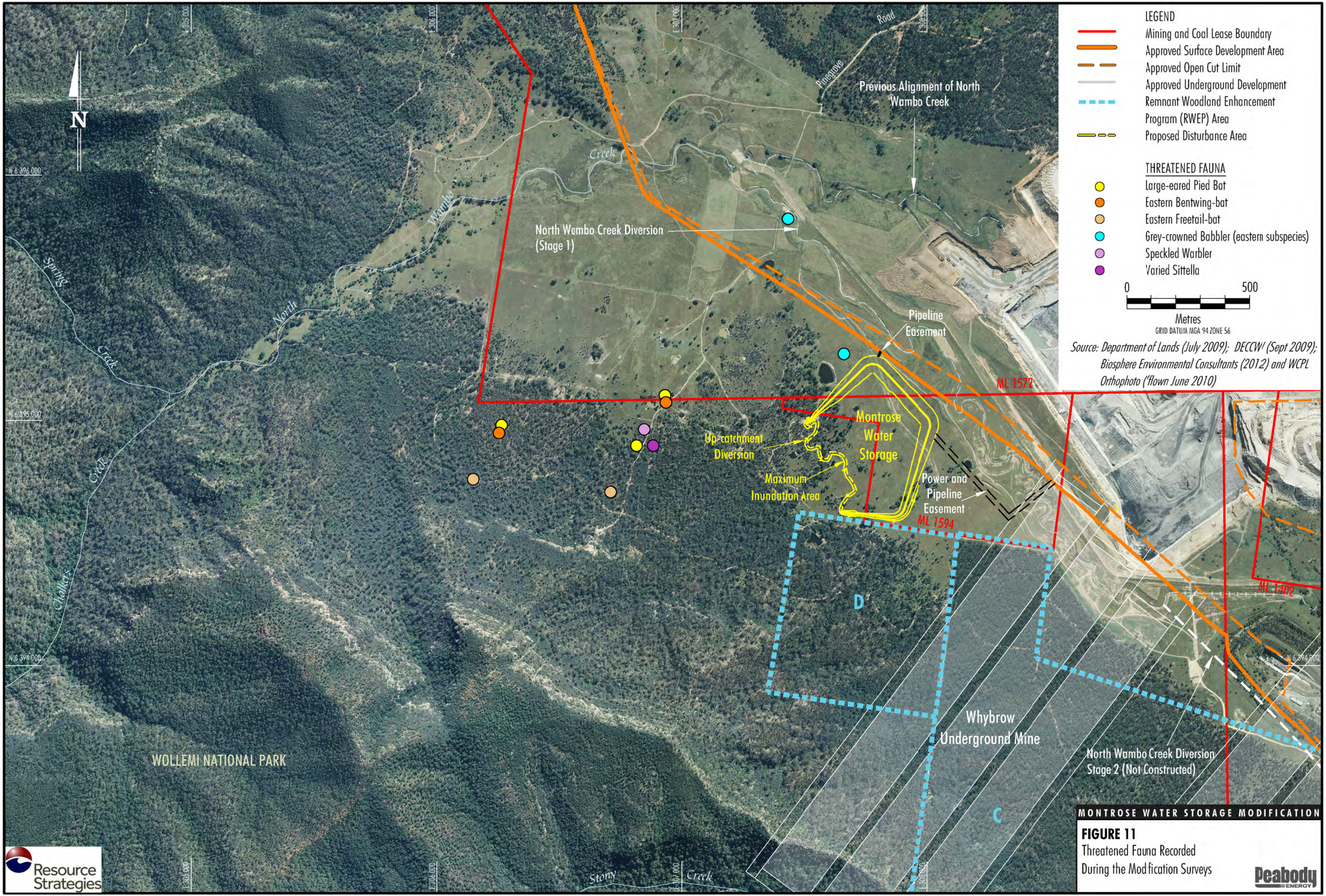
- The area proposed to be cleared for the construction of the Montrose Water Storage is small (i.e. 21 ha of open pasture land and 2.6 ha of Low Regenerating Woodland on Alluvium). As such, the Modification would not result in the fragmentation or isolation of an area of habitat for a threatened fauna species.
- Large areas of high quality woodland habitat exists outside of the Montrose Water Storage area to the south and to the west of the Montrose Water Storage area (Figure 2).
- Vegetation clearance for the Modification would be undertaken in accordance with Vegetation Clearance Protocol included in the existing Flora and Fauna Management Plan (WCPL, 2010a).
- The existing Flora and Fauna Management Plan (WCPL, 2010a) also includes protocols to manage threats to fauna such as feral animals, noxious weeds and fires.

4.7 NOISE AND BLASTING

4.7.1 Background

Richard Heggie Associates assessed the potential noise and vibration impacts of Wambo in 2003 (Richard Heggie Associates, 2003). The study assessed construction and operation noise, blasting noise and vibration, off-site road transport noise and cumulative mine noise effects at potentially affected receptors against applicable assessment criteria.

Richard Heggie Associates (2003) identified 54 privately-owned dwellings and 12 vacant private landholdings where the predicted Wambo noise levels exceeded the project-specific noise assessment criteria. This included 14 privately-owned dwellings within the noise management zone (1 to 5 A-weighted decibels [dBA] above applicable project specific noise criteria) and 40 privately-owned dwellings within the noise affectation zone (>5 dBA above applicable project specific noise criteria). In addition, five privately-owned dwellings were predicted to exceed the relevant vibration and/or blast overpressure criteria. WCPL subsequently purchased a number of the properties that were predicted to exceed the relevant noise and blasting criteria.



LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- - - Approved Open Cut Limit
- Approved Underground Development
- - - Remnant Woodland Enhancement Program (RWEF) Area
- - - Proposed Disturbance Area

THREATENED FAUNA

- Large-eared Pied Bat
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Grey-crowned Babbler (eastern subspecies)
- Speckled Warbler
- Varied Sittella

0 500
Metres
GRID DATUM MGA 94 ZONE 56

Source: Department of Lands (July 2009); DECCW (Sept 2009); Biosphere Environmental Consultants (2012) and WCPL Orthophoto (flown June 2010)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 11
Threatened Fauna Recorded
During the Modification Surveys



Noise Monitoring Program

The Noise Monitoring Program (WCPL, 2007a) for Wambo was established in 2005 and details relevant noise criteria, monitoring program, noise management protocols (including exceedance protocol and the complaint handling response protocol), and reporting requirements.

Attended quarterly noise monitoring is conducted in accordance with the Noise Monitoring Program (WCPL, 2007a). During the 2010/2011 financial year there were no exceedances of the applicable Wambo noise criteria during attended noise monitoring (WCPL, 2011a). The locations of the attended noise monitoring sites are shown on Figure 4.

In addition to attended quarterly noise monitoring, real-time noise monitoring is used as a noise management tool at Wambo. The real-time noise monitoring data is used to assist in the implementation of proactive management measures to avoid potential operational noise non-compliances (WCPL, 2007a).

The real-time noise monitoring system records 15 minute statistical data, continuous audio files and meteorological data (WCPL, 2007a). The locations of the real-time noise monitoring sites are shown on Figure 4.

Blast Monitoring Program

The Blast Monitoring Program (WCPL, 2009) for Wambo was established in 2005 and details relevant vibration and blast overpressure criteria, monitoring program, blast management protocols (including exceedance protocol and the complaint handling response protocol), and reporting requirements.

Blast monitoring is conducted at four locations (Figure 4) in accordance with the Blast Monitoring Program (WCPL, 2009). During the 2010/2011 financial year a total of 68 blasts were conducted at Wambo and one exceedance of the relevant blast overpressure criteria and no exceedances of the relevant vibration criteria were recorded (WCPL, 2011a).

4.7.2 Environmental review

Potential noise related impacts of the Modification would be associated with the construction of the Montrose Water Storage and associated supporting infrastructure (i.e. pumps, pipelines and powerline). Construction works would generally be undertaken during daytime hours (7.00 am to 6.00 pm Monday to Friday and 7.00 am to 4.00 pm Saturday) for approximately 6 months.

The nearest private dwelling to the proposed location of the Montrose Water Storage is located approximately 3 km to the north-west (Figure 4). A significant ridge is located between the Montrose Water Storage and this dwelling.

In comparison to the scale of open cut mining operations at Wambo and given the location of the nearest private dwelling, the Modification has minimal potential to increase intrusive noise levels at the nearest private dwelling (i.e. with the daytime only and short-term nature of the construction works associated with the Modification that would utilise only limited mobile fleet items).

Notwithstanding, the following existing noise management measures would continue to be implemented for the Modification (WCPL, 2007a):

- regular maintenance of plant and equipment and pre-start up inspections;
- positioning of portable generators and machinery to take advantage of existing natural and man-made barriers; and
- equipment is turned off or throttled down when not in use.

In addition, WCPL would continue to implement attended and real-time noise monitoring and response protocols in accordance with the Noise Monitoring Program (WCPL, 2007a). The Noise Monitoring Program (WCPL, 2007a) would be reviewed, and if necessary, revised to include the Modification (subject to Development Consent conditions).

4.8 AIR QUALITY

4.8.1 Background

The potential air quality impacts of Wambo were assessed by Holmes Air Sciences in 2003 (Holmes Air Sciences, 2003). The assessment considered the potential air quality emissions likely to be generated by Wambo and surrounding mining operations at potentially affected receptors against applicable assessment criteria.

A total of 28 residences were predicted to experience cumulative dust deposition, total suspended particulate (TSP) or particulate matter less than 10 microns (PM₁₀) above the applicable assessment criteria during the life of Wambo. Eighteen of the 28 residences, where exceedances were predicted, were owned by other mining companies or WCPL.

Air Quality Monitoring Program

An Air Quality Monitoring Program (WCPL, 2008b) for Wambo was established in 2005 and details relevant air quality criteria, monitoring program, air quality management protocols (including air quality monitoring protocol and the complaint response protocol), mitigation and management measures, and reporting requirements.

Air quality monitoring conducted at Wambo includes dust deposition and dust concentrations (as TSP and PM₁₀). The locations of the air quality monitoring sites are shown on Figure 4.

The annual average dust deposition results at all sites located outside WCPL-owned land were within the Environment Protection Authority (EPA) criterion (i.e. 4 grams per square metre per month [$\text{g}/\text{m}^2/\text{month}$]) in during the 2010/2011 financial year (WCPL, 2011a).

TSP concentrations are measured by high volume samplers at four locations (Figure 4). All results demonstrate compliance with the EPA annual average TSP criterion (i.e. 90 micrograms per cubic metre [$\mu\text{g}/\text{m}^3$]) during the 2010/2011 financial year (WCPL, 2011a).

PM₁₀ concentrations are measured by TEOMs at four locations (Figure 4). All results demonstrate compliance with the EPA annual average PM₁₀ criterion (i.e. 30 $\mu\text{g}/\text{m}^3$) during the 2010/2011 financial year (WCPL, 2011a). Development Consent DA 305-7-2003 includes Project-only (50 $\mu\text{g}/\text{m}^3$) and cumulative (150 $\mu\text{g}/\text{m}^3$) 24-hour PM₁₀ criteria for Wambo.

There were two occurrences when the 24-hour PM₁₀ concentrations were above the EPA 24-hour PM₁₀ criterion (i.e. 50 $\mu\text{g}/\text{m}^3$) during the 2010/2011 financial year (WCPL, 2011a).

The recorded levels above 50 $\mu\text{g}/\text{m}^3$ are unlikely to have resulted from the operation of Wambo alone, as 'background' contributions from neighbouring mines and other sources (e.g. agriculture) would have contributed.

There have been no exceedances of the cumulative criterion recorded at Wambo during the 2010/2011 financial year (WCPL, 2011a).

4.8.2 Environmental Review

Potential air quality related impacts related impacts of the Modification would be associated with the construction of the Montrose Water Storage embankments and soil stripping.

The nearest private dwelling to the proposed location of the Montrose Water Storage is located approximately 3 km to the north-west (Figure 4). Given the short-term nature of the construction required, the Modification is unlikely to result in adverse air quality impacts at the nearest private dwellings.

Notwithstanding, the following existing air quality management measures would continue to be implemented for the Modification (WCPL, 2008b):

- minimising disturbance areas;
- progressively rehabilitating disturbed land to reduce total disturbed area;
- revegetating topsoil stockpiles which are not planned to be used for over three months;
- regular watering of disturbance areas;
- implementing speed limits on roads to minimise dust generation; and
- modifying construction operations during unfavourable weather conditions to reduce dust generation.

In addition, WCPL would continue to implement air quality monitoring and response protocols in accordance with the Air Quality Monitoring Program (WCPL, 2008b). The Air Quality Monitoring Program (WCPL, 2008b) would be reviewed, and if necessary, revised to include the Modification (subject to Development Consent conditions).

4.9 GREENHOUSE GAS EMISSIONS

4.9.1 Background

In accordance with the *National Greenhouse Accounts (NGA) Factors* (Commonwealth Department of Climate Change and Energy Efficiency [DCCEE], 2011), direct greenhouse emissions are referred to as Scope 1 emissions, and indirect emissions are referred to as Scopes 2 and 3 emissions.

The major sources of greenhouse gas emissions at Wambo include:

- combustion of diesel during mining operations (Scope 1);
- use of explosives (Scope 1);
- fugitive emissions of methane (Scope 1);
- off-site generation of electricity that is consumed at Wambo (Scope 2); and
- combustion of product coal produced at Wambo by third parties (Scope 3).

Holmes Air Sciences (2003) calculated the following predicted greenhouse gas emissions from Wambo over the 21 year life:

- combustion of diesel, use of explosives, fugitive emissions and generation of electricity consumed on-site (Scopes 1 and 2) – 45.4 Mt carbon dioxide-equivalent (CO_{2-e}); and
- combustion of product coal by third parties (Scope 3) – 157 Mt CO_{2-e}.

WCPL is currently implementing a number of measures to minimise, to the greatest extent practicable, greenhouse gas emissions from Wambo. Relevant measures are described below:

- Maximising energy efficiency as a key consideration in the development of the mine plan. For example, significant savings of greenhouse gas emissions (through increased energy efficiency) are achieved by mine planning decisions which minimise haul distances for coal and waste rock transport and therefore fuel use.
- Installation of Power Factor Correction equipment in the CHPP.
- Potential investigation into the beneficial re-use of methane gas at Wambo.

4.9.2 Environmental Review

Incremental greenhouse gas emissions associated with the Modification would be related to construction of the Montrose Water Storage and associated supporting infrastructure (i.e. additional diesel consumption) and the operation of pumps (i.e. additional electricity consumption).

An assessment of the incremental greenhouse gas emissions (Scopes 1, 2 and 3) for the Modification was conducted using empirical emission factors provided by the *National Greenhouse Accounts (NGA) Factors* (DCCEE, 2011).

Incremental greenhouse gas emissions associated with the Modification (over the remaining life of Wambo) would be related to the increased:

- combustion of diesel for construction (approximately 0.37 kilo tonnes [kt] CO_{2-e} of Scope 1 and 0.028 kt CO_{2-e} of Scope 3 emissions); and
- consumption of electricity (approximately 6.33 kt CO_{2-e} of Scope 2 and 1.21 kt CO_{2-e} of Scope 3 emissions).

4.10 ROAD TRANSPORT

The Golden Highway is the principal road servicing the Wambo area and links the New England Highway (near Singleton) to the Newell and Mitchell Highways to the west of Wambo. The Golden Highway via Putty Road provides the primary access between Wambo and Singleton. The local road network in the Wambo area comprises Wallaby Scrub Road and Pinegrove Road.

The Wambo workforce currently consists of approximately 842 employees and contractors (WCPL, 2011a).

The Modification would result in a temporary demand (6 months) for approximately 12 additional employees/contractors during construction (Section 3.6). This is expected to result in an approximate 1% increase in total Wambo employee and contractor vehicle movements to site. While these additional movements may be measureable, it is unlikely that they would be outside of existing seasonal and daily variations in traffic movements on the surrounding public road network.

There would be no material change in the vehicle movements associated with consumable deliveries (e.g. diesel) to Wambo associated with the Modification.

Given the above, it is considered the Modification would not result in any significant changes to the approved road transport impacts of Wambo.

4.11 VISUAL

The local visual landscape is dominated by the rugged escarpments of the Wollemi National Park and the forested landforms that rise behind the escarpments to above 600 m AHD. At lower elevations to the south of Jerrys Plains and north of Bulga, rocky, forested spurs protrude from the Wollemi National Park. Other features of the local visual landscape include (WCPL, 2003):

- remnant vegetation and isolated landforms;
- riparian vegetation and flood plain features of the Hunter River and Wollombi Brook;
- local watercourses, including Waterfall, North Wambo, Stony and Wambo Creeks;
- coal mining operations;
- agricultural land, including cropping, dairy and beef production and small-scale viticulture and olive groves; and
- residential areas including Warkworth, Bulga and Jerrys Plains.

The Montrose Water Storage and associated infrastructure would be located on WCPL-owned land between the Wambo open cut and the Wollemi National Park (Figure 2) and there would be limited views available from non-WCPL-owned land.

The visual prominence of the Montrose Water Storage would be relatively minor in comparison to the approved Wambo operations.

Other infrastructure (e.g. pumps, pipelines and powerline) are also minor in nature and would not be visually prominent.

Night-lighting required for the Montrose Water Storage would be associated with pumping infrastructure and would be minor. As this night-lighting would be adjacent to approved fixed and mobile lighting associated with the Wambo open cut operations, there is expected to be no change in night-lighting impacts at any non-WCPL-owned land.

Given the above, it is considered the Modification would not result in any significant changes to the approved visual impacts of Wambo.

4.12 NON-ABORIGINAL HERITAGE

EJE Town Planning (2003) assessed the potential non-Aboriginal impacts of Wambo in 2003. The assessment included surveys of lands in the vicinity of Wambo and an assessment of the heritage significance of sites identified during these surveys.

No items of heritage significance were identified in the Montrose Water Storage area.

Given the above, it is considered that the Modification would not result in any additional impacts to items of non-Aboriginal heritage.

4.13 SOCIO-ECONOMICS

Gillespie Economic conducted an economic assessment for Wambo in 2003 (Gillespie Economics, 2003). The assessment concluded that Wambo has the following regional impact (Gillespie Economics, 2003):

- \$706 million (M) in annual direct and indirect regional output or business turnover;
- \$238M in annual direct and indirect regional value added;
- \$104M in annual direct and indirect household income; and
- 1,763 direct and indirect regional jobs.

The Wambo workforce currently consists of approximately 842 employees and contractors (WCPL, 2011a).

Temporary demand (6 months) for approximately 12 additional employees/contractors would provide some minor additional economic and employment benefits to the region.

It is anticipated that this minor short-term employment demand would be met by existing residents and contractors in the Hunter Region.

4.14 HAZARD AND RISK

A Preliminary Hazard Analysis (PHA) was conducted in 2003 to assess the potential hazards and risks associated with Wambo. The PHA comprised a qualitative assessment of risks to the public, property and the environment associated with the development and operations of Wambo (Resource Strategies, 2003). The PHA was conducted in accordance with the general principles of risk evaluation and assessment provided in the DoP guidelines for *Multi-Level Risk Assessment* (NSW Department of Urban Affairs and Planning, 1999).

The PHA identified no incremental risks posing significant off-site impacts (Resource Strategies, 2003).

It is considered that the Modification would not change the existing potential risk areas identified in the PHA conducted for Wambo as the proposed activities associated with the Modification are consistent with the activities assessed in the PHA. However, environmental management plans and monitoring programmes would be reviewed, and if necessary, revised to include the Modification and manage any associated environmental risks (subject to Development Consent conditions).

4.15 CONSIDERATION OF CUMULATIVE IMPACTS WITH OTHER NEARBY MINING OPERATIONS

There are a number of mining operations in the vicinity of Wambo including United Collieries, Mt Thorley-Warkworth and Hunter Valley Operations.

Given the minor nature of the Modification and that no significant impacts are expected as a result of the Modification (Section 4), it is expected that there would be no significant adverse cumulative impacts as a result of the Modification.

5 STATUTORY CONTEXT

Wambo was approved under Part 4 of the EP&A Act in February 2004 (Development Consent DA 305-7-2003 – Attachment 1).

As outlined in Section 1.3, WCPL consulted with the DP&I in June 2012 with regards to seeking the necessary approvals for the Modification and based on this consultation, this EA has been prepared under section 75W of the EP&A Act.

Clause 12 of Schedule 6A of the EP&A Act provides that section 75W of Part 3A of the EP&A Act continues to apply to modifications of development consents referred to in clause 8J(8) of the *Environmental Planning and Assessment Regulation, 2000* (EP&A Regulation) following the repeal of Part 3A.

Wambo was approved under Part 4 of the EP&A Act in February 2004 and was a development consent under Division 4 of Part 4 of the Act (relating to State significant development). Therefore Development Consent DA 305-7-2003 is a development consent that falls within clause 8J(8)(c) of the EP&A Regulation. That is, section 75W of the EP&A Act continues to apply to modifications to the Wambo Development Consent DA 305-7-2003, notwithstanding its repeal.^[1]

Approval for the Modification will be sought as a modification to the Development Consent DA 305-7-2003 under section 75W of the EP&A Act. Section 75W of the EP&A Act relevantly provides:

75W Modification of Minister's approval

(1) *In this section:*

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

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

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

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

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

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

...

^[1] Part 3A of the EP&A Act (as in force immediately before its repeal) continues to apply for Wambo. The description and quotations of relevant references to clauses of Part 3A in this document are as if Part 3A of the EP&A Act is still in force.

5.1 GENERAL STATUTORY REQUIREMENTS

Singleton Local Environmental Plan 1996

Wambo is wholly within the Singleton LGA (Figure 1). The following sub-sections identify the provisions in the *Singleton Local Environmental Plan 1996* (Singleton LEP) which may have relevance to the Modification.

Clause 16(3) of the Singleton LEP relevantly provides:

- (3) *The Council must have regard to the objectives for development in a zone when determining a development application in respect of land within the zone.*

Wambo lies wholly within land zoned “Rural Zone” (Zone 1[a]). Under the Singleton LEP the objectives of the “Rural Zone” (Zone 1[a]) are:

- (a) *to protect and conserve agricultural land and to encourage continuing viable and sustainable agricultural land use,*
- (b) *to promote the protection and preservation of natural ecological systems and processes,*
- (c) **to allow mining where environmental impacts do not exceed acceptable limits and the land is satisfactorily rehabilitated after mining,**
- (d) *to maintain the scenic amenity and landscape quality of the area,*
- (e) *to provide for the proper and co-ordinated use of rivers and water catchment areas,*
- (f) *to promote provision of roads that are compatible with the nature and intensity of development and the character of the area.*

The Modification is consistent with the applicable objectives of the Singleton LEP for the “Rural Zone” (Zone 1[a]). The potential environmental impacts of the Modification are assessed in Section 4 and a description of the rehabilitation of the Modification is provided in Section 3.7.

Under the Singleton LEP “coal mining” is permissible on lands zoned “Rural Zone” (Zone 1[a]) with development consent as coal mining is not listed as being a relevant prohibited use in the zoning table.

Clause 20 of the Singleton LEP sets out requirements for environmental buffers around mines:

- (1) *This clause applies to land used by the Army or as an airport, mine, coal mine, explosives factory, or for an extractive industry, hazardous industry, intensive agriculture, intensive livestock keeping establishments or offensive industry.*
- (2) *In considering a development application relating to land to which this clause applies, the consent authority must take into account whether an environmental buffer area has been provided around the site of that development which is adequate to ensure that significant adverse environmental effects do not occur on surrounding land.*
- (3) *In considering a development application relating to land within such an environmental buffer area, the consent authority must take into account whether the proposed development will, in the opinion of the consent authority, be adversely affected to a significant extent by the land use in response to which the buffer area is provided.*

Wambo is surrounded by significant areas of WCPL and other mine-owned lands.

The potential impacts of the Project on the local amenity of adjoining privately-owned land are considered where relevant in the noise and blasting, air quality and visual sections (Sections 4.7, 4.8 and 4.11).

Hunter Regional Environmental Plan (Heritage) 1989

Clause 5(2) of the Singleton LEP excludes the Singleton LGA from the *Hunter Regional Environmental Plan (Heritage) 1989* (Hunter REP [Heritage]). All items of local, regional and State significance contained within the Hunter REP (Heritage) are listed in Schedule 3 of the Singleton LEP.

Notwithstanding, no items listed in Schedule 3 of the Singleton LEP are located in the Montrose Water Storage area.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* (Mining SEPP) regularises the various environmental planning instruments that previously controlled mining activities.

Clause 5(3) of the Mining SEPP gives it primacy where there is an inconsistency between the provisions of the Mining SEPP and the provisions of any other environmental planning instrument (except the *State Environmental Planning Policy (Major Projects) 2005*, *State Environmental Planning Policy No. 14 [Coastal Wetlands]* and *State Environmental Planning Policy No. 26 [Littoral Rainforest]*).

- **Clause 2**

Clause 2 sets out the aims of the Mining SEPP as follows:

- (a) *to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and*
- (b) *to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and*
- (c) *to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.*

- **Clause 7**

Clause 7(1) of the Mining SEPP states that development for any of the following purposes may be carried out only with development consent:

- (a) *underground mining carried out on any land,*
- (b) *mining carried out:*
...
(ii) *on land that is, immediately before the commencement of this clause, the subject of a mining lease under the Mining Act 1992 or a mining licence under the Offshore Minerals Act 1999,*

Wambo (incorporating the Modification) comprises mining within existing Wambo mining and coal leases (Figure 2).

- **Clause 8**

Clause 8 of the Mining SEPP provides:

8 Determination of permissibility under local environmental plans

- (1) *If a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if provisions of the plan are satisfied:*
 - (a) *development for that purpose may be carried out on that land with development consent without those provisions having to be satisfied, and*
 - (b) *those provisions have no effect in determining whether or not development for that purpose may be carried out on that land or on the determination of a development application for consent to carry out development for that purpose on that land.*
- (2) *Without limiting subclause (1), if a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if the consent authority is satisfied as to certain matters specified in the plan, development for that purpose may be carried out on that land with development consent without the consent authority having to be satisfied as to those specified matters.*

- **Clause 12**

Clause 12 of the Mining SEPP requires that, before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:

- (a) *consider:*
 - (i) *the existing uses and approved uses of land in the vicinity of the development, and*
 - (ii) *whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*

- (iii) *any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and*
- (b) *evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and*
- (c) *evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).*

Land use in the vicinity of Wambo is characterised by a combination of coal mining operations, agricultural land uses and the village of Warkworth. Land use in the Montrose Water Storage area is agricultural land with areas of remnant native woodland and is wholly located on WCPL-owned land.

The potential impacts of the Modification on existing agricultural land and remnant native woodland are described in Sections 4.1 and 4.5.

The development of the Modification would result in temporary demand (6 months) for approximately 12 additional employees/contractors which would provide some minor additional economic and employment benefits to the region.

The Modification is considered to be compatible with existing and future land uses in the Wambo area.

- **Clause 14**

Clause 14(1) of the Mining SEPP requires that, before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the approval should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:

- (a) *that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,*
- (b) *that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,*
- (c) *that greenhouse gas emissions are minimised to the greatest extent practicable.*

In addition, clause 14(2) requires that, without limiting clause 14(1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programmes or guidelines concerning greenhouse gas emissions.

The potential impacts of the Modification on surface water and groundwater resources are discussed in Sections 4.2 and 4.3, including measures to minimise potential impacts which are described in Sections 4.2.2 and 4.3.2. The potential impacts of the Modification on threatened species and biodiversity are described in Sections 4.5 and 4.6, including measures to minimise potential impacts which are described in Section 4.5.2.

Existing Wambo greenhouse gas abatement measures are described in Section 4.9.1. The Modification greenhouse gas emissions estimate is provided in Section 4.9.2. These sections of the EA provide a quantitative assessment of potential scope 1, 2 and 3 greenhouse gas emissions of the Modification.

- **Clause 15**

Clause 15 of the Mining SEPP requires that:

- (1) *Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery.*
- (2) *Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.*
- (3) *The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.*

The Modification would not change the currently approved mining areas or mining methods. It would facilitate the efficient mining of the North Wambo Underground Mine by providing alternative capacity to allow the South Wambo Dam to be emptied while it is subsided.

- **Clause 16**

Clause 16(1) of the Mining SEPP requires that, before granting consent for development for the purposes of mining or extractive industry that involves the transport of materials, the consent authority must consider whether or not the consent should be issued subject to conditions that do any one or more of the following:

- (a) *require that some or all of the transport of materials in connection with the development is not to be by public road,*
- (b) *limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools,*
- (c) *require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.*

The primary public road network transport routes to and from Wambo include routes that are adjacent to rural areas, industrial/commercial areas, residential areas and schools.

It is considered the Modification would not result in any significant changes to the approved road transport impacts of Wambo (Section 4.10).

- **Clause 17**

Clause 17 of the Mining SEPP requires that before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the approval should be issued subject to conditions aimed at ensuring the rehabilitation of land that will be affected by the development.

In particular, the consent authority must consider whether conditions of the consent should:

- (a) *require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or*
- (b) *require waste generated by the development or the rehabilitation to be dealt with appropriately, or*

- (c) *require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the Contaminated Land Management Act 1997), or*
- (d) *require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.*

The Montrose Water Storage would be rehabilitated in accordance with the Flora and Fauna Management Plan (WCPL, 2010a) or kept post-mining for beneficial use by the relevant background landholder (Section 3.7).

State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)

Clause 13 of *State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)* requires the consent authority, in considering a Development Application for a potentially hazardous or a potentially offensive industry, to take into account:

- (c) *in the case of development for the purpose of a potentially hazardous industry—a preliminary hazard analysis prepared by or on behalf of the applicant, and*
- (d) *any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application), and*

...

The Modification would not significantly alter the consequences or likelihood of a hazardous event occurring at Wambo as the operational activities on-site would be generally unchanged. Notwithstanding, environmental management plans and monitoring programmes would be reviewed, and if necessary, revised by WCPL to include the Modification and manage any associated environmental risks (subject to Development Consent conditions).

State Environmental Planning Policy No. 44 (Koala Habitat Protection)

State Environmental Planning Policy No. 44 (Koala Habitat Protection) (SEPP 44) requires the consent authority for any Development Application in certain LGAs (including Singleton) to consider whether land subject to a Development Application is "potential Koala habitat" or "core Koala habitat".

An assessment of potential and core Koala habitat was conducted in the EIS. This assessment concluded that lands within the vicinity of Wambo do not contain potential or core Koala habitat (WCPL, 2003). The provisions of SEPP 44 are therefore not considered to be applicable to the Modification.

State Environmental Planning Policy No. 55 (Remediation of Land)

State Environmental Planning Policy No. 55 (Remediation of Land) (SEPP 55) aims to provide a State-wide planning approach to the remediation of contaminated land. Under SEPP 55, planning authorities are required to consider the potential for contamination to adversely affect the suitability of the site for its proposed use.

A consent authority must consider the following under Clause 7(1):

- (a) *it has considered whether the land is contaminated, and*
- (b) *if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and*
- (c) *if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.*

Further, under Clause 7(2), before determining an application for consent to carry out development that would involve a change of use of land, the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned, carried out in accordance with the contaminated land planning guidelines.

Because the Montrose Water Storage is within existing Wambo mining and coal leases, no change of use is proposed and no preliminary land contamination investigation is required.

Environment Protection and Biodiversity Conservation Act, 1999

The objective of the EPBC Act is to provide for the protection of those aspects of the environment that are of *national* environmental significance. Proposals that are likely to have a significant impact on a matter of environmental significance are defined as a controlled action under the EPBC Act.

Proposals that are, or may be, a controlled action are required to be referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) to determine whether or not the action is a controlled action.

Wambo was referred to SEWPAC due to the potential for impacts to occur to the following matters of environmental significance under the EPBC Act:

- Listed threatened species and ecological communities.
- Listed migratory species.

Wambo was determined to be a *controlled action* under the EPBC Act (EPBC 2003/1138) and was subsequently approved on 23 November 2004.

The potential impacts of the Modification on flora and fauna have been assessed in Appendices C and D and Sections 4.5 and 4.6. The Modification would not have a significant impact on any matter of national environmental significance.

It is therefore considered that there is no need to refer the Modification to the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities.

5.2 MANAGEMENT PLANS THAT REQUIRE REVISION

The following management plans would be reviewed, and if necessary, revised to include the Modification (subject to the Modification):

- Groundwater Monitoring Program (WCPL, 2010d);
- Surface Water Monitoring Program (WCPL, 2010e);
- Erosion and Sediment Control Plan (WCPL, 2010g);
- Flora and Fauna Management Plan (WCPL, 2010a);

- Noise Monitoring Program (WCPL, 2007a); and
- Air Quality Monitoring Program (WCPL, 2008b).

In addition, the site water balance would be reviewed to incorporate the Modification. The results of the site water balance review would be reported in the Annual Review in accordance with Condition 25, Schedule 4 of the Development Consent DA-305-7-2003.

6 REFERENCES

- Australasian Groundwater and Environmental Consultants (2003) *Wambo Development Project Groundwater Impact Assessment*.
- Biosphere Environmental Consultants (2012) *Wambo Coal Mine Montrose Water Storage Modification Terrestrial Fauna Assessment*.
- Department of Climate Change and Energy Efficiency (2011) *National Greenhouse Accounts (NGA) Factors*.
- Department of Environment and Climate Change (2007) *Threatened Species Assessment Guidelines: The Assessment of Significance*.
- Department of Environment and Conservation (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*.
- Department of Environment and Conservation and Department of Primary Industries (2005) *Draft Guidelines for Threatened Species Assessment*.
- Department of Environment, Climate Change and Water (2010) *Due Diligence Code of Practice for the Protection of Aboriginal Objects*.
- Department of Mineral Resources (1999) *Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of New South Wales*.
- Department of Urban Affairs and Planning (1999) *Multi-Level Risk Assessment*. Revised edition.
- EJE Town Planning (2003) *Wambo Development Project Non-Aboriginal Heritage Impact Statement*.
- FloraSearch (2012) *Montrose Water Storage Modification – Flora Assessment*.
- GHD (2007) *Report for Upper Section, North Wambo Creek Geophysical Survey – July 2007*. Prepared for Wambo Coal Pty Ltd.
- Gilbert and Associates (2003) *Wambo Development Project Surface Water Assessment*.
- Gillespie Economics (2003) *Wambo Development Project Economic Assessment*.
- Greg Richards and Associates (2003) *Wambo Development Project Bat Fauna Assessment*.
- Holmes Air Sciences (2003) *Air Quality Impact Assessment: Wambo Development Project*.
- Hunter Catchment Management Trust (2002) *Integrated Catchment Management Plan for the Hunter Catchment 2002*.
- Minerals Council (2010) *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects*.
- Mount King Ecological Surveys (2003) *Wambo Development Project Terrestrial Fauna Assessment*.
- NSW Agriculture (1983) *Agricultural Land Classification for Part of the Singleton Shire between Bulga and Jerrys Plains, NSW*.
- NSW Agriculture (2002) *Agriculture Suitability Class*.
- NSW Government (2012) *Draft Upper Hunter Strategic Regional Land Use Plan (DSRLUP)*.
- Orchid Research (2003) *Wambo Development Project Flora Assessment*.
- Resource Strategies (2003) *Wambo Development Project Preliminary Hazard Analysis*.
- Richard Heggie Associates (2003) *Wambo Development Project Construction, Operating and Transportation – Noise and Blasting Impact Assessment*.
- RPS (2012) *Aboriginal Due Diligence Assessment Montrose Water Storage Modification*.
- RPS Harper Somers O'Sullivan (2009) *2009 Annual Ecological Monitoring Report*. Prepared for Wambo Coal Pty Ltd

- Soil Conservation Service of NSW (1985) *1:100,000 Land Capability Mapping, New South Wales*. Department of Sustainable Natural Resources.
- Strata Engineering (2005) *Surface and Subsurface Investigation Programme*.
- Wambo Coal Pty Limited (2003) *Wambo Development Project Environmental Impact Statement*.
- Wambo Coal Pty Limited (2006) *North Wambo Underground Mine Subsidence Management Plan*.
- Wambo Coal Pty Limited (2007a) *Noise Monitoring Program*.
- Wambo Coal Pty Limited (2007b) *North Wambo Creek Diversion Plan*.
- Wambo Coal Pty Limited (2008a) *Annual Environmental Management Report 2007 – 2008*.
- Wambo Coal Pty Limited (2008b) *Air Quality Monitoring Program*.
- Wambo Coal Pty Limited (2008c) *Bushfire Management Plan*.
- Wambo Coal Pty Limited (2009) *Blast Monitoring Program*.
- Wambo Coal Pty Limited (2010a) *Flora and Fauna Management Plan*.
- Wambo Coal Pty Limited (2010b) *Environmental Management Strategy*.
- Wambo Coal Pty Limited (2010c) *Environmental Monitoring Program*.
- Wambo Coal Pty Limited (2010d) *Groundwater Monitoring Program*.
- Wambo Coal Pty Limited (2010e) *Surface Water Monitoring Program*.
- Wambo Coal Pty Limited (2010f) *Erosion and Sediment Control Plan*.
- Wambo Coal Pty Limited (2010g) *Surface and Groundwater Response Plan*.
- Wambo Coal Pty Limited (2010h) *North Wambo Creek Subsidence Response Strategy*.
- Wambo Coal Pty Limited (2011a) *Annual Environmental Management Report 2010 – 2011*.
- Wambo Coal Pty Limited (2011b) *Life of Mine Rejects Emplacement Strategy*.
- White, E. (2003) *Wambo Development Project Aboriginal Heritage Assessment*.



WAMBO

MONTROSE WATER STORAGE MODIFICATION ENVIRONMENTAL ASSESSMENT

ATTACHMENT 1

CONSOLIDATED DEVELOPMENT CONSENT
DA 305-7-2003

Development Consent

Section 80 of the *Environmental Planning & Assessment Act 1979*

I, the Minister Assisting the Minister for Infrastructure and Planning (Planning Administration), approve the Development Application referred to in schedule 1, subject to the conditions in schedules 3 to 6.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the on-going environmental management of the development.

SIGNED

Diane Beamer MP
**Minister Assisting the
Minister for Infrastructure and Planning
(Planning Administration)**

Sydney

4 February 2004

File No: S02/02197

Blue type represents 2004 modification

Red type represents May 2005 modification

Green represents January 2006 modification

Pink represents April 2006 Modification

Orange represents October 2006 Modification

Violet represents January 2007 Modification

Brown represents June 2009 Modification

Lime represents August 2009 Modification

Blue with yellow background represents February 2011 Modification

SCHEDULE 1

Development Application:	DA 305-7-2003;
Applicant	Wambo Coal Pty Limited;
Consent Authority:	Minister for Infrastructure and Planning;
Land:	See Appendix 1;
Proposed Development:	<p>The development of open cut and underground mining operations at the Wambo coal mine, which includes:</p> <ul style="list-style-type: none">• continued development of open cut and underground mining operations within existing Wambo Coal Pty Limited (WCPL) mining and coal leases and into new mining lease application area;• selective auger mining of the Whybrow, Redbank Creek, Wambo and Whynot seams up to 200 m beyond the open cut limits within WCPL owned land;• continued placement of waste rock and coarse rejects within mine waste rock emplacements;• continued placement of tailings within open cut voids and capping with waste rock and coarse rejects;• an extension to the existing Wollemi Underground Mine Box Cut (within the limits of the development open cut mining area)

- to provide direct access for three underground longwall panels in the Whybrow Seam;
- longwall mining of the Wambo Seam via the open cut highwall;
- construction of a portal and drift access to facilitate longwall mining of the Arrowfield and Bowfield Seams;
- an upgrade of the existing Coal Handling and Preparation Plant (CHPP) to facilitate increased coal production;
- development of a water control structure across North Wambo Creek at the north-western limit of the open cut operation, and a channel to allow the passage of flows to the lower reaches of North Wambo Creek around the open cut development;
- degazettal and physical closure of Pinegrove Road;
- development of new access roads and internal haul roads;
- relocation of the existing explosives magazine and construction of additional hydrocarbon storage facilities;
- relocation of the administration area and site offices;
- extraction of up to 14.7 million tonnes of run-of-mine (ROM) coal a year;
- operation of the mine 24 hours a day, 7 days a week;
- continued haulage of coal by road from Wambo Coal Mine to Mt Thorley Coal Loader prior to the commissioning of the Wambo "Rail and Train Loading Infrastructure" (which is the subject of a separate development application: DA 177-8-2004); and
- haulage of coal by the Wambo "Rail and Train Loading Infrastructure".

State Significant Development:

The proposal is classified as State significant development, under section 76A(7) of the *Environmental Planning & Assessment Act 1979*, because it involves coal-mining related development that requires a new mining lease under section 63 of the *Mining Act 1992*.

Integrated Development:

The proposal is classified as integrated development, under section 91 of the *Environmental Planning & Assessment Act 1979*, because it requires additional approvals under the:

- *Protection of the Environment Operations Act 1997*;
- *National Parks & Wildlife Act 1974*;
- *Water Act 1912*;
- *Fisheries Management Act 1994*;
- *Heritage Act 1977*;
- *Roads Act 1993*; and
- *Mine Subsidence Compensation Act 1961*.

Designated Development:

The proposal is classified as designated development, under section 77A of the *Environmental Planning & Assessment Act 1979*, because it is for a coal mine that would "produce or process more than 500 tonnes of coal a day", and consequently meets the criteria for designated development in schedule 3 of the *Environmental Planning & Assessment Regulation 2000*.

BCA Classification:

Class 5:	Office upgrade
Class 9b:	Bathhouse
Class 10a:	Car park
	Heavy vehicle wash station
	Gas drainage bores
	De-watering bores
Class 10b:	Coal conveyor

Note:

- 1) To find out when this consent becomes effective, see section 83 of the *Environmental Planning & Assessment Act 1979 (EP&A Act)*;
- 2) To find out when this consent is liable to lapse, see section 95 of the *EP&A Act*; and
- 3) To find out about appeal rights, see section 97 of the *EP&A Act*.

SCHEDULE 2 DEFINITIONS

Annual Review	The review required by Condition 5 of Schedule 6
Applicant	Wambo Coal Pty Limited
BCA	Building Code of Australia
Bore	Any bore or well or excavation or other work connected or proposed to be connected with sources of sub-surface water, and used or proposed to be used or capable of being used to obtain supplies of such water whether the water flows naturally at all times or has to be raised whether wholly or at times by pumping or other artificial means
CCC	Community Consultative Committee
Council	Singleton Shire Council
DA	Development Application
Day	Day is defined as the period from 7am to 6pm on Monday to Saturday, and 8am to 6pm on Sundays and Public Holidays
DECCW	Department of Environment, Climate Change and Water
Department	Department of Planning
DII	Department of Industry and Investment
Director-General	Director-General of Department of Planning, or delegate
DSC	Dams Safety Committee
EIS	Environmental Impact Statement
Environmental consequences	The environmental consequences of subsidence impacts, including: damage to infrastructure, buildings and residential dwellings; loss of surface flows to the subsurface; loss of standing pools; adverse water quality impacts; development of iron bacterial mats; cliff falls; rock falls; damage to Aboriginal heritage sites; impacts on aquatic ecology; ponding
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
Evening	Evening is defined as the period from 6pm to 10pm
First Workings	Underground workings which establish access to the coal resource area
GTA	General Term of Approval
Land	Land means the whole of a lot in a current plan registered at the Land Titles Office at the date of this consent
Minister	Minister for Planning, or delegate
MOP	Mining Operations Plan
MSB	Mine Subsidence Board
Night	Night is defined as the period from 10pm to 7am on Monday to Saturday, and 10pm to 8am on Sundays and Public Holidays
NOW	NSW Office of Water
Offset Strategy	The revegetation and enhancement program described in the EIS for the Wambo Development Project, dated July 2003
PCA	Principal Certifying Authority appointed under Section 109E of the Act
Privately-owned land	Land excluding land owned by a mining company, where: <ul style="list-style-type: none"> • A private agreement does not exist between the Applicant and the land owner; and • There are no land acquisition provisions requiring the Applicant to purchase the land upon request from the land owner.
Rehabilitation	The treatment or management of land disturbed by the development for the purpose of establishing a safe, stable and non-polluting environment, including the remediation of impacts
ROM Coal	Run-of-mine coal
RTA	Roads and Traffic Authority
SEE	Statement of Environmental Effects
Safe, serviceable & repairable	Safe means no danger to users who are present, serviceable means available for its intended use, and repairable means damaged components can be repaired economically
Southern Area	See Figure HA-5 in Appendix HA of Volume 4 of the EIS for the Wambo Development Project
Site	Land to which the DA applies
Subsidence effects	Deformation of the ground mass due to mining, including all mining-induced ground movements, such as vertical and horizontal displacement, tilt, strain and curvature
Subsidence impacts	Physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upside and surface depressions or troughs

Vacant land

Vacant land is defined as the whole of the lot in a current plan registered at the Land Titles Office that does not have a dwelling situated on the lot and is permitted to have a dwelling on that lot at the date of this consent.

TABLE OF CONTENTS

1.	ADMINISTRATIVE CONDITIONS	6
2.	SPECIFIC ENVIRONMENTAL CONDITIONS	
	Acquisition Upon Request	8
	Air Quality	8
	Noise	10
	Meteorological Monitoring	11
	Blasting & Vibration	12
	Subsidence	13
	Rejects Emplacement Strategy	15
	Surface & Ground Water	16
	Flora & Fauna	19
	Aboriginal Cultural Heritage	21
	Wambo Homestead Complex	22
	Traffic & Transport	23
	Visual Impact	24
	Greenhouse Gas	25
	Waste Minimisation	25
	Hazards Management	25
	Bushfire Management	26
	Rehabilitation	26
	Mine Exit Strategy	26
3.	ADDITIONAL PROCEDURES FOR AIR QUALITY & NOISE MANAGEMENT	27
4.	ENVIRONMENTAL MANAGEMENT, MONITORING, AUDITING & REPORTING	
	Environmental Management Strategy	30
	Environmental Monitoring Program	30
	Annual Review	30
	Revision of Strategies, Plans and Programs	30
	Independent Environmental Audit	31
	Community Consultative Committee	31
	Reporting	31
	Access to Information	32
5.	APPENDIX 1: SCHEDULE OF LAND	33
6.	APPENDIX 2: INDEPENDENT DISPUTE RESOLUTION PROCESS	35
7.	APPENDIX 3: MAPS FOR ABORIGINAL CULTURAL HERITAGE INVESTIGATIONS	36

**SCHEDULE 3
ADMINISTRATIVE CONDITIONS**

Obligation to Minimise Harm to the Environment

1. The Applicant shall implement all practicable measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the development.

Terms of Approval

2. The Applicant shall carry out the development generally in accordance with the:
 - (a) DA 305-7-2003;
 - (b) EIS titled *Wambo Development Project*, volumes 1-5, dated July 2003, and prepared by Resource Strategies Pty. Ltd.;
 - (c) letter from Holmes Air Sciences to the Department, dated 3 September 2003, and titled *Wambo Development Project - Response Air Quality Assessment*;
 - (d) letter from Wambo Coal Pty. Ltd. to the Department, dated 24 October 2003, and titled *Wambo Development Project – Development Application Amendment (DA 305-7-2003-i)*;
 - (e) Statement of Environmental Effects titled *Wambo Development project – Wambo Seam Underground Mine Modification*, dated January 2005, and prepared by Wambo Coal Pty Ltd;
 - (f) document titled *Wambo Development Project – Modification of DA 305-7-2003-I*, dated 24 October 2005;
 - (g) document titled *Wambo Development Project – Modification of DA 305-7-2003-I*; dated 23 January 2006;
 - (h) document titled *Wambo Development Project – Modification of DA 305-7-2003-I*; dated 27 July 2006;
 - (i) document titled *Wambo Coal Mine Modification Statement of Environmental Effects*; dated September 2006;
 - (j) document titled *Wambo Coal Mine Statement of Environmental Effects on Proposed Modification*, dated March 2009;
 - (k) document titled *Wambo Coal Mine Modification Statement of Environmental Effects*, dated June 2009 and the response to submissions dated July 2009;
 - (l) the modification application DA 305-7-2003 MOD 9 and accompanying letter prepared by Wambo Coal Pty Ltd; and
 - (m) conditions of this consent.
3. If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this consent shall prevail to the extent of any inconsistency.
4. The Applicant shall comply with any reasonable requirement/s of the Director-General arising from the Department's assessment of:
 - (a) any reports, plans or correspondence that are submitted in accordance with this consent; and
 - (b) the implementation of any actions or measures contained in these reports, plans or correspondence.

Deferred Commencement

5. This consent shall only commence when the Applicant has surrendered all previous development consents for the Wambo coal mine, excluding DA No. 108/91 issued by Singleton Shire Council, to the satisfaction of the Director-General.

Limits on Approval

6. This consent lapses 21 years after the date it commences.
7. The Applicant shall not extract more than 14.7 million tonnes of ROM coal a year from the development.

Management Plans/Monitoring Programs

- 7A The Applicant may prepare and submit for approval all the management plans and monitoring programs required by this consent on a progressive basis. Where such management plans and monitoring programs are required before carrying out any development, or stage of development, they may be prepared and submitted for approval in relation to either discrete components of the development or for a specified time period.

Structural Adequacy

8. The Applicant shall ensure that all new buildings and structures, and any alterations or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

Notes:

- *Under Part 4A of the EP&A Act, the Applicant is required to obtain construction and occupation certificates for the proposed building works.*
- *Part 8 of the EP&A Regulation sets out the requirements for the certification of development.*
- *The development is located in the Patrick Plains Mine Subsidence District. Under section 15 of the Mine Subsidence Compensation Act 1961, the Applicant is required to obtain the Mine Subsidence Board's approval before constructing or relocating any improvements on the site.*

Demolition

9. The Applicant shall ensure that all demolition work is carried out in accordance with AS 2601-2001: *The Demolition of Structures*, or its latest version.

Operation of Plant and Equipment

10. The Applicant shall ensure that all plant and equipment used at the site, or to transport coal off-site, are:
 - (a) maintained in a proper and efficient condition; and
 - (b) operated in a proper and efficient manner.

Section 94 Contribution

11. Before carrying out any development, or as agreed otherwise by Council, the Applicant shall pay Council \$60,000 in accordance with Council's Section 94 Contribution Plan.

Community Enhancement Contribution

12. Before carrying out any development, or as agreed otherwise by Council, the Applicant shall pay Council \$15,000 for the enhancement of community infrastructure or services in the Warkworth/Jerrys Plains area.

**SCHEDULE 4
SPECIFIC ENVIRONMENTAL CONDITIONS**

ACQUISITION UPON REQUEST

1. Upon receiving a written request for acquisition from the landowner of the land listed in Table 1, the Applicant shall acquire the land in accordance with the procedures in conditions 9-11 of schedule 5:

2 – Lambkin	23A & B - Kannar
13C - Skinner	31A,B,C & D - Fisher
19A & B – Kelly	51 – Hawkes
22 – Henderson	56 - Haynes

Table 1: Land subject to acquisition upon request

Note: For more information on the numbering and identification of properties used in this consent, see Attachment 1 of the EIS for the Wambo Development Project.

AIR QUALITY

Impact Assessment Criteria

2. The Applicant shall ensure that the air pollution generated by the development does not exceed the criteria listed in Tables 2, 3, and 4 at any privately-owned land.

Pollutant	Averaging period	Criterion
Total suspended particulate (TSP) matter	Annual	90 µg/m ³
Particulate matter < 10 µm (PM ₁₀)	Annual	30 µg/m ³

Table 2: Long term impact assessment criteria for particulate matter

Pollutant	Averaging period	Criterion
Particulate matter < 10 µm (PM ₁₀)	24 hour	50 µg/m ³

Table 3: Short term impact assessment criterion for particulate matter

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m ² /month	4 g/m ² /month

Table 4: Long term impact assessment criteria for deposited dust

Note: Deposited dust is assessed as insoluble solids as defined by Standards Australia, 1991, AS 3580.10.1-1991: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.

Land Acquisition Criteria

3. If the air pollution generated by the development exceeds the criteria in Tables 5, 6, and 7 at any privately-owned land, the Applicant shall, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in conditions 9-11 of schedule 5.

Pollutant	Averaging period	Criterion
Total suspended particulate (TSP) matter	Annual	90 µg/m ³
Particulate matter < 10 µm (PM ₁₀)	Annual	30 µg/m ³

Table 5: Long term land acquisition criteria for particulate matter

Pollutant	Averaging period	Criterion	Percentile ¹	Basis
Particulate matter < 10 µm (PM ₁₀)	24 hour	150 µg/m ³	99 ²	Total ³
Particulate matter < 10 µm (PM ₁₀)	24 hour	50 µg/m ³	98.6	Increment ⁴

Table 6: Short term land acquisition criteria for particulate matter

¹Based on the number of block 24 hour averages in an annual period.

²Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the Director-General in consultation with the DECCW.

³Background PM₁₀ concentrations due to all other sources plus the incremental increase in PM₁₀ concentrations due to the mine alone.

⁴Incremental increase in PM₁₀ concentrations due to the mine alone.

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m ² /month	4 g/m ² /month

Table 7: Long term land acquisition criteria for deposited dust

Note: Deposited dust is assessed as insoluble solids as defined by Standards Australia, 1991, AS 3580.10.1-1991: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.

¹Monitoring

4. The Applicant shall establish air quality monitoring stations at a minimum of 4 locations around the site, including the residence on property 40 (Muller) whilst privately-owned, to monitor (by sampling and obtaining results by analysis) the concentration of each pollutant in Table 8 to the satisfaction of DECCW and the Director-General, using the specified averaging period, frequency, and sampling method:

Pollutant	Units of Measure	Averaging Period	Frequency	Sampling method ¹
PM ₁₀	µg/m ³	24 hour, annual	Continuous	AS3580.9.8 – 2001 ²
TSP	µg/m ³	24 hour, annual	1 day in 6	AM-15
Dust Deposition	g/m ² /month	Month, annual	Continuous	AM-19
Siting	-	-	-	AM-1

Table 8: Air quality monitoring

¹ NSW EPA, 2001, Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.

¹ Incorporates DECCW GTA

²Standards Australia, 2001, AS3580.9.8-2002, Method for Sampling and Analysis of Ambient Air - Determination of Suspended Particulate Matter - PM₁₀ Continuous Direct Mass Method using a Tapered Element Oscillating Microbalance Analyser, or any other method that is approved by the DECCW and the Director-General.

5. Before carrying out any development, the Applicant shall prepare an Air Quality Monitoring Program, in consultation with DECCW, and to the satisfaction of the Director-General.

²NOISE

Noise Impact Assessment Criteria

6. The Applicant shall ensure that the noise generated by the development does not exceed the noise impact assessment criteria presented in Table 9.

Day <i>L</i> _{Aeq(15 minute)}	Evening/Night <i>L</i> _{Aeq(15 minute)}	Night <i>L</i> _{A1(1 minute)}	Land Number
35	41	50	94 – Curlewis
35	40	50	3 – Birrell
			4B – Circosta
			15B - McGowen/Caslick
			16 – Cooper
			23C – Kannar
			25 – Fenwick
			28A & B – Garland
			33 -Thelander/O'Neill
			39 – Northcote
			40 – Muller
254A – Algie			
35	39	50	5 – Strachan
			6 - Merrick
			7 - Maizey
			37 - Lawry
35	38	50	48 - Ponder
			1 - Brosi
			17 - Carter
			18 - Denney
			38 - Williams
			49 - Oliver
			63 - Abrocuff
75 - Barnes			
35	37	50	91 - Bailey
			27 - Birralea
			43 - Carmody
			137 - Woodruff
35	36	50	163 - Rodger/Williams
			246 - Bailey
			13B - Skinner
35	35	50	178 - Smith
			188 - Fuller
			262A, B & C - Moses
35	35	50	All other residential or sensitive receptors, excluding the receptors listed in condition 1 above

Table 9: Noise impact assessment criteria dB(A)

Notes:

- a) Noise from the development is to be measured at the most affected point or within the residential boundary, or at the most affected point within 30 metres of a dwelling (rural situations) where the dwelling is more than 30 metres from the boundary, to determine compliance with the *L*_{Aeq(15 minute)} noise limits in the above table. Where it can be demonstrated that direct measurement of noise from the development is impractical, the DECCW may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy). The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.

² Incorporates DECCW GTAs

- b) Noise from the development is to be measured at 1 metre from the dwelling façade to determine compliance with the $L_{A1(1 \text{ minute})}$ noise limits in the above table.
- c) The noise emission limits identified in the above table apply under meteorological conditions of:
- Wind speeds of up to 3 m/s at 10 metres above ground level; or
 - Temperature inversion conditions of up to 3°C/100m, and wind speeds of up to 2 m/s at 10 metres above ground level.

Land Acquisition Criteria

7. If the noise generated by the development exceeds the criteria in Table 10, the Applicant shall, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in conditions 9-11 of schedule 5.

Day/Evening/Night $L_{Aeq(15 \text{ minute})}$	Property
43	94 - Curlewis
	23C – Kannar
	254A - Algie
40	All other residential or sensitive receptor, excluding the receptors listed in condition 1 above

Table 10: Land acquisition criteria dB(A)

Note: Noise generated by the development is to be measured in accordance with the notes presented below Table 9 above.

Monitoring

8. The Applicant shall conduct real-time monitoring of the noise generated by the development at a minimum of four properties to the south and north-west of the site, in general accordance with the *NSW Industrial Noise Policy* and *AS1055-1997: Acoustics – Description and Measurement of Environmental*.
9. Before carrying out any development, the Applicant shall prepare a Noise Monitoring Program to the satisfaction of the Director-General, which includes a noise monitoring protocol for evaluating compliance with the criteria in Tables 9 & 10.

³METEOROLOGICAL MONITORING

10. The Applicant shall establish a permanent meteorological station at a location approved by the **DECCW**, and to the satisfaction of the Director-General, to monitor the parameters specified in Table 11, using the specified units of measure, averaging period, frequency, and sampling method in the table.

Parameter	Units of measure	Averaging period	Frequency	Sampling method ¹
Lapse rate	°C/100m	1 hour	Continuous	Note ²
Rainfall	mm/hr	1 hour	Continuous	AM-4
Sigma Theta @ 10 m	°	1 hour	Continuous	AM-2
Siting	-	-	-	AM-1
Temperature @ 10 m	K	1 hour	Continuous	AM-4
Temperature @ 2 m	K	1 hour	Continuous	AM-4
Total Solar Radiation @ 10m	W/m ²	1 hour	Continuous	AM-4
Wind Direction @ 10 m	°	1 hour	Continuous	AM-2
Wind Speed @ 10 m	m/s	1 hour	Continuous	AM-2

Table 11: Meteorological monitoring

¹ NSW EPA, 2001, *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*.

² The Applicant shall calculate lapse rate from measurements made at 2m and 10m.

³ Incorporates **DECCW** GTA

⁴BLASTING & VIBRATION

Airblast Overpressure Limits

11. The Applicant shall ensure that the airblast overpressure level from blasting at the development does not exceed the criteria in Table 12 at any residence on privately-owned land with the exception of property 13C (Skinner) (see condition 20 below).

Airblast overpressure level (dB(Lin Peak))	Allowable exceedance
115	5% of the total number of blasts over a period of 12 months
120	0%

Table 12: Airblast overpressure impact assessment criteria

Ground Vibration Impact Assessment Criteria

12. The Applicant shall ensure that the ground vibration level from blasting at the development does not exceed the criteria in Table 13 at any residence on privately-owned land with the exception of property 13C (Skinner) (see condition 20 below).

Peak particle velocity (mm/s)	Allowable exceedance
5	5% of the total number of blasts over a period of 12 months
10	0%

Table 13: Ground vibration impact assessment criteria

Blasting Hours

13. The Applicant shall only carry out blasting at the development between 9 am and 5 pm Monday to Saturday inclusive. No blasting is allowed on Sundays, public holidays or any other time without the written approval of DECCW.

Public Notice

14. During the life of the development, the Applicant shall:
- operate a Blasting Hotline, or alternate system agreed to by the Director-General, to enable the public to get up-to-date information on blasting operations at the development; and
 - notify the occupants of any land within 2 km of the site about this hotline or system on an annual basis.

Property Inspection

15. Before carrying out any blasting, the Applicant shall advise all landowners within 2 km of the site that they are entitled to a property inspection.
16. If the Applicant receives a written request for a property inspection from any landowner within 2 km of the site, the Applicant shall:
- within 28 days of receiving the request, commission a suitably qualified person, whose appointment has been approved by the Director-General, to inspect the condition of any building or structure on the land, and recommend measures to mitigate any potential blasting impacts; and
 - give the landowner a copy of this property inspection report within 14 days of receiving the report.

Cumulative Impacts

17. The Applicant shall undertake all reasonable steps to co-ordinate blasting at the development with the blasting at surrounding mines – such as Bulga, Mount Thorley, Warkworth, and Hunter Valley Operations – to minimise the cumulative impacts of blasting in the region.

⁴ Incorporates DECCW GTA

Monitoring

18. The Applicant shall monitor the airblast overpressure and ground vibration impacts of the development at a minimum of four locations around the site, using the specified units of measure, frequency, sampling method, and location in Table 14.

Parameter	Units of Measure	Frequency	Sampling Method	Measurement Location
Airblast overpressure	dB(Lin Peak)	During every blast	AS2187.2-1993 ¹	Not less than 3.5 m from a building or structure
Peak particle velocity	mm/s	During every blast	AS2187.2-1993	Not more than 30 m from a building or structure

Table 14: Airblast overpressure and ground vibration monitoring

¹Standards Australia, 1993, AS2187.2-1993: Explosives - Storage, Transport and Use - Use of Explosives.

19. Before carrying out any development, the Applicant shall prepare a detailed Blast Monitoring Program for the development, in consultation with DECCW, and to the satisfaction of the Director-General.

Blast Management

20. Before carrying out any development (unless otherwise agreed to by the Director-General), the Applicant shall prepare a Blast Management Plan for property 13C (Skinner) in consultation with the landowner, and to the satisfaction of the Director-General. This plan must include measures to minimise, mitigate, and if necessary remediate the blasting impacts on the property. The Applicant shall implement this plan whilst the property is privately-owned.

Property Investigations

21. If any landowner within a 2 km radius of the site claims that his/her property has been damaged as a result of blasting at the development, the Applicant shall:
- within 28 days of receiving this claim in writing, commission a suitably qualified person whose appointment has been approved by the Director-General to investigate the claim; and
 - give the landowner a copy of the property investigation report within 14 days of receiving the report.

If this independent investigation confirms the landowner's claim, and both parties agree with these findings, then the Applicant shall repair the damages to the satisfaction of the Director-General.

If the Applicant or landowner disagrees with the findings of the independent property investigation, then either party may refer the matter to the Director-General for resolution.

If the matter cannot be resolved within 21 days, the Director-General shall refer the matter to an Independent Dispute Resolution Process (See Appendix 2).

SUBSIDENCE

Performance Measures – Natural and Heritage Features, etc

22. The Applicant shall ensure that the development does not cause any exceedances of the performance measures in Table 14A, to the satisfaction of the Director-General.

Table 14A: Subsidence Impact Performance Measures

Water	
Wollombi Brook	Negligible impact. Controlled release of excess site water only in accordance with EPL requirements
Biodiversity	
Wollemi National Park	Nil impact.
Warkworth Sands Woodland Community	Minor cracking and ponding of the land surface or other impact. Negligible environmental consequences

White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community	Minor cracking and ponding of the land surface or other impact. Negligible environmental consequences
Heritage	
Wambo Homestead Complex	Negligible impact on heritage values, unless approval has been granted by the Heritage Branch and/or the Minister

Notes:

- 1) The Applicant will be required to define more detailed performance indicators for each of these performance measures in the various management plans that are required under this consent (see condition 22C below).
- 2) The requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of approval of modification 9.

Performance Measures – Built Features

22A. The Applicant shall ensure that the development does not cause any exceedances of the performance measures in Table 14B, to the satisfaction of the Director-General of DII.

Table 14B: Subsidence Impact Performance Measures

Built Features	
All built features	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.
Public Safety	
Public Safety	No additional risk

Notes:

- 1) The Applicant will be required to define more detailed performance indicators for each of these performance measures in Built Features Management Plans or Public Safety Management Plan (see condition 22C below).
- 2) The requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of modification 9.
- 3) Requirements regarding safety or serviceability do not prevent preventative or mitigatory actions being taken prior to or during mining in order to achieve or maintain these outcomes.
- 4) Compensation required under this condition includes any compensation payable under the Mine Subsidence Compensation Act 1961 and/or the Mining Act 1992.

22B. Any dispute between the Applicant and the owner of any built feature over the interpretation, application or implementation of the performance measures in Table 14B is to be settled by the Director-General of DII. The Director-General of DII may seek the advice of the MSB on the matter. Any decision by the Director-General of DII shall be final and not subject to further dispute resolution under this consent.

Extraction Plan

22C. The Applicant shall prepare and implement an Extraction Plan for the second workings within each seam to be mined to the satisfaction of the Director-General. Each Extraction Plan must:

- (a) be prepared by a team of suitably qualified and experienced persons whose appointment has been endorsed by the Director-General;
- (b) be approved by the Director-General before the Applicant carries out any of the second workings covered by the plan;
- (c) include detailed plans of the proposed first and second workings and any associated surface development;
- (d) include detailed performance indicators for each of the performance measures in Tables 14A and 14B;
- (e) provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed second workings, incorporating any relevant information obtained since this consent;
- (f) describe the measures that would be implemented to ensure compliance with the performance measures in Tables 14A and 14B, and manage or remediate any impacts and/or environmental consequences;
- (g) include the following to the satisfaction of DII:
 - a coal resource recovery plan that demonstrates effective recovery of the available resource;
 - a subsidence monitoring program to:
 - provide data to assist with the management of the risks associated with subsidence;
 - validate the subsidence predictions; and

- analyse the relationship between the subsidence effects and impacts under the plan and any ensuing environmental consequences;
 - a Built Features Management Plan to manage the potential subsidence impacts and/or environmental consequences of the proposed second workings, and which:
 - addresses in appropriate detail all items of public infrastructure and all classes of other built features; and
 - has been prepared following appropriate consultation with the owner/s of potentially affected feature/s;
 - a Public Safety Management Plan to ensure public safety in the mining area; and
 - appropriate revisions to the Rehabilitation Management Plan required under condition 40A; and
- (h) include a:
- Water Management Plan, which has been prepared in consultation with DECCW and NOW, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on surface water resources, groundwater resources and flooding, and which includes:
 - surface and groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse impacts on water resources or water quality;
 - a program to monitor and report groundwater inflows to underground workings; and
 - a program to manage and monitor impacts on groundwater bores on privately-owned land;
 - Biodiversity Management Plan, which has been prepared in consultation with DECCW and DII, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on flora and fauna;
 - Land Management Plan, which has been prepared in consultation with any affected public authorities, to manage the potential impacts and/or environmental consequences of the proposed second workings on land in general;
 - Heritage Management Plan, which has been prepared in consultation with DECCW, the Department's Heritage Branch and relevant stakeholders for Aboriginal and non-Aboriginal heritage, to manage the potential environmental consequences of the proposed second workings on heritage sites or values; and
- (i) include a program to collect sufficient baseline data for future Extraction Plans.

Notes:

- 1) An SMP approved by DII prior to 30 July 2011 is taken to satisfy the requirements of this condition.
- 2) Management plans prepared under condition 22C(h) should address all potential impacts of proposed underground coal extraction on the relevant features. Other similar management plans required under this consent (eg under conditions 30 - 35 and 44 - 48) are not required to duplicate these plans or to otherwise address the impacts associated with underground coal extraction.

- 22D. The Applicant shall ensure that the management plans required under condition 22C(h) above include:
- (a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this consent;
 - (b) a detailed description of the measures that would be implemented to remediate predicted impacts; and
 - (c) a contingency plan that expressly provides for adaptive management.

First Workings

- 22E. The Applicant may carry out first workings within the underground mining area, other than in accordance with an approved extraction plan, provided that DII is satisfied that the first workings are designed to remain stable and non-subsiding in the long term, except insofar as they may be impacted by approved second workings.

Note: The intent of this condition is not to require an additional approval for first workings, but to ensure that first workings are built to geotechnical and engineering standards sufficient to ensure long term stability, with negligible resulting direct subsidence impacts.

Payment of Reasonable Costs

- 22F. The Applicant shall pay all reasonable costs incurred by the Department to engage independent experts to review the adequacy of any aspect of an Extraction Plan.

REJECTS EMPLACEMENT STRATEGY

- 22G. Within 6 months of this consent commencing, the Applicant shall prepare a Life of Mine Rejects Emplacement Strategy for the development, to the satisfaction of the Director-General of DII.

⁵SURFACE & GROUND WATER

Note: The Applicant is required to obtain licences for the development under the Water Act 1912 and the Protection of the Environment Operations Act 1997.

Pollution of Waters

23. Except as may be expressly provided by a DECCW licence, the Applicant shall comply with section 120 of the *Protection of the Environment Operations Act 1997* during the carrying out of the development.

Discharge Limits

24. Except as may be expressly provided by a DECCW licence or the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*, the Applicant shall:
- not discharge more than 250 ML/day from the licenced discharge point/s at the development;
 - ensure that the discharges from any licenced discharge point comply with the limits in Table 15:

Pollutant	Units of measure	100 percentile concentration limit
pH	pH	$6.5 \leq \text{pH} \leq 9$
Non-filterable residue	mg/litre	NFR ≤ 120

Table 15: Discharge Limits

Note: This condition does not authorise the pollution of waters by any other pollutants.

Site Water Balance

25. ⁶Each year, the Applicant shall:
- review the site water balance for the development against the predictions in the EIS;
 - re-calculate the site water balance for the development;
 - assess current and forecast compliance with the rules of the Hunter River Salinity Trading Scheme; and
 - report the results in the **Annual Review**.

North Wambo Creek Diversion

26. The Applicant shall design, construct, maintain, and rehabilitate the temporary North Wambo Creek Bypass, the temporary North Wambo Creek Pipeline, and the North Wambo Creek Diversion in consultation with DII, **NOW** and to the satisfaction of the Director-General.

Note: The Department accepts that the Applicant is not required to "rehabilitate" the temporary North Wambo Creek Bypass.

27. Within one month of completing the construction of the temporary North Wambo Creek Bypass, the temporary North Wambo Creek Pipeline, and the North Wambo Creek Diversion, the Applicant shall submit an as-executed report, certified by a practising registered engineer, to the Director-General.
28. Prior to destroying the original creek line by open cut mining, the Applicant shall demonstrate that the relevant stage of the North Wambo Creek Diversion is operating successfully from a hydrological and biological point of view to the satisfaction of DII and the Director-General.

Note: This condition does not apply to the temporary North Wambo Creek Bypass.

Chitter Dump Dam

- 28A. The Applicant shall design and construct the Chitter Dump Dam in consultation with United Collieries Pty Ltd, and to the satisfaction of the DSC and DII. The design of the dam must be accompanied by

⁵ Incorporates DECCW GTA

⁶ These calculations must exclude the clean water system, including any sediment control structures, and any dams in the mine lease area which fall under the Maximum Harvestable Right Dam Capacity; include any dams that are licensable under Section 205 of the Water Act 1912, and water harvested from any non-harvestable rights dam on the mine lease area; address balances of inflows, licenced water extractions, and transfers of water from the site to other sites; include an accounting system for water budgets; and include a salt budget.

a detailed assessment of the potential operational and environmental risks associated with the dam, particularly in relation to potential subsidence-related impacts.

South Wambo Dam

28B. The Applicant shall design and construct the South Wambo Dam to the satisfaction of the DSC and DII. The design of the dam must be accompanied by a detailed assessment of the potential operational and environmental risks associated with the dam, particularly in relation to potential subsidence-related impacts.

Monitoring

29. The Applicant shall:
- (a) measure:
 - the volume of water discharged from the site;
 - water use on the site;
 - dam and water structure storage levels,
 - water transfers across the site; and
 - water transfers between the site and surrounding mines;
 - (b) monitor the quality of the surface water:
 - discharged from the licenced discharge point/s at the development; and
 - upstream and downstream of the development;
 - (c) monitor flows in the Wollombi Brook; and North Wambo, South Wambo, and Stony Creeks;
 - (d) monitor the volume and quality of water inflows from each separate source to the underground and open cut workings; and
 - (e) monitor regional ground water levels and quality in the alluvial and overburden aquifers during the development and at least 10 years after mining; and
 - (f) periodically assess groundwater pressure response in the coal measures; to the satisfaction of DECCW, NOW and the Director-General.

Site Water Management Plan

30. Before carrying out any development, the Applicant shall prepare a Site Water Management Plan for the development in consultation with DII and NOW, and to the satisfaction of the Director-General. This plan must include:
- (a) the predicted site water balance;
 - (b) the North Wambo Creek Diversion Plan;
 - (c) an Erosion and Sediment Control Plan;
 - (d) a Surface Water Monitoring Program;
 - (e) a Ground Water Monitoring Program;
 - (f) a Surface and Ground Water Response Plan; and
 - (g) a strategy for the decommissioning water management structures on the site.

By the end of October 2009, the Applicant shall revise the Site Water Management Plan in consultation with DII, DECCW and NOW, and to the satisfaction of the Director-General.

Note: The North Wambo Creek Diversion Plan must also be prepared in consultation with NSW Fisheries.

31. The North Wambo Creek Diversion Plan shall include:
- (a) the detailed design and specifications of the creek diversion, including the flow control bund, cut off wall, and channel;
 - (b) a revegetation program for the channel using a range of suitable native riparian and floodplain species;
 - (c) the detailed design of the system that would return intercepted ground water to the alluvial aquifer downstream of the open cut;
 - (d) a construction program for the creek diversion, describing how the work would be staged, and progressively integrated with the mining operations and the mine waste emplacement drainage system;
 - (e) water quality, ecological and geomorphic performance criteria for the creek diversion;
 - (f) a program to monitor water quality, ecological, and geomorphic integrity of the creek diversion; and
 - (g) a program to inspect and maintain the creek diversion and revegetation works during the development.

Note: The Applicant may prepare and submit the North Wambo Diversion Plan on a progressive basis to reflect the relevant stages of the proposed diversion.

32. The Erosion and Sediment Control Plan shall:
- be consistent with the requirements of the Department of Housing's *Managing Urban Stormwater: Soils and Construction* manual;
 - identify activities that could cause soil erosion and generate sediment;
 - describe the location, function, and capacity of erosion and sediment control structures; and
 - describe measures to minimise soil erosion and the potential for the migration of sediments to downstream waters.
33. ⁷The Surface Water Monitoring Program shall include:
- detailed baseline data on surface water flows and quality in the Wollombi Brook, and North Wambo, South Wambo, and Stony Creeks;
 - surface water impact assessment criteria;
 - a program to monitor surface water flows and quality in the Wollombi Brook; and North Wambo, South Wambo, and Stony Creeks;
 - a program to monitor bank and bed stability in North Wambo, South Wambo, and Stony Creeks;
 - a program to monitor the quantity and quality of the vegetation in the riparian zones adjacent to North Wambo, South Wambo, and Stony Creeks; and
 - a program to monitor the effectiveness of the Erosion and Sediment Control Plan.
34. The Ground Water Monitoring Program shall include:
- detailed baseline data on ground water levels and quality, based on statistical analysis, to benchmark the pre-mining natural variation in groundwater levels and quality;
 - ground water impact assessment criteria;
 - a program to monitor the volume and quality of ground water seeping into the open cut and underground mining workings;
 - a program to monitor regional ground water levels and quality in the alluvial and overburden aquifers; and
 - a program to investigate and monitor potential water loss from the Chitter Dump Dam and South Wambo Dam, including potential migration of stored water toward Wollombi Brook.
35. The Surface and Ground Water Response Plan shall include:
- measures to mitigate any adverse impacts on existing water supply bores or wells;
 - measures to mitigate the loss of surface water flows in the surface water streams or channel on the site;
 - deleted;
 - measures to mitigate the long term direct hydraulic connection between the backfilled open cut and the North Wambo Creek alluvium if the potential for an downstream adverse impact is detected;
 - measures to address the decrease in throughflow rates caused by the development within the Wollombi Brook alluvium downstream of the open cut;
 - measures to address any reduction in the stability or ecological quality of the North Wambo Creek Diversion below the established performance criteria;
 - trigger levels for the relinquishment of water extraction rights to compensate for surface and groundwater losses from streams, channels or alluvials to open cut and underground mining workings;
 - the procedures that would be followed if any unforeseen impacts are detected during the development; and
 - response times for undertaking the above measures.

Surface & Sub-surface Investigation Program

36. Deleted

Independent Audit

37. **Prior to seeking approval from the Department for each extraction plan**, unless the Director-General directs otherwise, the Applicant shall commission a suitably qualified person, whose appointment has been approved by the Director-General, to conduct an independent audit of the subsidence, surface water, and ground water impacts of the development. This audit shall:
- review the monitoring data for the development;
 - identify any trends in the monitoring data;
 - examine the subsidence, surface water, and ground water impacts of the development;
 - compare these impacts against the relevant impact assessment criteria and predictions in the EIS; and, if necessary;
 - recommend measures to reduce, mitigate, or remediate these impacts.

⁷ Incorporates DECCW GTA

38. If the independent audit determines that the subsidence, surface water, and/or ground water impacts resulting from the underground mining operations are greater than those predicted in the EIS, the Applicant shall:
- assess the significance of these impacts;
 - investigate measures to minimise these impacts, including modifying subsequent mine plans; and
 - describe what measures would be implemented to reduce, minimise, mitigate or remediate these impacts in the future;
- to the satisfaction of the Director-General.

Final Void Strategy

39. At the end of Year 7 of the development, or as directed otherwise by the Director-General, the Applicant shall prepare a Final Void Management Plan for the development, in consultation with the **DII**, the Director-General and Council, and to the satisfaction of the Director-General. This Plan must:
- investigate options for the future use of the final void;
 - re-assess the potential groundwater impacts of the development; and
 - describe what actions and measures would be implemented to:
 - minimise any potential adverse impacts associated with the final void; and
 - manage, and monitor the potential impacts of, the final void over time.

FAUNA & FLORA

Offset Strategy

40. Within the limits of current technology and best practice flora and fauna management, as determined by the Director-General in consultation with the Hunter Coalfield Flora & Fauna Advisory Committee (**when established**), the Applicant shall implement:
- the offset strategy summarised in Table 16; and
 - any subsequent revisions to the offset strategy, prepared in consultation with the Hunter Coalfield Flora & Fauna Advisory Committee (**when established**), and approved in writing by the Director-General;
- to the satisfaction of the Director-General.

Area	Size
Remnant Woodland Enhancement Area A	424 ha
Remnant Woodland Enhancement Area B	454 ha
Remnant Woodland Enhancement Area C	202 ha
Open Cut Woodland Revegetation	1,570ha
Other Areas (e.g. Community 15 and the Southern Area)	Where practicable

Table 16: Broad Targets for Offset Strategy

Notes:

- (b) *The Director-General shall form the Hunter Coalfield Flora & Fauna Advisory Committee to:*
- provide on-going advice on the Flora and Fauna Management Plan; and*
 - monitor and review the performance of the implementation of the Remnant Woodland Enhancement Program.*
- (c) *The area of Open Cut Woodland Revegetation in Table 16 is based on the establishment of 50% woodland within the mixed woodland/pasture areas shown in the EIS, and with the agreement of the Director-General, may vary depending on the shape of the final landform and the approved mine closure plan.*

Deed of Agreement

41. **Within 18 months of the commencement of this consent**, the Applicant shall enter into a Deed of Agreement with the Minister. In this agreement, the Applicant shall agree to:
- conserve and manage the land in the offset strategy in accordance with the Remnant Woodland Enhancement Program (see Condition 47) in the Flora & Fauna Management Plan (see Condition 44),
 - apply to rezone the land in Remnant Woodland Enhancement Area A for the purpose of:
 - protecting the land for conservation; and
 - excluding open cut mining;
 - conserve and manage the land in Remnant Woodland Enhancement Area A in accordance with any Aboriginal cultural heritage conservation agreement (see Condition 51);
 - exclude open cut mining in Remnant Woodland Enhancement Areas B and C, unless, in the opinion of the Minister, the Applicant has demonstrated that there is a clear justification for this

on social, economic, and/or environmental grounds. To assist the Minister in his decision-making, the Applicant shall:

- establish the coal reserve in Remnant Woodland Enhancement Area Areas B and C;
 - investigate the options for mining this reserve;
 - assess the implications of any open cut coal mining proposal on the offset strategy and broad conservation outcomes; and
 - assess the environmental, economic and social aspects of any open cut mining proposal in the area; and
- (e) apply to rezone Remnant Woodland Enhancement Areas B and C, in whole or in part, excluding any lands approved for open-cut mining by the Minister.

41A. By the end of December 2009, the Applicant shall:

- (a) incorporate an offset of at least 46 hectares, generally consistent with the offset described in the 2009 SEE, into the Remnant Woodland Enhancement Program (see condition 47); and
- (b) establish mechanisms within the Flora and Fauna Management Plan for long-term conservation and management of this offset in accordance with condition 41 (d) & (e).

Hunter Coalfield Flora & Fauna Advisory Committee Contribution

42. The Applicant shall contribute a reasonable amount, up to \$20,000, each year towards the operation of the Hunter Coalfield Flora & Fauna Advisory Committee (when established).

Strategic Study Contribution

43. If, during the development, the Department commissions a strategic study into the regional vegetation corridor stretching from the Wollemi National park to the Barrington Tops National Park, then the Applicant shall contribute a reasonable amount, up to \$20,000, towards the completion of this study.

Flora & Fauna Management Plan

44. Before carrying out any development, the Applicant shall prepare a Flora and Fauna Management Plan for the development, in consultation with the Hunter Coalfield Flora and Fauna Advisory Committee (when established), and to the satisfaction of the Director-General. This plan must include:
- (a) a Vegetation Clearance Protocol;
 - (b) a Threatened Species Management Protocol;
 - (c) a Remnant Woodland Enhancement Program;
 - (d) a Flora and Fauna Monitoring Program;
 - (e) strategies to manage any subsidence impacts in the Remnant Woodland Enhancement Areas; and
 - (f) a description of who would be responsible for monitoring, reviewing, and implementing the plan.

By the end of December 2009, the Applicant shall revise the Flora and Fauna Management Plan for the development to the satisfaction of the Director-General.

45. The Vegetation Clearance Protocol shall include:
- (a) the delineation of areas of remnant vegetation to be cleared;
 - (b) progressive clearing;
 - (c) pre-clearance surveys;
 - (d) identification of fauna management strategies;
 - (e) collection of seed from the local area;
 - (f) salvage and reuse of material from the site; and
 - (g) control of weeds during clearing activities.
46. The key components of the Threatened Species Management Protocol shall include:
- (a) observations/surveys for threatened species (facilitated by the vegetation clearance surveys and Flora and Fauna Monitoring Program);
 - (b) consultation with regulatory authorities; and
 - (c) threatened species management strategies and reporting.
47. The Remnant Woodland Enhancement Program shall include:
- (a) a habitat assessment of Remnant Woodland Enhancement Areas A, B, C and the offset area described in the 2009 SEE, to obtain additional information on existing habitat resources and characteristics of each area;
 - (b) investigation of other areas to be included in the Program, including the *Acacia anuera* Community (Community 15) and the Southern Area;
 - (c) appropriate enhancement strategies to be implemented based on the habitat assessment including:

- the fencing of remnants to exclude livestock;
 - control measures to minimise the occurrence of weeds;
 - control measures to minimise the occurrence of feral pests;
 - limiting vehicular traffic;
 - selective planting of native vegetation; and
 - the provision of roosting/nesting resources for fauna.
48. The Flora and Fauna Monitoring Program shall include:
- (a) a program to monitor revegetation of disturbance areas including:
 - visual monitoring to determine the need for maintenance and/or contingency measures; and
 - monitoring of the quality of rehabilitation using Ecosystem Function Analysis (or a similar systems based approach) through the assessment of landscape function, vegetation dynamics and habitat complexity; and
 - (b) a program to monitor the effectiveness of offset strategy in accordance with the description in Table 17.

Monitoring Component	Monitoring Description
<i>Flora</i>	<i>A number of permanent flora survey quadrats (of varying sizes to survey tree, shrubs and ground cover) should be established in woodland enhancement areas to obtain quantitative data on plant species diversity and abundance.</i>
<i>Habitat Complexity</i>	<i>Habitat complexity should be monitored using a number of permanent transects established within woodland enhancement areas. Habitat complexity parameters such as canopy cover, shrub cover, ground vegetation cover, the amount of litter, fallen logs and rocks should be surveyed.</i>
<i>Terrestrial Fauna</i>	<i>Terrestrial fauna surveys should be conducted to monitor the usage of enhancement areas by vertebrate fauna. Monitoring may include fauna species diversity and abundance or, alternatively, the use of indicator species to measure the effectiveness of enhancement measures.</i>
<i>Aquatic Fauna</i>	<i>Freshwater macro-invertebrate monitoring, including an assessment of SIGNAL A values and water quality (e.g. temperature, pH, and salinity).</i>
<i>Specific Enhancement Initiatives</i>	<i>Monitoring of specific enhancement initiatives (e.g. the provision of nesting/roosting boxes, weed control or feral animal control).</i>

Table 17: Flora & Fauna Monitoring Program

Annual Review

49. The Applicant shall:
- (a) review the performance of the Flora and Fauna Management Plan annually, in consultation with the Hunter Coalfield Flora & Fauna Advisory Committee (when established); and
 - (b) revise the document as necessary to take into account any recommendations from the annual review.

Independent Audit

50. Within 5 years of the date of this consent, and every 5 years thereafter, unless the Director-General directs otherwise, the Applicant shall commission, and pay the full cost of, an Independent Audit of the offset strategy. This audit must:
- (a) be conducted by a suitably qualified, experienced, and independent person whose appointment has been endorsed by the Director-General;
 - (b) assess the performance of the offset strategy;
 - (c) review the adequacy of the Flora & Fauna Management Plan; and, if necessary,
 - (d) recommend actions or measures to improve the performance of the offset strategy, and the adequacy of the Flora & Fauna Management Plan.

⁸ABORIGINAL CULTURAL HERITAGE

Note: The Applicant is required to obtain consent from DECCW under the National Parks Wildlife Act 1974 to destroy Aboriginal sites and objects on the site.

Conservation Agreement

⁸ Incorporates DECCW GTAs

51. Within 12 months of the commencement of this consent, the Applicant shall develop a conservation agreement (as part of the Deed of Agreement with the Minister referred to in condition 41 above) for the management of Aboriginal cultural heritage in Remnant Woodland Enhancement Area A in consultation with the Aboriginal Communities and **DECCW**.

Salvage

52. Before making application for section 90 consents under *the National Parks & Wildlife Act 1974*, the Applicant shall develop a targeted, strategic salvage program for the development in consultation with **DECCW** and the Aboriginal communities.
53. Before the commencement of salvage operations, the Applicant shall ensure that a keeping place is established to house objects recovered from the salvage program.
54. The Applicant shall house the objects recovered during the salvage program in the keeping place established for the purpose.

Further Investigations

55. The Applicant shall:
- (a) investigate the cultural significance of the corridors A – Southern and B – Middle (see map in appendix 3) in consultation with the Aboriginal Communities;
 - (b) examine the possible pathways between Remnant Woodland Enhancement Area A (which includes the camp ground associated with the bora) and Wollemi National Park to the east; and
 - (c) investigate the feasibility of reserving from future mining operations, those areas identified as being of cultural significance to the Aboriginal Communities in consultation with **DECCW**.

Trust Fund Contribution

56. Before carrying out the development, or as agreed otherwise by the Director-General, the Applicant shall contribute \$50,000 to the Hunter Aboriginal Cultural Heritage Trust Fund for further investigations into Aboriginal cultural heritage, as defined by the Trust Deed.

⁹WAMBO HOMESTEAD COMPLEX

Section 60 Approval

57. An application under section 60 of the Heritage Act must be submitted to and approved by the Heritage Council prior to the commencement of any development on land within the State Heritage Register listing boundary for the Wambo Homestead Complex. In this regard a mine management plan shall be required to accompany the application which demonstrates that the proposed underground mining shall not have adverse heritage impacts on the WHC due to land subsidence.

Conservation Measures

58. Within 12 months of the commencement of this consent, the Applicant shall prepare a conservation management plan for the Wambo Homestead Complex in accordance with Heritage Office guidelines for the consideration of the Heritage Council of NSW.
59. The conservation policies and an interpretation strategy contained in the conservation management plan are to be implemented in accordance with a timetable to be contained in the a conservation management plan.
60. A suitably qualified and experienced consultant is to be engaged by the applicant to record an oral history of the Wambo Homestead Complex having regard to the strong associations of members of the local community with the site.
61. In circumstances where safe access to the Wambo Homestead Complex is able to be provided, opportunities are to be offered to the local community to visit the site during and after its conservation.
62. Prior to the commencement of mining operations, and then at yearly intervals prior to the approved structural engineer's inspections, a photographic record is to be prepared of all elevations of all structures within the Wambo Homestead Complex. The photographs are to be of archival quality in accordance with the Heritage Office guidelines, *How to Prepare Archival Records of Heritage Items 1994*, and *Guidelines for Photographic Recording of Heritage Items, 1994*. **The photographic record**

⁹ Incorporates NSW Heritage Council GTA

is to be lodged with NSW Heritage Office, and a copy is to be submitted to the Department and the Council.

Blasting

63. Ground vibration and air blast levels are to be monitored and recorded at a blast monitoring station to be established within the Wambo Homestead Complex for each blast within 2 km of the Wambo Homestead Complex.
64. A suitably qualified and experienced structural engineer, with expertise in vibration and blast monitoring is to be appointed to examine all monitoring records from the Wambo Homestead Complex blast monitoring station. The appointment of the structural engineer is to be approved in writing by the Director of the NSW Heritage Office.
65. Ground vibration and air blast levels experienced at the Wambo Homestead Complex blast monitoring station are not to exceed the structural damage assessment criteria prescribed by *Australian Standard AS 2187.2-1993 (or its latest version) "Explosives – Storage Transport and Use" for Sensitive and Heritage Structures* to prevent damage to the heritage items.
66. The approved structural engineer is to report to the Applicant on the monitoring results each month for blasting within 2 km of the Wambo Homestead Complex and 6 monthly for the remainder of the open cut mining operation and make recommendations to ensure the conservation and prevention of damage to the significant heritage structures. Copies of these reports are to be forwarded to the NSW Heritage Office.
67. The approved structural engineer is to inspect the Wambo Homestead Complex structures annually and as soon as practical, but no later than 3 days after blasting monitoring which exceeds the structural damage assessment criteria prescribed by AS 2187.2-1993 (or its latest version). During the period between blasting monitoring being recorded which exceeds the criteria in AS 2187.2-1993 (or its latest version) and the engineer's inspection, ground vibration from blasting is to be limited to a level which will prevent further blasting damage. The structural engineer is to advise the applicant and the NSW Heritage Office of any action required to repair the damage.
68. The approved structural engineer is to make an assessment of whether blasting within 2km of the Wambo Homestead Complex is to cease or be managed in order to stabilise or repair the damage, and so advise the applicant and the Director of the NSW Heritage Office. If blasting has been required to cease, it is not to resume until the damage has been stabilised or repaired, and the written approval for resumption has been issued by the Director of the NSW Heritage Office.

Rehabilitation

69. Following the cessation of the use of the coal haulage road which traverses the Wambo Homestead Complex property, the land is to be returned to its former condition (pre-1999) and the half palisade fence on the southern alignment of the mounting yard, which was removed, is to be reinstated as required by the approval of the Heritage Council for the construction of the road on 12 February 1999.

Movable Heritage Items

70. The Applicant shall liaise with the Power House Museum and Museums and Galleries Foundation regarding the significance of movable heritage which shall be displaced by the proposed open cut mining and suitable repositories for the conservation and storage of any significant items.

TRAFFIC & TRANSPORT

New Access Intersection

Note: The Applicant requires RTA approval under the Roads Act 1993 for the new intersection.

71. ¹⁰The Applicant shall design and construct the proposed new access intersection with the Golden Highway to the satisfaction of the RTA.

¹¹Road Closure

Note: The Applicant requires Council approval under the Roads Act 1993 prior to closing Pinegrove Road.

¹⁰ Incorporates RTA GTA

¹¹ Incorporates Council GTA

72. Prior to closing Pinegrove Road, the Applicant shall prepare and implement a Road Closure Management Plan in consultation with the affected landowners, and to the satisfaction of Council. This plan must describe the alternate access arrangements for any affected landowners.

Parking

73. The Applicant shall provide sufficient parking on-site for all mine-related traffic to the satisfaction of the Director-General.

Coal Haulage

74. The Applicant shall not transport more than 3 million tonnes of product coal a year from the site until a rail coal loader is commissioned in the vicinity of the site.

Note: The Applicant has submitted a separate development application to the Minister for the Wambo "Rail and Train Loading Infrastructure" (DA 306-7-2003).

75. The Applicant shall cease all coal haulage on public roads as soon as a rail coal loader is commissioned in the vicinity of the site, except in an emergency, and as agreed by the Director-General in consultation with Council.
76. If no rail loader is commissioned in the vicinity of the site within 2 years of the commencement of this consent, the Applicant shall submit a report to the Director-General outlining the alternatives to road haulage, and describing the proposed arrangements for transporting coal from the site.
77. The Applicant shall ensure that all loaded coal haulage vehicles entering or leaving the site are covered.
78. The Applicant shall pay Council 0.5 cents for each tonne of product coal hauled along Council roads to the Mount Thorley Coal Loader, in accordance with Council's Section 94 Contribution Plan.

Note: This contribution is subject to indexation by the Implicit Price Deflator, as published by the Australian Bureau of Statistics.

Monitoring

79. The Applicant shall:
- (a) keep records of the
 - amount of coal transported from the site each year; and
 - number of coal haulage truck movements generated each day by the development; and
 - (b) include these records in the **Annual Review**.

Traffic Management Plan

80. The Applicant shall prepare and implement a Traffic Management Plan in consultation with Council, and to the satisfaction of the RTA for the proposed blasting activities that require the temporary periodic closure of the Golden Highway. This plan shall ensure that adequate warning is given to road users prior to blasting, and that follow up inspections are made to ensure that public roads are safe and clear of debris.

VISUAL IMPACT

Visual Amenity

81. The Applicant shall implement measures to mitigate visual impacts including:
- (a) design and construction of development infrastructure in a manner that minimises visual contrasts; and
 - (b) progressive rehabilitation of mine waste rock emplacements (particularly outer batters), including partial rehabilitation of temporarily inactive areas.
82. The Applicant shall investigate and where feasible implement the following measures at locations assessed in the EIS as having a high potential visual impact:
- (a) implement landscaping works in consultation with affected rural residents (see Condition 83); and/or
 - (b) place and maintain visual screens between development infrastructure and the viewing location.

83. If a landowner of any dwelling assessed in the EIS as having a high potential visual impact requests the Applicant in writing to investigate ways to minimise the visual impact of the development on his/her dwelling, the Applicant shall:
- (a) within 28 days of receiving this request, commission a suitably qualified person whose appointment has been approved by the Director-General, to investigate ways to minimise the visual impacts of the development on the landowner's dwelling; and
 - (b) give the landowner a copy of the visual impact mitigation report within 14 days of receiving this report.

If both parties agree on the measures that should be implemented to minimise the visual impact of the development, then the Applicant shall implement these measures to the satisfaction of the Director-General.

If the Applicant and the landowner disagree on the measures that should be implemented to minimise the visual impact of the development, then either party may refer the matter to the Director-General for resolution.

If the matter cannot be resolved within 21 days, the Director-General shall refer the matter to an Independent Dispute Resolution Process (see Appendix 2).

Overburden Dumps

84. The Applicant shall construct the overburden emplacements generally in accordance with the EIS, and to the satisfaction of DII.

Lighting Emissions

85. The Applicant shall take all practicable measures to mitigate off-site lighting impacts from the development.
86. Unless otherwise agreed to by the Director-General, all external lighting associated with the development shall comply with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

GREENHOUSE GAS

87. For the life of the development, the Applicant shall:
- (a) monitor the greenhouse gas emissions generated by the development;
 - (b) investigate ways to reduce greenhouse gas emissions generated by the development; and
 - (c) report on greenhouse gas monitoring and abatement measures in the **Annual Review**, to the satisfaction of the Director-General.

WASTE MINIMISATION

88. For the life of the development, the Applicant shall:
- (a) monitor the amount of waste generated by the development;
 - (b) investigate ways to minimise waste generated by the development;
 - (c) implement reasonable and feasible measures to minimise waste generated by the development; and
 - (d) report on waste management and minimisation in the **Annual Review**, to the satisfaction of the Director-General.

HAZARDS MANAGEMENT

Spontaneous Combustion

89. The Applicant shall:
- (a) take the necessary measures to prevent, as far as is practical, spontaneous combustion on the site; and
 - (b) manage any spontaneous combustion on-site to the satisfaction of DII.

Dangerous Goods

90. The Applicant shall ensure that the storage, handling, and transport of:
- (a) dangerous goods is done in accordance with the relevant *Australian Standards*, particularly *AS1940* and *AS1596*, and the *Dangerous Goods Code*; and
 - (b) explosives are managed in accordance with the requirements of DII.

91. Before carrying out any development, the Applicant shall update the Safety Management System covering all operations on the site, including the safe storage of ammonium nitrate, to the satisfaction of the Director-General.

BUSHFIRE MANAGEMENT

92. The Applicant shall:
- (a) ensure that the development is suitably equipped to respond to any fires on-site; and
 - (b) assist the Rural Fire Service and emergency services as much as possible if there is a fire on-site during the development.
93. Before carrying out any development, the Applicant shall prepare a Bushfire Management Plan for the site, to the satisfaction of Council and the Rural Fire Service.

REHABILITATION

Progressive Rehabilitation

94. The Applicant shall carry out the rehabilitation of the DA area progressively, that is, as soon as reasonably practicable following disturbance.

Note: See also condition 81 of schedule 4.

Rehabilitation Management Plan

- 94A. The Applicant shall prepare and implement a Rehabilitation Management Plan for the development, to the satisfaction of the Director-General of DII. This plan must:
- (a) be prepared in consultation with the Department, DECCW, NOW, Council and the CCC;
 - (b) be prepared in accordance with any relevant DII guideline;
 - (c) build, to the maximum extent practicable, on the other management plans required under this consent; and
 - (d) be submitted to the Director-General of DII for approval by the end of December 2011.

Note: The Rehabilitation Management Plan should address all land impacted by the development, whether prior to or following the date of this consent. See also conditions 69 and 81 of schedule 4.

MINE EXIT STRATEGY

95. The Applicant shall work with the Council to investigate the minimisation of adverse socio-economic effects of a significant reduction in local employment levels and closure of the development at the end of its life.

**SCHEDULE 5
ADDITIONAL PROCEDURES FOR AIR QUALITY & NOISE MANAGEMENT**

Notify Landowners

1. If the air dispersion and/or noise model predictions in the documents listed in condition 2 of schedule 3 identify that the air pollution and/or noise generated by the development are likely to be greater than the air quality and/or noise impact assessment criteria in conditions 2 and 6 of schedule 4, then the Applicant shall notify the relevant landowners and/or existing or future tenants (including tenants of mine-owned properties) accordingly before it carries out any development.
2. If the results of the air quality and/or noise monitoring required in schedule 4 identify that the air pollution and/or noise generated by the development are greater than the air quality and/or noise impact assessment criteria in schedule 4, then the Applicant shall notify the relevant landowners and/or existing or future tenants (including tenants of mine-owned properties) at the end of each quarter.
3. Before carrying out any development, the Applicant shall develop a procedure in consultation with DECCW and NSW Health and approved by the Director-General, for notifying landowners and tenants referred to in condition 1. This procedure must ensure that:
 - (a) all existing and future tenants are advised in writing about:
 - air quality impacts likely to occur at the residence during the operational life of the mine; and
 - likely health and amenity impacts associated with exposure to particulate matter;
 - (b) the written advice in (a) is based on current air quality monitoring data, dispersion modelling results, research and literature; and
 - (c) there is an ongoing process for providing current air quality monitoring data, dispersion modelling results, research and literature to the tenants.

Independent Review

4. If a landowner considers the development to be exceeding the air quality and/or noise impact assessment criteria listed in schedule 4 at his/her dwelling, or at any proposed dwelling on his/her vacant land, then he/she may ask the Applicant for an independent review of the air pollution and/or noise impacts of the development on his/her dwelling, or proposed dwelling.

If the Director-General is satisfied that an independent review is warranted, the Applicant shall:

- (a) consult with the landowner to determine his/her concerns; and
- (b) commission a suitably qualified person – whose appointment has been approved by the Director-General – to conduct air quality and/or noise monitoring at the relevant dwelling to determine whether the development is complying with the relevant impact assessment criteria, and identify the source(s) and scale of any air quality and/or noise impact at the dwelling, and the development's contribution to this impact.

Within 14 days of receiving the results of this independent review, the Applicant shall give a copy of these results to the Director-General and landowner.

5. If the independent review (referred to in condition 4) determines that the development is complying with the relevant impact assessment criteria listed in schedule 4 at the dwelling, then the Applicant may discontinue the independent review with the approval of the Director-General.
6. If the independent review (referred to in condition 4) determines that the development is not complying with the relevant impact assessment criteria listed in schedule 4 at the dwelling, and that the development is primarily responsible for this non-compliance, then the Applicant shall:
 - (a) take all practicable measures, in consultation with the landowner, to ensure that the development complies with the relevant impact assessment criteria; and conduct further air quality and/or noise monitoring at the dwelling to determine whether these measures ensure compliance; or
 - (b) secure a written agreement with the landowner to allow exceedances of the air quality and/or noise impact assessment criteria listed in schedule 4.

If the additional monitoring referred to above subsequently determines that the development is complying with the relevant impact assessment criteria listed in schedule 4 at the dwelling, then the Applicant may discontinue the independent review with the approval of the Director-General.

If the measures referred to in (a) do not ensure compliance with the air quality and/or noise land acquisition criteria listed in schedule 4 at the dwelling, and the Applicant cannot secure a written agreement with the landowner to allow exceedances of the air quality and/or noise impact assessment criteria listed in schedule 4, then the Applicant shall, upon receiving a written request from the landowner, acquire all or part of the landowner's land in accordance with the procedures in conditions 9-11 below.

7. If the independent review determines that the development is not complying with the air quality and/or noise impact assessment criteria listed in schedule 4 at the dwelling, but that several mines are responsible for this non-compliance, then the Applicant shall, with the agreement of the landowner and other mine(s) prepare and implement a Cumulative Air Quality and/or Noise Impact Management Plan for the land to the satisfaction of the Director-General. This plan must provide the joint approach to be adopted by the Applicant and other mine(s) to manage cumulative air quality and/or noise impacts at the landowner's dwelling, and the acquisition of any land.

If the Applicant is unable to finalise an agreement with the landowner and/or other mine(s), and/or prepare a Cumulative Air Quality and Noise Impact Management Plan, then the Applicant or landowner may refer the matter to the Director-General for resolution.

If the matter cannot be resolved within 21 days, the Director-General shall refer the matter to an Independent Dispute Resolution Process.

If, following the Independent Dispute Resolution Process, the Director-General decides that the Applicant shall acquire all or part of the landowner's land, then the Applicant shall acquire this land in accordance with the procedures in conditions 9-11 below.

8. If the landowner disputes the results of the independent review (referred to in condition 4), either the Applicant or the landowner may refer the matter to the Director-General for resolution.

If the matter cannot be resolved within 21 days, the Director-General shall refer the matter to an Independent Dispute Resolution Process.

Land Acquisition

9. Within 6 months of receiving a written request from the landowner, the Applicant shall pay the landowner:
- (a) the current market value of the landowner's interest in the land at the date of this written request, as if the land was unaffected by the development the subject of the DA, having regard to the:
 - existing and permissible use of the land, in accordance with the applicable planning instruments at the date of the written request; and
 - presence of improvements on the land and/or any approved building or structure which has been physically commenced at the date of the landowner's written request, and is due to be completed subsequent to that date;
 - (b) the reasonable costs associated with:
 - relocating within the Singleton local government area, or to any other local government area determined by the Director-General;
 - obtaining legal advice and expert advice for determining the acquisition price of the land, and the terms upon which it is required; and
 - (c) reasonable compensation for any disturbance caused by the land acquisition process.

However, if within 6 months of receiving this written request, the Applicant and landowner cannot agree on the acquisition price of the land, and/or the terms upon which the land is to be acquired, then either party may refer the matter to the Director-General for resolution.

Upon receiving such a request, the Director-General shall request [the President of the NSW Division of the Australian Property Institute](#) to appoint a qualified independent valuer or Fellow of the Institute, to consider submissions from both parties, and determine a fair and reasonable acquisition price for the land, and/or terms upon which the land is to be acquired.

If either party disputes the independent valuer's determination, then the independent valuer must refer the matter back to the Director-General.

Upon receiving such a referral, the Director-General shall appoint a panel to determine a fair and reasonable acquisition price for the land, and/or the terms upon which the land is to be acquired, comprising the:

- (i) appointed independent valuer,
- (ii) Director-General or nominee, and
- (iii) President of the Law Society of NSW or nominee.

Within 14 days of receiving the panel's determination, the Applicant shall make a written offer to purchase the land at a price not less than the panel's determination.

If the landowner refuses to accept this offer within 6 months of the date of the Applicant's offer, the Applicant's obligations to acquire the land shall cease, unless otherwise agreed by the Director-General.

- 10. The Applicant shall bear the costs of any valuation or survey assessment requested by the independent valuer, panel, or the Director-General and the costs of determination referred to in Condition 9.
- 11. If the Applicant and landowner agree that only part of the land should be acquired, then the Applicant shall pay all reasonable costs associated with obtaining Council approval for any plan of subdivision, and registration of the plan at the Office of the Registrar-General.

**SCHEDULE 6
ENVIRONMENTAL MANAGEMENT, MONITORING, AUDITING & REPORTING**

ENVIRONMENTAL MANAGEMENT STRATEGY

1. Before carrying out any development, the Applicant shall prepare and implement an Environmental Management Strategy for the development to the satisfaction of the Director-General. This strategy must:
 - (a) provide the strategic context for environmental management of the development;
 - (b) identify the statutory requirements that apply to the development;
 - (c) describe in general how the environmental performance of the development would be monitored and managed during the development;
 - (d) describe the procedures that would be implemented to:
 - keep the local community and relevant agencies informed about the operation and environmental performance of the development;
 - receive, handle, respond to, and record complaints;
 - resolve any disputes that may arise during the course of the development;
 - respond to any non-compliance;
 - manage cumulative impacts; and
 - respond to emergencies; and
 - (e) describe the role, responsibility, authority, and accountability of all the key personnel involved in environmental management of the development.
2. Within 14 days of the Director-General's approval, the Applicant shall:
 - (a) send copies of the approved strategy to the relevant agencies, Council, and the CCC; and
 - (b) ensure the approved strategy is publicly available during the development.

ENVIRONMENTAL MONITORING PROGRAM

3. Before carrying out any development, the Applicant shall prepare an Environmental Monitoring Program for the development in consultation with the relevant agencies, and to the satisfaction of the Director-General. This program must consolidate the various monitoring requirements in schedule 4 of this consent into a single document.
4. The Applicant shall regularly review, and if necessary update, this program in consultation with the Director-General.

ANNUAL REVIEW

5. The Applicant shall submit an annual review of the environmental performance of the development to the satisfaction of the Director-General. This review must:
 - (a) describe the development (including any rehabilitation) that was carried out in the past year, and the development that is proposed to be carried out over the next year;
 - (b) include a comprehensive review of the monitoring results and complaints records of the development over the past year, which includes a comparison of these results against:
 - the relevant statutory requirements, limits or performance measures/criteria;
 - the monitoring results of previous years; and
 - the relevant predictions in the EIS;
 - (c) identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance;
 - (d) identify any trends in the monitoring data over the life of the development;
 - (e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
 - (f) describe what measures will be implemented over the next year to improve the environmental performance of the development.

REVISION OF STRATEGIES, PLANS AND PROGRAMS

6. Within 3 months of:
 - (a) the submission of an annual review under Condition 5 above;
 - (b) the submission of an audit report under Condition 7 below;
 - (c) the submission of an incident report under Condition 10 below; and
 - (d) any modification to the conditions of this consent, (unless the conditions require otherwise),the Applicant shall review, and if necessary revise, the strategies, plans, and programs required under this consent to the satisfaction of the Director-General.

Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.

INDEPENDENT ENVIRONMENTAL AUDIT

7. Every 3 years, unless the Director-General directs otherwise, the Applicant shall commission and pay the full cost of an Independent Environmental Audit of the development. This audit must:
- (a) be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General;
 - (b) include consultation with the relevant agencies;
 - (c) assess the environmental performance of the development and assess whether it is complying with the requirements in this consent and any relevant EPL or Mining Lease (including any assessment, plan or program required under these consents/approvals);
 - (d) review the adequacy of strategies, plans or programs required under the abovementioned consents/approvals; and
 - (e) recommend appropriate measures or actions to improve the environmental performance of the development, and/or any assessment, plan or program required under the abovementioned consents.

Note: This audit team must be led by a suitably qualified auditor and include experts in any field specified by the Director-General.

Within 6 weeks of the completion of this audit, or as otherwise agreed by the Director-General, the Applicant shall submit a copy of the audit report to the Director-General, together with its response to any recommendations contained in the audit report.

COMMUNITY CONSULTATIVE COMMITTEE

8. Before carrying out any development, the Applicant shall establish a new Community Consultative Committee to oversee the environmental performance of the development. This committee shall:
- (a) be comprised of:
 - 2 representatives from the Applicant, including the person responsible for environmental management at the mine;
 - 1 representative from Council; and
 - at least 3 representatives from the local community, whose appointment has been approved by the Director-General in consultation with the Council;
 - (b) be chaired by the representative from Council or by a third party as approved by the Director-General;
 - (c) meet at least twice a year; and
 - (d) review and provide advice on the environmental performance of the development, including any construction or environmental management plans, monitoring results, audit reports, or complaints.
9. The Applicant shall, at its own expense:
- (a) ensure that 2 of its representatives attend the Committee's meetings;
 - (b) provide the Committee with regular information on the environmental performance and management of the development;
 - (c) provide meeting facilities for the Committee;
 - (d) arrange site inspections for the Committee, if necessary;
 - (e) take minutes of the Committee's meetings;
 - (f) make these minutes available to the public for inspection within 14 days of the Committee meeting, or as agreed to by the Committee;
 - (g) respond to any advice or recommendations the Committee may have in relation to the environmental management or performance of the development;
 - (h) forward a copy of the minutes of each Committee meeting, and any responses to the Committee's recommendations to the Director-General within a month of the Committee meeting.

REPORTING

Incident Reporting

10. The Applicant shall notify the Director-General and any other relevant agencies of any incident associated with the development as soon as practicable after the Applicant becomes aware of the incident. Within 7 days of the date of the incident, the Applicant shall provide the Director-General and any relevant agencies with a detailed report on the incident.

Regular Reporting

11. The Applicant shall provide regular reporting on the environmental performance of the development on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this consent.

ACCESS TO INFORMATION

12. From the end of June 2011, the Applicant shall:
- (a) make copies of the following publicly available on its website:
- the documents referred to in Condition 2 of Schedule 3;
 - all current statutory consents for the development;
 - all approved strategies, plans and programs required under the conditions of this consent;
 - a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs;
 - a complaints register, updated on a monthly basis;
 - minutes of CCC meetings;
 - the annual reviews of the development;
 - any independent environmental audit of the development, and the Applicant's response to the recommendations in any audit;
 - any other matter required by the Director-General; and
- (b) keep this information up-to-date, to the satisfaction of the Director-General.

**APPENDIX 1
SCHEDULE OF LAND**

Freehold Land

DESCRIPTION	
Lot 79 DP753792	Lot 181 DP823775
Lot 57 DP753817	Lot 177 DP823775
Lot 160 DP753817	Lot 118 DP753792
Lot 18 DP753817	Lot 95 DP753792
Lot 71 DP753817	Lot 2 DP709722
Lot 161 DP753817	Por 131 DP753792
Lot 49 DP753792	Lot 2 DP616303
Lot 50 DP753792	Lot 1 DP720705
Lot 51 DP753792	Lot 2 DP720705
Lot 52 DP753792	Lot 3 DP720705
Lot 58 DP753792	Lot 4 DP720705
Lot 66 DP753792	Lot 45 DP753792
Lot 67 DP753792	Lot 46 DP753792
Lot 62 DP753792	Lot 4 DP542226
Lot 63 DP753792	Lot 5 DP542226
Lot 64 DP753792	Lot 1 DP241316
Lot C DP33149	Lot 7 DP3030
Lot 22 DP753817	Lot 23 DP3030
Lot A DP33149	Lot 92 DP755267
Lot 79 DP753821	Lot 109 DP753792
Lot 19 DP3030	Lot 110 DP753792
Lot 129 DP755267	Lot 111 DP753792
Lot 22 DP755267	Lot 112 DP753792
Lot 1 DP616303	Lot 103 DP753792
Lot 100 DP753792	Lot 104 DP753792
Lot 101 DP753792	Lot 82 DP548749
Lot 38 DP753792	Lot 83 DP548749
Lot 39 DP753792	Lot 1 DP110084
Lot 60 DP753792	Lot 2 DP110084
Lot 61 DP753792	Lot B DP33149
Lot 1 DP709722	Lot 113 DP753817
Lot 55 DP753792	Lot 2 DP617852

Crown Land Descriptions

Crown lands have been identified and numbered on the attached plan (PD003). Council controlled roads have been identified using geographical names where possible. Council and Crown roads and sections of Wollombi Brook with no real property identifier have their location described relative to adjoining lots.

Crown Land

1. Lot 170 DP 823775
2. Lot 208 DP 753817

Travelling Stock and Camping Reserve No. 5294

3. Lot 175 DP 823775

Council Roads

4. Wambo Mine Road
5. Road within Lot 1 DP 616303

6. Pine Grove Road
7. Road bounded by Lots 7,19 & 23 DP 3030, Lots 22 & 129 DP755267, Lot 83 DP548749 and Lot 1 DP 110084

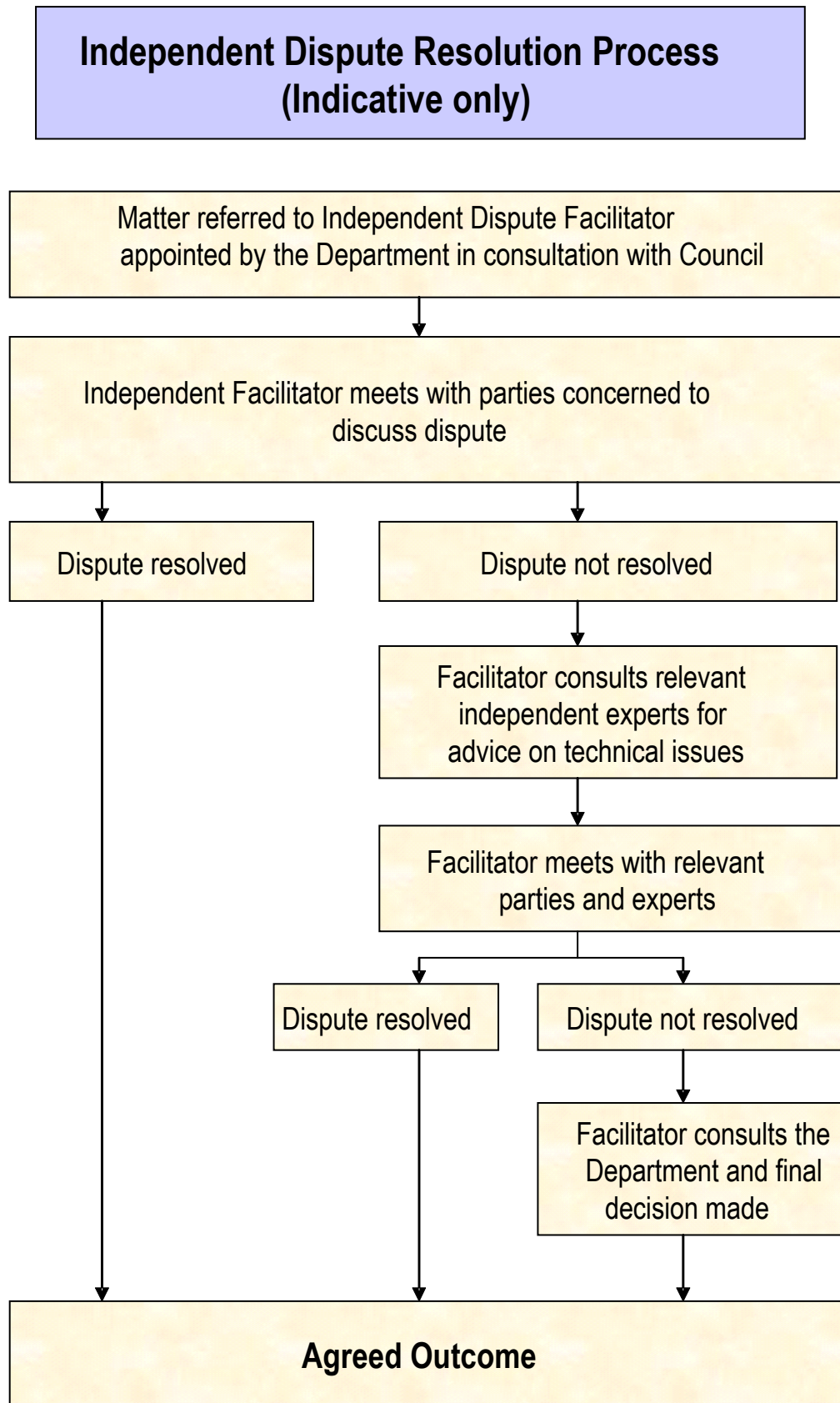
Crown Roads

8. Bounded by Lots 92 & 129 DP 755267
9. Bounded by Lots 4 & 5 DP 542226, Lots 2 &3 DP720705 and Lot 2 DP 616303
10. Bounded by Lots 38, 55, 61, 100, 101, 149 DP 753792, Lot 2 DP617852 and Lot 1 DP 616303
11. Within Lot 2 DP617852
12. Bounded by Lots 175, 177, 181 DP 823775
13. Bounded by Lot 177 DP 823775, 60, 62-64, 95, 118 DP 753792, Lot 2 DP617852
14. Bounded by Lots 170, 177 DP 823775, 49-51, 58, 118 DP 753792
15. Bounded by Lots 170 DP 823775, 49, 50, 52, 79 DP 753792, 18, 160, 161 DP753817
16. Bounded by Lots A & B DP 33149, 22, 66, 67, 71 DP 753817
17. Adjoining to the East and North Lot 79 DP753821

Wollombi Brook

18. Bounded by Lots 22 DP 755267, Lot 83 DP 548749, Lot 1 DP 110084, Lot 1 DP 241316, Lot 7 DP 3030

APPENDIX 2
INDEPENDENT DISPUTE RESOLUTION PROCESS



APPENDIX 3
MAP FOR ABORIGINAL CULTURAL HERITAGE INVESTIGATIONS
(See Condition 55)



1386000N

1386000N

LEGEND

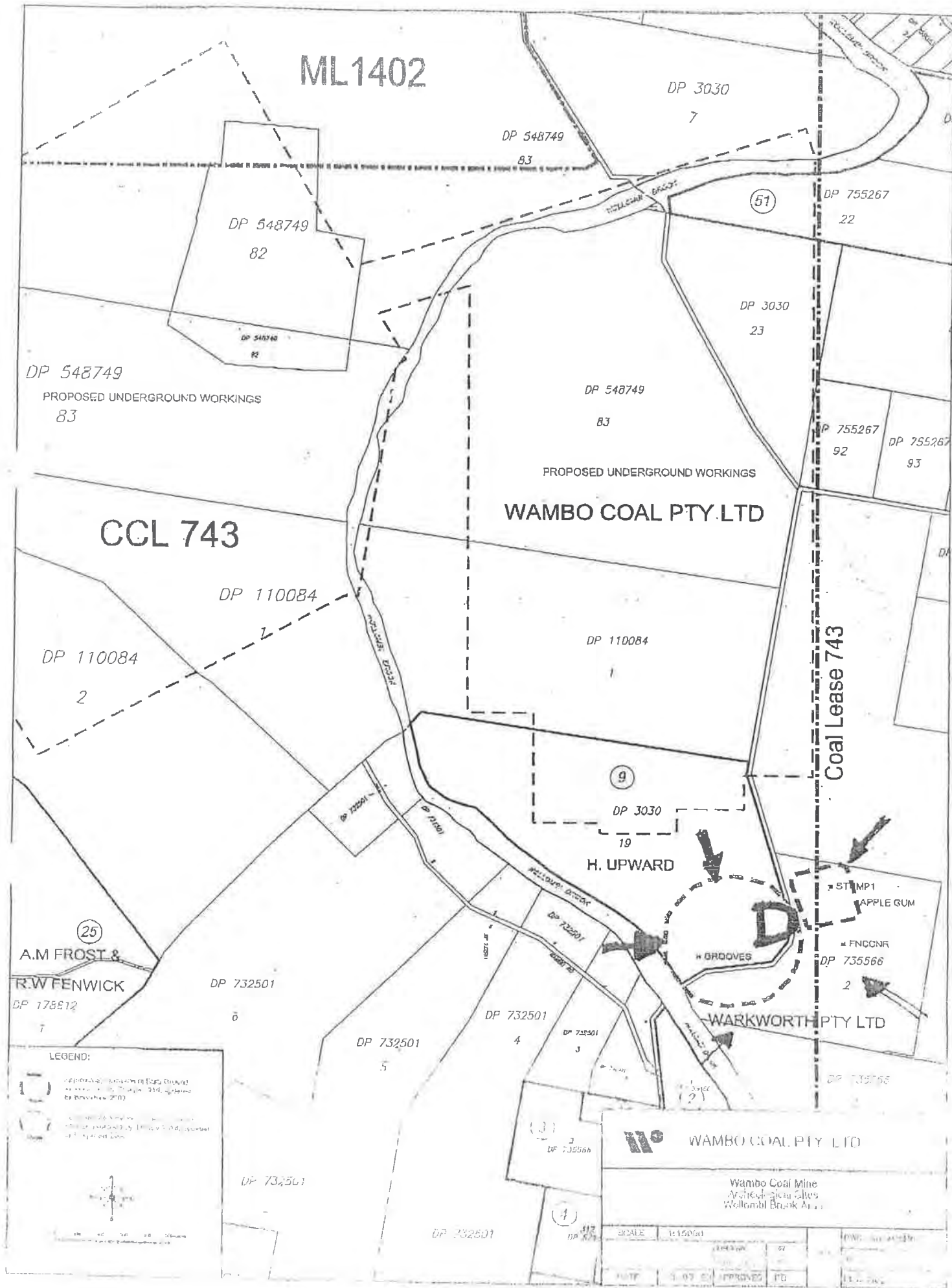
- Mining & Coal Lease Boundary
- - - Mining Lease Application Boundary
- Outline of Project Surface Development
- A Project Conversation Area

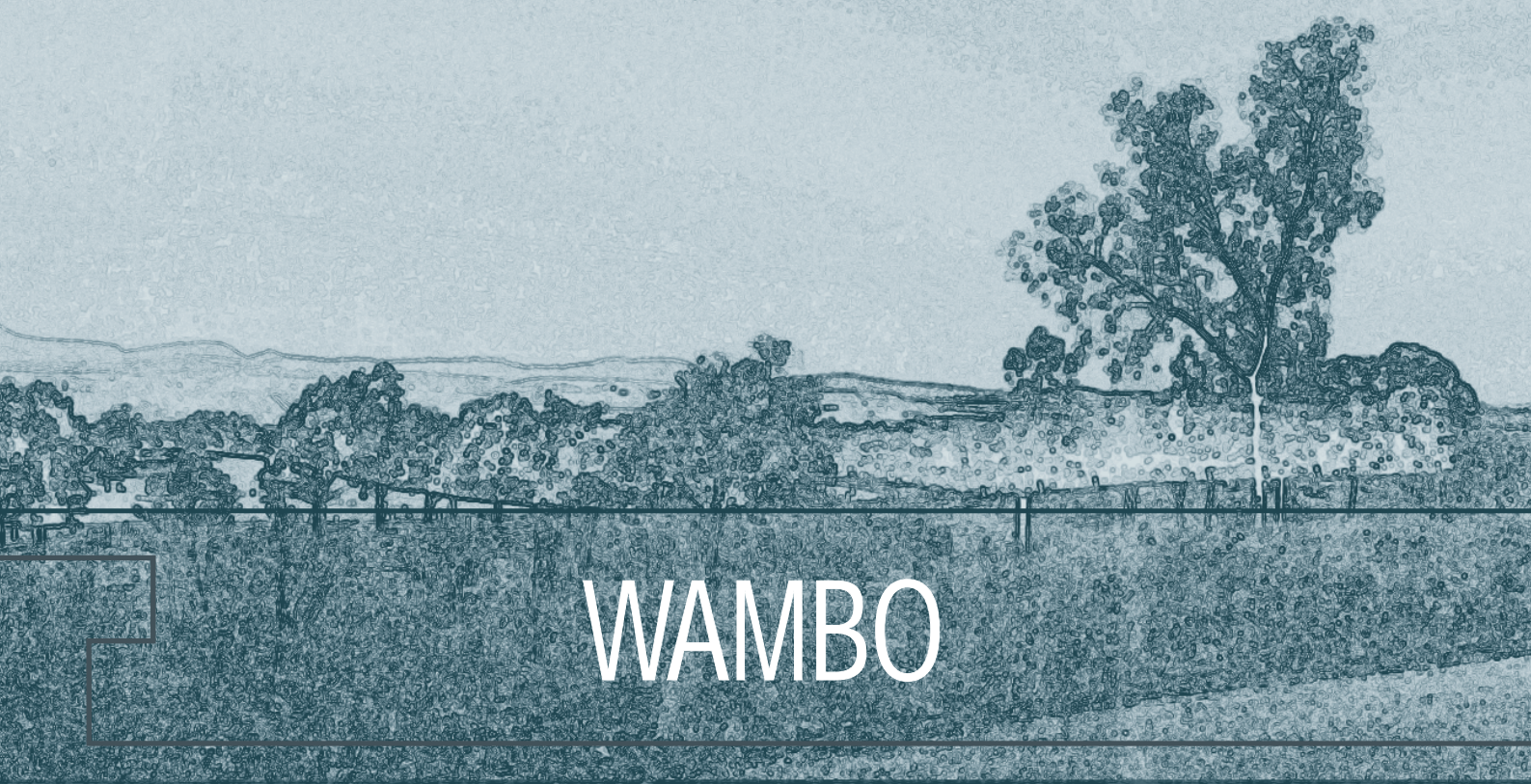


WAMBO DEVELOPMENT PROJECT

FIGURE 8
Location of Conversation Areas







WAMBO

MONTROSE WATER STORAGE MODIFICATION
ENVIRONMENTAL ASSESSMENT

APPENDIX A

ABORIGINAL CULTURAL HERITAGE ASSESSMENT



Aboriginal Due Diligence Assessment

Montrose Water Storage Modification

Prepared by:

RPS AUSTRALIA EAST PTY LTD

241 Denison St
Broadmeadow NSW 2292

T: +61 2 4940 4200
F: +61 2 4961 6794
E: newcastle@rpsgroup.com.au

Client Manager: Gillian Goode
Report Number: 113210-1
Version / Date: Final: June 2012

Prepared for:

WAMBO COAL PTY LTD

PMB1
Singleton NSW 2330

T: +61 2 6570 2209
F: +61 2 6570 2290
M: +61 (0)407 802 206
E: TFavell@peabodyenergy.com
W: www.peabodyenergy.com.au

Document Status

Version	Purpose of Document	Orig	Review	Review Date	Approval for Issue	Date
Draft	Draft for Client Review	G. Goode	Tessa Boer-Mah	22.6.2012	T. Boer-Mah	22.6.2012
Final	Final for Client	G. Goode	A. Byrne	27.06.2012	G. Goode	27.6.2012

Executive Summary

RPS Australia East Pty Ltd (RPS) has been commissioned by Wambo Coal Pty Ltd (WCPL) to undertake an Archaeological Due Diligence Assessment as part of a Section 75W Modification to Development Consent (DA 305-7-2003) for the Wambo Coal Mine which was granted by the Minister for Planning on 4 February 2004.

This report has been prepared in order to meet the requirements for an application by WCPL to the Minister for Planning under Section 75W of the Environmental Planning and Assessment Act 1979 (New South Wales [NSW]) for a proposed modification to Development Consent (DA 305-7-2003). WCPL is seeking approval for the construction of a water storage area and related surface facilities at Wambo Coal Mine (WCM). The proposed water storage area and related surface facilities are herein referred to as the Montrose Water Storage Dam (MWSD) or the Project. This due diligence report has been prepared for the area subject to the proposed activity.

This assessment has been undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects* (DECCW 2010) which requires that reasonable and practicable steps be taken to: identify whether or not Aboriginal objects are, or are likely to be, present in an area; determine whether or not their activities are likely to harm Aboriginal objects (if present); and determine if an Aboriginal Heritage Impact Assessment is required (DECCW 2010:2).

Investigations under the code have included the following:

- A search of the Aboriginal Heritage Information Management System (AHIMS) database identified that there were no Aboriginal objects or Aboriginal places in the immediate Project Area although there were a number of recorded sites in the local area.
- This report has considered landforms including: land within 200 metres of water, dune systems, ridgetops, headlands, land immediately above or below cliff faces and/or rock shelters/caves. Dune systems, ridgetops, cliff faces and rock shelters, while present in the regional area are not present in the Project Area. The MWSD Project Area is located on the north east facing lower slopes of the North Wambo Creek valley and lies between two unnamed tributaries.
- Desktop assessment included a review of previous archaeological and heritage studies in the vicinity of the Project Area.
- A visual inspection of the Project Area was undertaken on 21, 29 and 30 May 2012 and no Aboriginal objects, recorded sites or Aboriginal places were identified in the proposed activity area although a number of sites have been previously recorded in the surrounding area.

The Project Area adjoins Wollemi National Park and is bordered by Jerrys Plains and Wambo Ridges. The regional landscape is one of gently sloping rolling hills, including flood plain, creek banks, lower and mid slope areas. Wollombi Brook a high order tributary of the Hunter River lies to the east and associated large and small tributaries including North Wambo Creek, Wambo Creek (known locally as South Wambo Creek) and Stony Creek intersect the regional area.

The total area of disturbance is 23.6 hectares and the Project Area is situated within WCPL Mine Owned Land. The Project Area has a north easterly aspect and is gently sloping encompassing the lower and mid slopes of the North Wambo Creek valley and lies between two unnamed tributaries. The proposed modification will not impact on the nearby Wollemi National Park which lies to the south west nor on the area adjacent to Wollombi Brook which lies several kilometres to the east. WCPL have advised that all known and recorded sites in the surrounding area will be protected by high visibility barrier fencing to ensure that the proposed activity will not inadvertently impact or harm any Aboriginal objects at these sites.

The Project Area has been severely disturbed by previous farming practices including, but not limited to, extensive land clearing, the installation of fencing, dams, drainage modification works, electricity easements and associated infrastructure, slashing, livestock grazing and formed tracks and dirt access roads. Other disturbances include flooding of the major creek lines, animal burrows along the creek banks and lower slopes and extensive erosion across the area.

The May 2012 archaeological field survey was conducted by Senior Archaeologist Gillian Goode and Archaeologist Philippa Sokol both of RPS. No Aboriginal objects or archaeological sites were identified in the Project area.

Several archaeological field surveys had previously been undertaken in the area including: an Aboriginal heritage assessment (White 2003) which formed part of an Environmental Impact Statement for the Wambo Development Project; an Aboriginal cultural heritage assessment for an area adjacent to the Project area (RPS 2009-2011) and a survey to ground truth the position and extent of the areas of PAD J (AHIMS #37-5-0551) and PAD K (AHIMS #37-5-0552) which are located in the vicinity of the Project area (RPS 2009-2011). These studies had identified a number of sites in both the local and regional area but none in the proposed area of ground disturbance works for the MWSD.

A search of the AHIMS and WCPL/RPS databases revealed that there were two areas of potential archaeological deposit (PAD); (PAD J [AHIMS #37-5-0551] and PAD K [AHIMS #37-5-0552]) which were located to the east of the Project Area and an isolated find site (Wambo Site 230 [AHIMS #37-5-0353]), an artefact scatter site (Wambo Site 231 [AHIMS #37-5-0354]) and a potential archaeological deposit (PAD L [AHIMS #37-5-0553]) which lay to the north west of the Project Area (Figure 2).

During the course of archaeological investigations for an area immediately adjacent to the MWSD Project Area it was found that Wambo Site 230 (AHIMS #37-5-0353) was located on a gently sloping, north east facing foot slope on the edge of a small farm dam. This site had been identified as an isolated find by White (White 2003). Due to recent rain, the water level in the dam was found to be deeper than the level shown on the photo attached to the site card. One isolated find was located at this site in the south eastern corner of the small farm dam wall.

Wambo Site 231 (AHIMS #37-5-0354) was also located on the gentle north east facing slope. Sheet wash erosion had removed all topsoil exposing the B horizon. There was a large ants' nest and some leaf litter in the area. The artefact scatter site had been identified during the EIS works in 2003 (White 2003) but only one mudstone flake was identified at the site during the ground truth survey.

PAD L (AHIMS #37-5-0553) had also been identified by White in 2003 as having the potential for archaeological deposit. The area for PAD L was found to be a small strip of land between two ephemeral drainage lines. However, no artefacts were located on the surface of the PAD and there was no evidence of intact A horizon soils due to extensive sheet wash erosion. It is considered unlikely that there are any subsurface artefacts at the area designated by White 2003 as PAD L.

Due Diligence survey was undertaken by RPS (RPS 2012) to identify the position and extent of the areas of PAD J (AHIMS #37-5-0551) and PAD K (AHIMS #37-5-0552). PAD J and PAD K were found to be on a north east facing, lower to mid slope area (Figure 2); PAD J was adjacent to and to the west of an unnamed second order tributary of North Wambo Creek, and PAD K was to the south east of an unnamed first order tributary, close to the confluence of two unnamed first order tributaries and directly to the south east of PAD J.

No Aboriginal objects were identified in the MWSD activity area and therefore there is no identified risk of harm to Aboriginal objects. There were Aboriginal objects adjacent to the activity area and therefore as a

precautionary measure, WCPL will place a protective barrier fence around the recorded sites to ensure that these locations are avoided by mine personnel or infrastructure works.

RECOMMENDATIONS

Mine vehicles will utilise an existing access track currently in use by the WCM whilst constructing MWSD and associated infrastructure which includes the installation of power poles and the laying of pipes on the surface of the soil within the defined power and pipeline easements. Although there were a number of sites in both the local and regional area, there were no sites identified in the proposed MWSD activity area. However a number of sites were identified outside of the boundary of the proposed development works. In order to ensure that there is no risk of mine vehicles or associated mine works or infrastructure inadvertently impacting or harming any recorded sites in the surrounding area, WCPL intends to place a protective barrier fence around the sites Wambo Sites 230, PAD J, PAD K and PAD L.

Recommendations 1 to 5

The numbered recommendations below have been provided specifically for the proposed activity.

Recommendation 1

Aboriginal objects adjacent to the proposed activity area must be avoided and WCPL must advise all onsite personnel of the location of any archaeologically sensitive area and any Aboriginal site locations within the vicinity of any proposed works and instruct that they avoid them.

Recommendation 2

WCPL is to construct a protective, high visibility barrier around Wambo Sites 230, PAD J, PAD K and PAD L in order to ensure that there is no vehicular access across the archaeologically sensitive area.

Recommendation 3

Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 4

If additional ground surface disturbance works fall outside of the areas inspected as part of this project WCPL are advised to have those areas investigated by a qualified archaeologist with additional due diligence survey undertaken.

Recommendation 5

If WCPL is uncertain of the potential risk of impact to archaeological and cultural heritage sites, they should contact a suitably qualified archaeologist to investigate the area prior to impact.

Recommendations A to D

Recommendations A to D must also be followed for undertaking the activity (the construction works). These recommendations provide contingency procedures should unexpected Aboriginal objects or skeletal remains be identified during the activity (construction).

Recommendation A

All relevant WCPL staff and contractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.

Recommendation B

This due diligence report must be kept by WCPL so that it can be presented, if needed, as a defence from prosecution.

Recommendation C

If Aboriginal objects are identified in the Project Area during works, then all works in that area should cease and the area should be cordoned off. If the Aboriginal sites cannot be avoided OEH must be notified. Some works may not be able to be resumed until an Aboriginal Heritage Impact Permit is granted.

Recommendation D

In the event that skeletal remains are uncovered, work must cease immediately in that area and the area should be cordoned off. WCPL must contact the NSW Police with no further action taken until written advice is provided by the Police. If determined to be Aboriginal, OEH must be notified and a management plan prior to works re-commencing must developed in consultation with the relevant Aboriginal stakeholders.

Terms, Definitions & Abbreviations

Abbreviation/ Term	Meaning
Aboriginal Object	“any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains” (DECCW 2010:18).
Aboriginal Place	“a place declared under s.84 of the NPW Act that, in the opinion of the Minister, is or was of special significance to Aboriginal culture” (DECCW 2010:18). Aboriginal places have been gazetted by the minister.
Aboriginal Culturally Modified Tree	“means a tree that, before or concurrent with (or both) the occupation of the area in which the tree is located by persons of non-Aboriginal extraction, has been scarred, carved or modified by an Aboriginal person by: (a) the deliberate removal, by traditional methods, of bark or wood from the tree, or (b) the deliberate modification, by traditional methods, of the wood of the tree” NPW Regulation 80B (3). Culturally Modified trees are sometimes referred to as scarred trees
ACS	Aboriginal Community Stakeholders
Activity	A project, development, or work (this term is used in its ordinary meaning and is not restricted to an activity as defined by Part 5 EP&A Act 1979).
ACHIA	Aboriginal Cultural Heritage Impact Assessment
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
cal. years BP	Calibrated years before present, indicates a radiocarbon date has been calibrated using the dendrochronology curves, making the date more accurate than an uncalibrated date.
DECCW	Department of Environment, Climate Change and Water (is now the Office of Environment and Heritage – OEH)
DGPS	Differential global positioning system
Disturbed Land	“Land is disturbed if it has been the subject of a human activity that has changed the land’s surface, being changes that remain clear and observable.” (DECCW 2010:18).
Due Diligence	“taking reasonable and practical steps to determine whether a person’s actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm” (DECCW 2010:18)
EIS	Environmental Impact Statement
EP&A Act	NSW Environmental Planning and Assessment Act 1979
GDA	Geodetic Datum Australia
Harm	“destroy, deface, damage an object, move an object from the land on which it is situated, cause or permit an object to be harmed.” (DECCW 2010:18)
LGA	Local Government Area
MOL	Mine Owned Land
NPW Act	NSW National Parks and Wildlife Act 1974
MWSD	Montrose Water Storage Dam
NPW Regulation	NSW National Parks and Wildlife Regulation 2009
OEH	Office of Environment and Heritage (formerly DECCW)
PAD	Potential Archaeological Deposit
PEA	Peabody Energy Australia
Project Area	Project Area is the area subject to the proposed activity
RWEA	Remnant Woodland Enhancement Area
WCM	Wambo Coal Mine
WCPL	Wambo Coal Pty Limited

Contents

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION	9
1.1 The Project Area.....	9
1.2 The Proposed Activity	10
1.3 Authorship and Acknowledgements.....	10
2.0 LEGISLATIVE CONTEXT	13
2.1 National Parks & Wildlife Act (1974, as amended)	13
2.2 National Parks and Wildlife Regulation (2009).....	14
2.3 Due Diligence and Codes of Practice	14
2.3.1 Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010).....	15
2.4 Aboriginal Community Consultation	15
3.0 ENVIRONMENTAL AND HERITAGE CONTEXT	16
3.1 Local Environment.....	16
3.1.1 Geology.....	16
3.1.2 Soils	17
3.1.3 Topography and Hydrology	18
3.1.4 Climate.....	18
3.1.5 Flora and Fauna	18
3.2 Aboriginal Heritage Information Management System (AHIMS).....	19
3.3 Archaeological and Heritage Literature Review	20
3.3.1 White, E. 2003. Aboriginal Heritage Assessment for Resource Strategies Pty Ltd. Wambo Development Project – (Environmental Impact Statement)	21
3.3.2 RPS (2009-2011), Archaeological Reports to Wambo Mine	21
3.4 Synthesis	22
4.0 VISUAL INSPECTION AND FIELD RESULTS	23
4.1 Visual Inspection.....	23
4.1.1 Survey Unit 1 Mid Slope Area.....	25
4.1.2 Survey Unit 2 Lower Slope Area	25
4.2 Visual Inspection Summary	28
4.2.1 RESULTS	28
4.2.2 CONCLUSION.....	28
5.0 IMPACT ASSESSMENT AND MITIGATION	29
6.0 CONCLUSIONS AND RECOMMENDATIONS	30
7.0 REFERENCES	32
8.0 PLATES	34
GLOSSARY OF SITE TYPES	52

Tables

Table 1: Summary of AHIMS Results ordered by site types & frequency within a 9km ²	20
Table 2: Summary of AHIMS Results ordered by site types & frequency near the immediate Project Area...	20

Figures

Figure 1: Project Area.....	11
Figure 2: Recorded Sites Near Project Area	12
Figure 3: Survey Units	24
Figure 4: Proposed Activity Area and Protective Barrier Fencing	26

Plates

Plate 1: Survey Unit 1 - View to north showing south western part of the mid slope area and the highly disturbed cleared paddock.	34
Plate 2: Survey Unit 1 - View to south showing cleared paddock and unnamed tributary to the west of the Project Area.	34
Plate 3: Survey Unit 1 - View north east showing modified contour bank and North Wambo Creek Diversion works near the open cut mine area.	35
Plate 4: Survey Unit 1 - View showing previously cleared paddock and small stands of saplings.	35
Plate 5: Survey Unit 1 - View to east showing existing access track and unnamed tributary to east of Project Area.	36
Plate 6: Survey Unit 1 - Western bank of unnamed tributary to east of the Project area showing extensive sheet wash erosion and B horizon soils.	36
Plate 7: Survey Unit 2 - View to east showing mid slope (Survey Unit 1) and lower slope (Survey Unit 2) areas bisected by existing dirt track and contour bank.	37
Plate 8: Project Area - View to east showing access track.	37
Plate 9: Break in slope between mid slope (Survey Unit 1) and lower slope (Survey Unit 2) areas.....	38
Plate 10: Survey Unit 2 - View north east showing modified contour bank and North Wambo Creek Diversion works.	38
Plate 11: Survey Unit 2 - Pebbles on surface of B horizon.	39
Plate 12: Survey Unit 2 - View to north east showing unnamed tributary to east of Project area.....	39
Plate 13: View to north west showing upper part of same unnamed tributary to east of Project area.....	40
Plate 14: PAD J - View to north east showing area of PAD J to west of an unnamed tributary of North Wambo Creek.....	40
Plate 15: PAD K - View to north showing PAD K and small crest to east of an unnamed tributary of North Wambo Creek.....	41
Plate 16: Wambo Site 230 – View to west showing dam at Wambo Site 230.	41
Plate 17: Wambo Site 230 - View to west, dam wall with artefact on surface.....	42
Plate 18: Wambo Site 230 - Rhyolite flake.....	42

Plate 19: View showing drainage line to west of Project Area43
Plate 20: PAD L - view to south west43
Plate 21: Wambo Site 231 – view to north showing sheet wash erosion and B horizon soils.44
Plate 22: Wambo 231 - mudstone flake44

Appendices

Appendix 1 Legislative Requirements45
Appendix 2 AHIMS50
Appendix 3 Site Types.....51

1.0 Introduction

RPS has been commissioned by Wambo Coal Pty Ltd (WCPL) to undertake an Archaeological Due Diligence Assessment for the Montrose Water Storage Dam (MWSD) as part of a Section 75W modification to Development Consent (DA 305-7-2003) for the Wambo Coal Mine which was granted by the Minister for Planning on 4 February 2004.

The purpose of a due diligence report is to demonstrate that reasonable and practicable measures were taken to prevent harm to an Aboriginal object or place and this due diligence study has been undertaken in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010).

This assessment has been undertaken in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects (DECCW 2010) which requires reasonable and practicable steps be taken to: identify whether or not Aboriginal objects are, or are likely to be, present in an area; determine whether or not their activities are likely to harm Aboriginal objects (if present); and determine if an Aboriginal Heritage Impact Assessment is required (DECCW 2010:2).

This report has considered the relevant environmental and archaeological information, landforms, disturbances and the nature of the proposed activity and has formulated appropriate recommendations accordingly.

1.1 The Project Area

The Project Area is located at Wambo Coal Mine at Warkworth in the Singleton Local Government Area (LGA). Wambo Coal Mine (WCM) is located approximately 15 kilometres (km) west of the township of Singleton and is adjacent to Wollemi National Park – refer Figure 1. The immediate study area is located to the south west of North Wambo Creek in WCPL Owned Lands (MOL).

This report has been prepared in order to meet the requirements for an application by WCPL to the Minister for Planning under Section 75W of the Environmental Planning and Assessment Act 1979 (New South Wales [NSW]) and clause 8J(8)(b) of the Environmental Planning and Assessment Regulation 2000 (NSW) for a proposed modification to Development Consent (DA 305-7-2003). The project seeks approval for a Water Storage Area at Wambo Coal Mine (WCM) which consists of the installation of a water storage dam and related surface facilities and infrastructure to be located to the south west of the existing North Wambo Creek Diversion works. The MWSD and its surrounds are hereafter referred to as the Project Area (refer Figure 1).

The Project Area adjoins Wollemi National Park and is bordered by Jerrys Plains and Wambo Ridges. The regional landscape is one of gently sloping rolling hills, including flood plain, creek banks, lower and mid slope areas. Wollombi Brook a high order tributary of the Hunter River lies to the east and associated large and small tributaries including North Wambo Creek, Wambo Creek (known locally as South Wambo Creek) and Stony Creek intersect the regional area.

The Project Area has been severely disturbed by previous farming practices including, but not limited to, extensive land clearing, the installation of fencing, dams, drainage modification works, livestock grazing, slashing, electricity easements and associated infrastructure, formed tracks and dirt access roads. Other disturbances include flooding of the major creek lines, animal burrows along the creek banks and lower slopes and there is extensive sheet wash erosion across the area. The area is therefore considered disturbed according to the definition in the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010:18).

A due diligence assessment is required under Step 1 and Step 2a of the Due Diligence Code (DECCW 2010:11-12) as there will be ground disturbance works associated with the installation of the MWSD and associated infrastructure (Figure 1) and there are recorded sites (PAD J, PAD K, PAD L and Wambo Site 230) near the area (Figure 2).

1.2 The Proposed Activity

The proposed activity is for the construction of a water storage area and associated infrastructure at WCM and is situated wholly within WCPL MOL. The total area of disturbance for the MWSD covers an area of 23.6 hectares. The Project Area has a north easterly aspect and lies between two unnamed tributaries of North Wambo Creek. The area is gently sloping, encompassing the lower and mid slopes to the south west of North Wambo Creek. The proposed modification will not impact on the nearby Wollemi National Park which lies to the south west.


The May 2012 archaeological field survey was conducted by Senior Archaeologist Gillian Goode and Archaeologist Philippa Sokol both of RPS. This due diligence report has been prepared for the area subject to the proposed activity, herein referred to as the "Project Area" (Figure 1). No Aboriginal objects or archaeological sites were identified in the area of the proposed activity for the MWSD (Figure 2). However a number of recorded sites were identified in the surrounding area. WCPL have advised that all known and recorded sites in the surrounding area will be protected by high visibility barrier fencing to ensure that the proposed activity will not inadvertently impact or harm any Aboriginal objects at these sites. The area of the PADs and artefact site will be buffered and the protective barrier will be placed outside of this buffer.

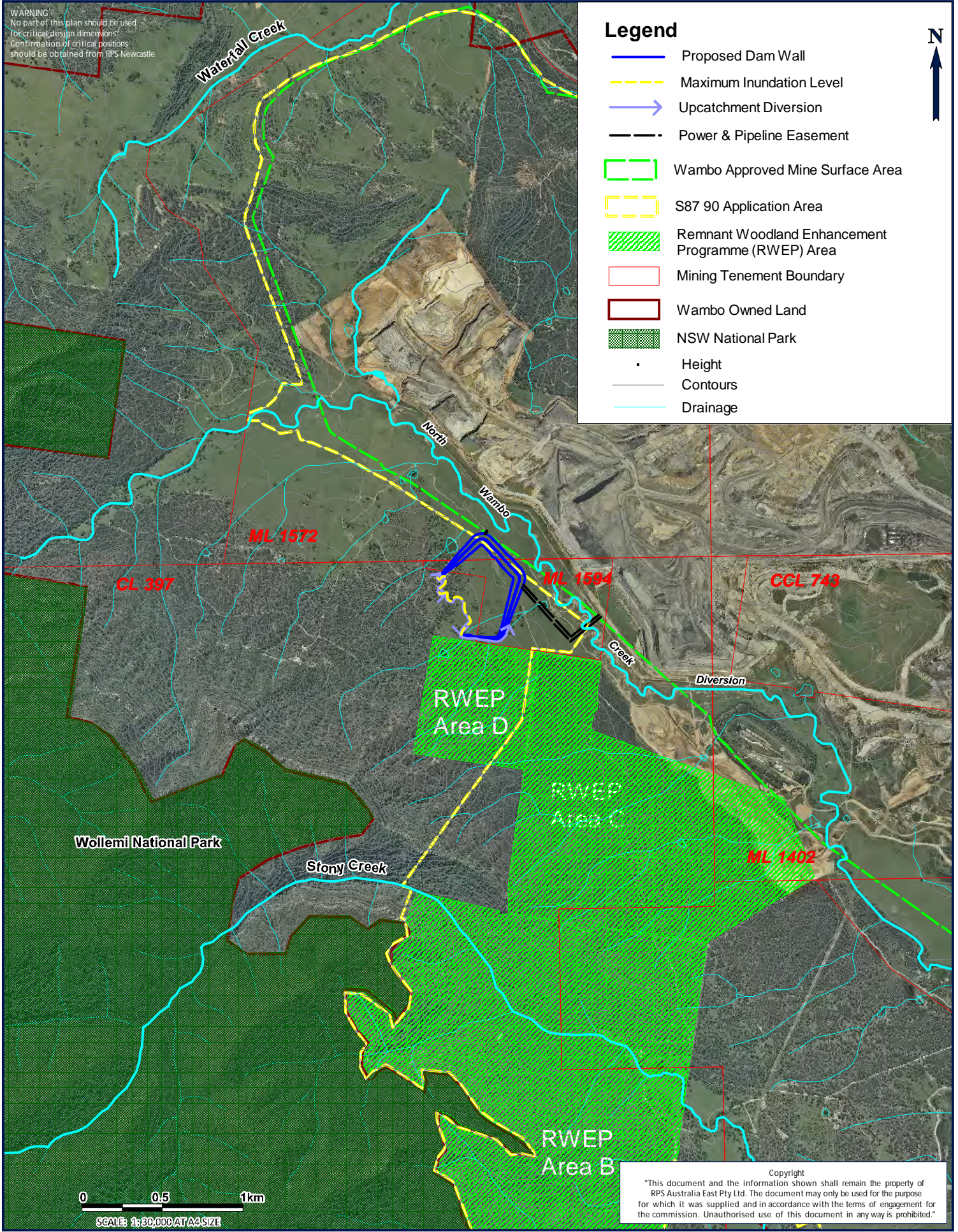
1.3 Authorship and Acknowledgements

This report was prepared by RPS Senior Archaeologist Gillian Goode. The report was reviewed by Tessa Boer-Mah, Newcastle Cultural Heritage Manager and Senior Archaeologist of RPS.

WARNING:
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Legend

-  Proposed Dam Wall
-  Maximum Inundation Level
-  Upcatchment Diversion
-  Power & Pipeline Easement
-  Wambo Approved Mine Surface Area
-  S87 90 Application Area
-  Remnant Woodland Enhancement Programme (RWE) Area
-  Mining Tenement Boundary
-  Wambo Owned Land
-  NSW National Park
-  Height
-  Contours
-  Drainage



Copyright
"This document and the information shown shall remain the property of RPS Australia East Pty Ltd. The document may only be used for the purpose for which it was supplied and in accordance with the terms of engagement for the commission. Unauthorised use of this document in any way is prohibited."

TITLE: FIGURE 1: PROJECT AREA
29-30/05/2012

LOCATION: WAMBO

DATUM: (GDA 94)
PROJECTION: MGA ZONE 56

DATE: 27/06/2012
PURPOSE: HERITAGE

LAYOUT REF: J:\JOBS\Wambo\Wambo Mapping Database\ Archaeology
VERSION (PLAN BY) C A4 (GG-NW)

CLIENT: WAMBO COAL
JOB REF: 113210

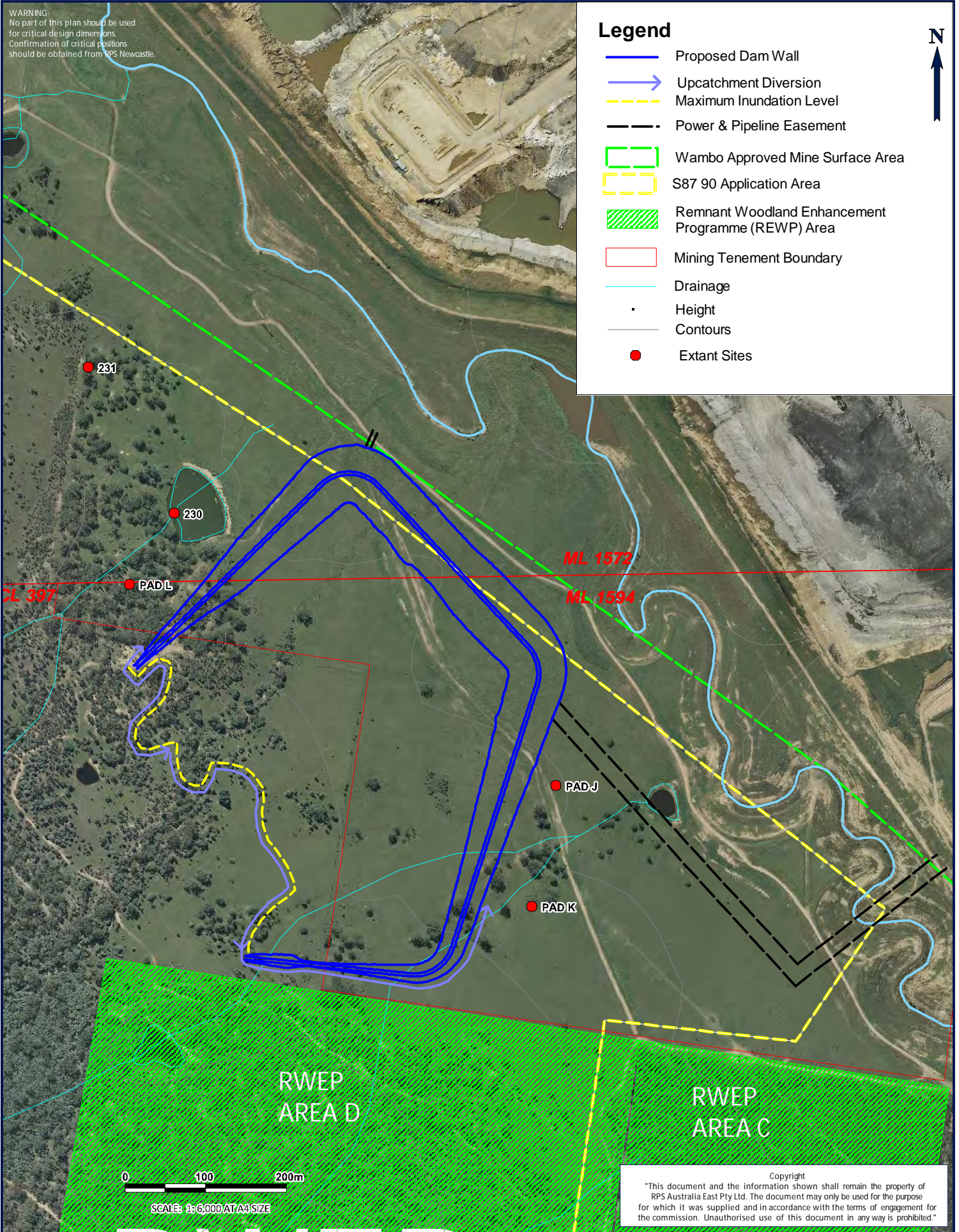
RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au



WARNING
No part of this plan should be used
for critical design dimensions.
Confirmation of critical positions
should be obtained from RPS Newcastle.

Legend

-  Proposed Dam Wall
-  Upcatchment Diversion
-  Maximum Inundation Level
-  Power & Pipeline Easement
-  Wambo Approved Mine Surface Area
-  S87 90 Application Area
-  Remnant Woodland Enhancement Programme (REWP) Area
-  Mining Tenement Boundary
-  Drainage
-  Height
-  Contours
-  Extant Sites



Copyright
"This document and the information shown shall remain the property of RPS Australia East Pty Ltd. The document may only be used for the purpose for which it was supplied and in accordance with the terms of engagement for the commission. Unauthorised use of this document in any way is prohibited."

TITLE: FIGURE 2: AHIMS SITES
NEAR PROJECT AREA
29-30/05/2012

LOCATION: WAMBO

DATUM: (GDA 94)
PROJECTION: MGA ZONE 56

DATE: 27/6/2012
PURPOSE: HERITAGE

LAYOUT REF: J:\JOBS\Wambo\Wambo Mapping Database\
Archaeology
VERSION (PLAN BY)C A4(GG-NW)

CLIENT: WAMBO COAL
JOB REF: 113210

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS

2.0 Legislative Context

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

Although there are a number Acts protecting and managing cultural heritage in New South Wales (see Appendix 1); the primary ones which apply to this report include:

- National Parks and Wildlife Act (1974) (NPW Act).
- National Parks and Wildlife Regulation (2009).

In brief, the National Parks and Wildlife Act (1974, as amended) protects Aboriginal heritage (places, sites and objects) within NSW; the National Parks and Wildlife Regulation 2009 provides a framework for undertaking activities and exercising due diligence.

2.1 National Parks & Wildlife Act (1974, as amended)

The National Parks and Wildlife Act (1974, as amended) protects Aboriginal heritage (places, sites and objects) within NSW. Protection of Aboriginal heritage is outlined in s86 of the Act, as follows:

- "A person must not harm or desecrate an object that the person knows is an Aboriginal object" s86(1).
- "A person must not harm an Aboriginal object" s86(2).
- "A person must not harm or desecrate an Aboriginal place" s86(4).

Penalties apply for harming an Aboriginal object or place. The penalty for knowingly harming an Aboriginal object (s86[1]) and/or an Aboriginal place (s86[4]) is up to \$550,000 for an individual and/or imprisonment for 2 years; and in the case of a corporation the penalty is up to \$1.1 million. The penalty for a strict liability offence (s86[2]) is up to \$110,000 for an individual and \$200,000 for a corporation.

Harm under the NPW Act is defined as any act that; destroys defaces or damages the object, moves the object from the land on which it has been situated, causes or permits the object to be harmed. However, it is a defence from prosecution if the proponent can demonstrate 1) that harm was authorised under an Aboriginal Heritage Impact Permit (AHIP) (and the permit was properly followed), or 2) that the proponent exercised due diligence in respect to Aboriginal heritage. The '**due diligence**' defence (**s87(2)**), states that if a person or company has exercised due diligence to ascertain that no Aboriginal object was likely to be harmed as a result of the activities proposed for the Project Area (subject area of the proposed activity); then liability from prosecution under the NPW Act 1974 will be removed or mitigated if it later transpires that an Aboriginal object was harmed.

Notification of Aboriginal Objects

Under section 89A of the Act (1974) Aboriginal objects (and sites) must be reported to the Director-General of OEH within a reasonable time (unless it has previously been recorded and submitted to AHIMS). Penalties of \$11,000 for an individual and \$22,000 for a corporation may apply for each object not reported.

2.2 National Parks and Wildlife Regulation (2009)

The NSW National Parks and Wildlife Regulation (2009) provides a framework for undertaking activities and exercising due diligence in respect to Aboriginal heritage. The National Parks and Wildlife Regulation (2009) outlines the recognised due diligence codes of practice which are relevant to this report, but it also outlines procedures for Aboriginal Heritage Impact Permit (AHIP) applications and Aboriginal Cultural Heritage Consultation Requirements (ACHCRs); amongst other regulatory processes.

2.3 Due Diligence and Codes of Practice

The **advantage of a Due Diligence** assessment is that:

- it assists in avoiding unintended harm to Aboriginal objects;
- provides certainty to land managers and developers about appropriate measures for them to take;
- encourages a precautionary approach;
- provides a defence against prosecution if the process is followed; and
- results in more effective conservation outcomes for Aboriginal cultural heritage.

One of the benefits of the due diligence provisions are that they provide a simplified process of investigating the Aboriginal archaeological context of an area to determine if an Aboriginal Heritage Impact Permit (AHIP) is required.

Under the section 80A of the National Parks and Wildlife Regulation (2009) the following due diligence codes recognised:

- (a) the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW published by the Department of Environment, Climate Change and Water and dated 13 September (2010);
- (b) the Plantations and Reafforestation Code (being the Appendix to the Plantations and Reafforestation (Code) Regulation (2001) as in force on 15 June 2010;
- (c) the Private Native Forestry Code of Practice (2008) approved by the Minister for Climate Change, Environment and Water and published in the Gazette on 8 February 2008;
- (d) the NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects(2010) published by NSW Minerals Council Ltd and dated 13 September 2010;
- (e) the Aboriginal Objects Due Diligence Code for Plantation Officers Administering the Plantations and Reafforestation (Code) Regulation 2001 (Kempff 2010) published by the Department of Industry and Investment and dated 13 September 2010; and
- (f) the Operational Guidelines for Aboriginal Cultural Heritage Management published by Forests NSW (2010) and dated 13 September 2010.

This report has been written to meet the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010).

2.3.1 Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010)

This publication sets out a minimum benchmark for acceptable due diligence investigations to be followed. The purpose of the code is set out reasonable and practical steps in order to:

- (1) identify whether or not Aboriginal objects (and places) are, or are likely to be, present in an area;
- (2) determine whether or not their activities are likely to harm Aboriginal objects (if present); and
- (3) determine whether an AHIP application is required. (DECCW 2010:2)

Investigations under the code include the following:

- A search of the Aboriginal Heritage Information Management System (AHIMS) database to identify if there are previously recorded Aboriginal objects or places in the Project area;
- Identification of landscape features including, land within 200m of water, dune systems, ridgetops, headlands, land immediately above or below cliff faces and/or rockshelters/caves;
- Desktop assessment including a review of previous archaeological and heritage studies and any other relevant material;
- Visual inspection of the project area to identify if there are Aboriginal objects present; and
- Assessment as to whether an AHIP is required.

This report has complied with the requirements of the code listed above. Other requirements under the code are outlined below.

Aboriginal consultation is not required for an investigation under the due diligence code (DECCW 2010:3). However, if the due diligence investigation shows that the activities proposed for the area are likely to harm objects or likely objects within the landscape, then an Aboriginal Heritage Impact Permit will be required with full consultation.

A record of the due diligence procedure followed must be kept to ensure it can be used as a defence from prosecution (DECCW 2010:15).

Following a due diligence assessment (where an AHIP application was not required), an activity must proceed with caution. If any Aboriginal objects are identified during the activity, then works should cease in that area and OEH notified (DECCW 2010:13). The due diligence defence does not authorise continuing harm.

2.4 Aboriginal Community Consultation

Aboriginal community consultation is not a formal requirement of the due diligence process (DECCW 2010:3); therefore the proponent is not obliged to undertake Aboriginal community consultation.

Aboriginal community consultation was not undertaken for this due diligence report.

3.0 Environmental and Heritage Context

Aboriginal heritage due diligence requires that available knowledge and information is considered and forms part of the desktop assessment required in Step 4 of the Due Diligence Code (DECCW 2010:12-13). The purpose of reviewing the relevant environmental and heritage information is to assist in identifying whether Aboriginal objects or places are present within the Project Area.

3.1 Local Environment

An understanding of environmental context is important for the purpose of predictive modelling and the interpretation of Aboriginal sites. The Aboriginal cultural heritage due diligence assessment process identifies whether Aboriginal sites or places are present or are likely to be present within the Project Area. The potential for subsurface archaeological deposit is also assessed. The local environment provided natural resources for Aboriginal people such as: stone (for manufacturing stone tools), food and medicines, wood and bark (for implements such as shields, spears, canoes, bowls and for shelters), as well as areas for camping and other activities.

3.1.1 Geology

Aboriginal people often made stone tools using siliceous, metamorphic or igneous rocks and therefore understanding the local geology can provide important information regarding resources in a Project Area. The nature of stone exploitation by Aboriginal people depends on the characteristics of the source, for example whether it outcrops on the surface (a primary source), or whether it occurs as gravels (a secondary source) (Doelman, Torrence et al. 2008).

The Project Area is characterised by the Late Permian Singleton Supergroup which is part of the Permian Singleton Coal Measures (Department of Mines 1969). The surface geology of the Project Area is predominantly the Wollombi Coal Measures and the Wittingham Coal Measures (Sniffin, McIlveen et al. 1988).

The Jerrys Plains Subgroup (Pswj) of the Wittingham Coal Measures, comprising Permian coal seams in association with conglomerate, sandstone, siltstone, tuff and claystone, predominates in the lower reaches of South Wambo Creek and along the banks of North Wambo Creek.

The Watts Sandstone Sediments (Psls) of the Wollombi Coal Measures occur on the north east facing slopes of Jerrys Plains Ridge and Wambo Ridge in the western part of Wambo Coal Mine. These distinct massive medium to coarse grained quartz lithic sandstones are predominantly in the mid slope area of these steep sided ridgelines.

The Undifferentiated Sediments (Pslz) of the Wollombi Coal Measures occur on the upper slopes of Jerrys Plains Ridge and along both banks of South Wambo and Stony Creeks. The sediments are inferior coal seams with carbonaceous shale siltstone, sandstone and tuffaceous claystone.

The basal conglomeratic quartz sandstone and minor shale sediments of the Widden Brook Conglomerate (Rna) which forms part of the Early Triassic Narrabeen Group occur on the top of Jerrys Plains Ridge, the hills flanking Stony Creek and to the south and west of South Wambo Creek.

Quaternary alluvial silt, sandy silt and gravel deposits (Qha) and Quaternary silty sand and sand deposits (Qhb) dominate most of the eastern part of the Project Area. These point bars, levee and over bank deposits occur along the flats and gently sloping banks of Wollombi Brook, North Wambo Creek, South Wambo Creek and Stony Creek. Other deposits in the vicinity of Wollombi Brook may include relict alluvial terraces of silt

and gravel with possible silicified deep weathering profile of silcrete (Cza) and Aeolian sand dunes (Czb) (Sniffin, McIlveen et al. 1988).

The presence of sandstone is important for Aboriginal occupation as sandstone was commonly used for grinding stone artefacts. Overhangs and caves in sandstone cliffs and boulders below the cliff line were sometimes used for shelter. Rock engravings and grinding grooves may be found in areas of exposed sandstone and sandstone outcrops particularly along creek beds. No overhangs, caves or sandstone outcrops occur in the Project area.

Raw materials available in the local area including silcrete, indurated mudstone, silicified tuff, chert, basalt, rhyolite and petrified wood were commonly used by Aboriginal people for manufacturing flaked stone tools. The softer shales and claystones are highly susceptible to water erosion processes and are generally unsuitable for the manufacture of stone tools.

3.1.2 Soils

Wambo MOL is characterised primarily by Lees Pinch soil landscape with some areas of remnant Ogilvie Triassic sandstone, shale and conglomerate (Kovac and Lawrie 1991:243-249, 304-307). In the southern part of Wambo MOL, the colluvial soils of the Bulga soil landscape predominate and the sandy silts and silts of Quaternary alluvium extend along the banks of the major creek lines. An aeolian sand dune system occurs to the east of Wollombi Brook.

The Lees Pinch soil landscape covers the steep mountains and rolling hills in the south west of Wambo MOL. Sands are typically shallow in this rocky area and are highly siliceous shallow loams, with yellow podzolic soils and earthy sands on some upper slopes, some yellow and brown earths on foot slopes and yellow and grey soloths at breaks in slope (Kovac and Lawrie 1991:243-249). Talus occurs on some mid and lower slopes and alluvial material is deposited in the main valleys and along the alluvial flats (Kovac and Lawrie 1991:212-215).

The Ogilvie soil landscape covers the benched areas and scarp slopes below the vertical sandstone and conglomerate cliffs (Kovac and Lawrie 1991:304-307). Conglomerate and sandstone rock outcrop is common, with shallow loams and sands (lithosols) and brown solodic soils occurring on the lower slopes. Siliceous sands and sandy earths can occur in drainage lines.

The Bulga soil landscape covers the colluvial slopes in Wambo MOL (Kovac and Lawrie 1991:125-128). Soils are predominantly yellow soloths in the upper to mid slope areas, together with yellow and brown solodic soils and brown earths on the lower slopes.

Sandy silts and silts of Quaternary alluvium extend along the banks of North Wambo Creek, South Wambo Creek and the lower reaches of Stony Creek (Kovac and Lawrie 1991:212-218). The Aeolian sand deposits of the Warkworth Sands lie to the east of Wollombi Brook. Some areas are characterised by shallow deposits of windblown sands that overlie flat lying sandstones.

The Project Area is characterised by duplex soils with clear to sharp horizon boundaries. A horizon soils are generally shallow and less than 100 millimetres thick and therefore have low potential to contain stratified archaeological material. The clay and stony B horizon soils are generally severely eroded and have been exposed to the effects of water runoff and sheet wash erosion; the A horizon soils can be re-deposited in the lower slope areas on a previously eroded B horizon (Kovac and Lawrie 1991:449). Both of these landscapes are residual and may contain soils which have formed over a long period of time by the in situ weathering of parent material. It would be expected that any artefacts that may occur in the area would be atop the exposed B horizon or in the shallow A horizon soils but that due to the evidence of erosion and other disturbances it is unlikely that in situ artefacts will be found in these areas.

3.1.3 Topography and Hydrology

The Project Area is located in the Hunter Valley and lies in the Central Lowlands Topographic Zone (Kovac and Lawrie 1991:13). Wambo MOL lies to the north east of Wambo Ridge and Jerrys Plains Ridge which are part of the Southern Mountains. These steeply sloping sandstone escarpments are on the eastern edge of the Wollemi National Park and form a common boundary between the National Park and WCM.

Jerrys Plains Ridge and Wambo Ridge are typified by rugged steep mountains with steep sided precipitous sandstone cliffs along the ridgelines, stony plateaux and rock lined narrow gorges. The north east facing talus and screed slopes below the ridgeline lie above moderate to gently sloping foot slopes and toe slopes which descend to the river flats of North Wambo Creek and Wollombi Brook.

The topography of the majority of the Wambo Mine area is characterised by rounded undulating to rolling hills, low hills and broad gentle foot slopes extending to river terraces, broad shallow river valleys with extensive level flood plains and linear gilgai in the clayey soils (Kovac and Lawrie 1991:13). The gilgai are formed due to clay soils alternately drying and wetting and the resultant clay horizons shrinking and swelling. These gilgai are evident as depressions and mounds in flat lying areas and linear waterholes in ephemeral drainage channels that are easily eroded forming erosion scours. Calcium carbonate molecules in the soils aggregate and erode out on the surface of the B horizon. Gilgai vary in size but would have been an important water source in areas that lacked permanent running water.

Wollombi Brook, North Wambo Creek, South Wambo Creek and Stony Creek are high order watercourses in the general locality of the Project Area and would have been important areas for obtaining potable water.

3.1.4 Climate

Approximately 18,000 years ago, climatic conditions began to alter which affected the movement and behaviour of past populations within their environs. During this time, notably at the start of the Holocene (more than 11,000 years ago), the melting of the ice sheets in the Northern Hemisphere and Antarctica caused the sea levels to rise, with a corresponding increase in rainfall and temperature. The change in climatic conditions reached its peak about 6,000 years ago (Short 2000:19-21). Up until 1,500 years ago, temperatures decreased slightly and then stabilised about 1,000 years ago, which is similar to the temperatures currently experienced. Consequently, the climate of the Project Area for the past 1,000 years would probably have been much the same as present day, providing a year round habitable environment.

The Project Area is located in the Singleton area which is situated in the Hunter region. The Project Area has a temperate climate that is affected by its proximity to the mountain ranges to the south west. Summer and autumn are the wettest seasons with an average annual rainfall of approximately 720 millimetres and the temperatures averaging between 12 degrees and 24 degrees Celsius (Bureau of Meteorology 2010). The temperate climate would be suitable for occupation for the majority of the year providing suitable shelter could be obtained during the wet periods.

3.1.5 Flora and Fauna

The historic settlement of the Hunter Valley included modification of the original vegetation communities, particularly through clearing for pastoral land uses. According to broad scale vegetation mapping for NSW (Keith 2002) and prior to such modifications, the Project Area was dominated by two vegetation communities, the Hunter-Macleay Dry Sclerophyll Forests and the Sydney Hinterland Dry Sclerophyll Forests.

The Hunter-Macleay Dry Sclerophyll Forests are characterised by an open canopy with trees reaching up to 30 metres tall, including spotted gums, iron barks, grey gums, boxes and turpentine. The understorey consists of a sparse layer of shrubs and a semi-continuous cover of grasses (Keith 2006:124). The Sydney Hinterland Dry Sclerophyll Forests occur throughout the Sydney sandstone basin below elevations of 600 metres. The trees vary in size between 10 metres tall on ridges and dry slopes and up to 25 metres in tall gorges and sheltered slopes. The shrub understorey is more open and less diverse than that of the coastal dry sclerophyll forests (Keith 2006:148).

The large array of resource plant species available in the area indicates that the region would have also supported a rich variety of fauna species such as macropods, koalas, possums, gliders and a range of reptile and bird species. Evidence for consumption of such faunal species has been recovered from Aboriginal archaeological excavations in the Sydney basin region (Attenbrow 2003:72-73). Such flora and fauna may have also been utilised for tools and clothing.

It is considered that the area would have been well resourced in terms of water and food with a wide diversity of fauna and flora available in the local and regional area, although today the landscape has been highly disturbed by extensive clearing and previous farming practices.

3.2 Aboriginal Heritage Information Management System (AHIMS)

A search was made of the OEH Aboriginal Heritage Information Management System (AHIMS) database and Wambo Sites Register (Appendix 2). The search results showed that there were a large number of previously recorded Aboriginal sites within the Wambo Coal Mine boundary including extensive numbers of artefact scatters and isolated finds, potential archaeological deposits (PADs), some grinding grooves, scarred trees and ceremonial site/bora ground (Table 1 and Table 2). Of these sites, it was found that there were several recorded sites near the Project Area but none within the proposed activity area. Recorded extant sites in the surrounding area were Wambo Sites 230, 231 and PAD L to the north west of the proposed Project Area and PAD J and PAD K were which were located to the east of the Project Area.

Stone artefacts generally are found in flat or gently sloping, open regions and on level, well drained land features in close proximity to water courses. Scar trees are usually found in close proximity to water or on easily accessible slopes. Grinding grooves are usually found along creek beds with outcropping sandstone rocks or near rock shelters. No grinding groove sites were evident in the creek lines in the vicinity of the proposed MWSD and although there were a number of mature trees in the area none revealed evidence of cultural scarring. The areas designated as PAD's by White (2003) were identified by landform type and the areas of PAD were inspected to determine whether any artefacts were exposed on the surface and whether there were intact A horizon soils. No artefacts were found on the surface of PAD J, PAD K or PAD L. No artefacts or Aboriginal objects were found in the footprint for the MWSD area or associated infrastructure.

In the regional area artefact scatters and isolated finds predominate. A bora ground and grinding grooves have also been recorded in the regional area but these sites are some distance from the Project area. The bora ground was on the eastern bank of Wollombi Brook several kilometres to the south east of the Project Area. The rock art/engraving site was approximately 2km to the south west in the Wollemi National Park.

There were no Aboriginal sites or objects in the immediate Project Area.

Table 1: Summary of AHIMS Results ordered by site types & frequency within a 9km²

Site Type	Frequency	Percent
Artefact Site (Artefact Scatters & Isolated Find)	77	84.61%
Grinding Groove with Artefact	1	1.10%
PAD	12	13.19%
Rock Art/Engraving	1	1.10%
Total	91	100%

Table 2: Summary of AHIMS Results ordered by site types & frequency near the immediate Project Area

Site Type	Frequency	Percent
Artefact Scatter	1	20%
Isolated Find	1	20%
PAD	3	60%
Total	5	100%

The results of the AHIMS searches show that the area is most likely to have been used for camping and resource procurement. The Project area is composed of gently sloping toe slopes, gentle to moderately sloping foot slopes and moderately sloping mid slopes. The upper slopes located mostly outside of the Project area are comprised of very steeply sloping scree and talus slopes with vertical sandstone cliffs forming the Wambo and Jerrys Plains Ridgelines that trend from the north west to the south east. These north east facing ridgelines are generally inaccessible and were unlikely to have been utilised as trading routes as there are more accessible passes through the mountains to the north west and south west of the area. The area to the north east had a higher density of artefact scatters and isolated finds and as such the Project area appears to have been less densely occupied or used in the past than another nearby landscapes.

A full glossary of Aboriginal site types is located in Appendix 3.

3.3 Archaeological and Heritage Literature Review

A review of previous archaeological and heritage reports is required as part of the desktop assessment and has been undertaken in accordance with the Due Diligence Code of Practice (DECCW 2010:13).

A large number of archaeological works have been undertaken in the general region around Wambo, including the Jerrys Plains and Warkworth areas.

The Project Area is located in the Hunter Valley. Archaeological evidence suggests that Aboriginal occupation of the Hunter Valley region began at least 35,000 years ago (Koettig 1987). Additional chronological evidence was recovered from the Hunter Valley's north east mountains for which the following dates Before Present (BP), were assigned: 34,580±650 (Beta-17009), >20,000 (Beta-20056) and 13,020±360 years (Beta-17271) (Koettig 1987, as cited in Attenbrow 2006). These dates show that the region was occupied during the Pleistocene (>11,000 years ago). As such sites are generally rare; they are likely to contain significant archaeological/scientific information, while also demonstrating extended occupation of Aboriginal people in the region.

However, the majority of Aboriginal sites in the region are dated to the more recent Holocene (less than 11,000 years ago). This may reflect Aboriginal occupation patterns, but may also be influenced by the inaccessibility of potential coastal Pleistocene sites which were inundated when sea levels rose and reached

present levels approximately 6000 years ago (Mulvaney and Kamminga 1999:223). Evidence for Holocene Aboriginal occupation has been recovered from Bobadeen (7,760 cal. Years BP), as well as Milbrodale (1,420 cal. Years BP) and Sandy Hollow (1,310 cal. Years BP) (Moore 1970:58).

Using colonial records Brayshaw (1986) conducted an extensive research of the landscape and the known Aboriginal communities in the broader Hunter Valley area. Although the ethnographic literature does not help to locate Aboriginal camp sites in the Hunter Valley, it does refer to ceremonial grounds and carved trees. However these represent only a small proportion of the sites occurring in the Hunter Valley. The literature does indicate that in the Hunter Valley, as elsewhere, Aboriginal numbers were quickly and greatly reduced by European diseases.

In addition to the regional studies, portions of WCM owned and leased lands and the Project Area have been previously surveyed and assessed by various heritage consulting bodies/organisations. An overview of some of the heritage projects conducted over WCM owned and leased lands, is provided below. Although there have been numerous surveys conducted in the past, only a select few relevant to the Project area have been described.

3.3.1 White, E. 2003. Aboriginal Heritage Assessment for Resource Strategies Pty Ltd. Wambo Development Project – (Environmental Impact Statement)

White conducted an archaeological Aboriginal heritage assessment of the proposed Wambo Development Project. The existing Wambo open-cut and underground mines are located on the west side of the Wollombi Brook and south of the Hunter River. This study was part of an Environmental Impact Statement (EIS) being prepared by Wambo Coal (White 2003). The study area was relatively large, covering approximately 60 square kilometres (km²) and included the Project area.

The study identified a total of 292 sites in the Project area. Site types identified in the study area include grinding grooves, a probable scarred tree, two sites with glass artefacts and two other sites which included historical materials indicating they may have been contact sites. Two locations have been identified as potential dateable geomorphic contexts, a red sand body on which two sites were identified and a yellow sand dune east of Wollombi Brook. The remaining sites are open artefact scatters and isolated finds. One hundred and ten isolated finds were identified along with 69 artefact scatters of only two to four visible artefacts. Only 18 sites had more than 50 artefacts. The analysis undertaken by White of the artefact assemblages found variation in the distribution of stone raw materials across the study area, particularly silcrete (White 2003).

White (2003:D7) identified a number of areas where no Aboriginal sites had been found but which she considered might have the potential for archaeological deposit. Due to poor ground exposure and survey constraints she nominated several landforms as areas of PAD. The PADs were viewed from a vehicle or a look-out point (White 2003:D145) and recorded accordingly. White (2003:D146) chose the locations for the PADs based on artefact densities found at other areas with similar landforms. She considered it was possible that the areas she identified as PADs may have the potential for artefacts but recognised that closer inspection of these areas was required. Due to survey constraints at the time White did not survey the PADs on foot.

3.3.2 RPS (2009-2012), Archaeological Reports to Wambo Mine

In addition to these works, RPS has undertaken a number of due diligence surveys, archaeological surveys including mine expansion constraints studies and AHIP surface collection and excavations (2009-2012).

In 2010, RPS undertook a survey of an area immediately adjacent to the Project area. Three previously recorded sites were identified in the area. One isolated find site Wambo Site 230 (AHIMS #37-5-0353) at a

dam, an artefact scatter site on a severely eroded lower to mid slope area Wambo Site 231 (AHIMS #37-5-0354) and a potential archaeological deposit at the confluence of two first order ephemeral creek lines PAD L (AHIMS #37-5-0553). One scar tree site Wambo 324 was also identified further to the north west.

A survey to ground truth the position and extent of the areas of PAD J (AHIMS #37-5-0551) and PAD K (AHIMS #37-5-0552) which are located in the vicinity of the Project area was also undertaken by RPS in 2012.

3.4 Synthesis

A review of the environmental context of the region indicates that the probability of identifying sites in the overall regional area is high. The geology underlying the local and regional area would have provided raw materials suitable for the manufacture of stone tools and the proximity of the Project Area to Wollombi Brook, North Wambo Creek, Stony Creek and South Wambo Creek suggests that the area would have been largely suitable for occupation.

However the area has been subject to disturbance including farming related practices such as clearing, fencing, dam construction, grazing and slashing. Other disturbances include flooding of the major creek lines, animal burrows along the creek banks and lower slopes, formed dirt tracks, pipelines, creek diversion works, farm buildings, electricity easements and associated infrastructure. Extensive land clearing has removed many of the mature trees in the regional area but the vegetation where not completely cleared, may possibly contain scarred trees.

The extensive alluvial flood plains of the major high order streams suggest that much of the flood prone areas would have been unsuitable for occupation but the soil landscape suggests that some regional parts of the WCM may have the potential to contain *in situ* subsurface artefact deposits specifically where the soils remain deep. The aeolian sand deposits of the Warkworth Sands area lie to the east of Wollombi Brook and some of the sandsheets are characterised by shallow deposits of windblown sands that overlie flat lying sandstones. Overview of the environmental context indicates that there were probably rich food and raw material sources available in the Project Area and it may therefore have been a favourable area for Aboriginal occupation.

As previously discussed several archaeological field surveys had been undertaken in the vicinity of the Project area including: an Aboriginal heritage assessment (White 2003) which formed part of an Environmental Impact Study for the Wambo Development Project, an Aboriginal cultural heritage assessment for an area adjacent to the Project area and a survey to ground truth the position and extent of the areas of PAD J (AHIMS #37-5-0551) and PAD K (AHIMS #37-5-0552) which are located in the vicinity of the Project area.

These studies had identified a number of sites in both the local and regional area but none in the proposed activity area of ground disturbance works for the Project. The only sites found in the surrounding area were: two areas of potential archaeological deposits, PAD J (AHIMS #37-5-0551), PAD K (AHIMS #37-5-0552) both of which were located to the east of the Project Area and an isolated find site Wambo Site 230 (AHIMS #37-5-0353), an artefact scatter site Wambo Site 231 (AHIMS #37-5-0354) and an additional area of PAD AHIMS #37-5-0553 PAD L (Figure 2). These sites were to the north west of the Project Area. No artefacts were found on the surface of any of the PADs. One artefact was identified on the surface of the south eastern wall of a small dam (Wambo Site 230) and one artefact was identified on the surface of the B horizon further to the north west (Wambo Site 231). These sites occur outside of the proposed activity area and therefore will not be impacted on by the proposed works (Figure 2).

4.0 Visual Inspection and Field Results

A visual inspection of the Project Area was undertaken to identify whether Aboriginal objects were present on the ground surface or were likely to be present below the ground surface. In accordance with Step 4 of the Due Diligence Code a qualified archaeologist undertook the visual inspection (DECCW 2010:12-13).

4.1 Visual Inspection

The visual inspection of the Project Area for the construction of the MWSD was conducted on the 21, 29 and 30 May 2012 (Figure 3). The visual inspection was undertaken by Gillian Goode, Senior Archaeologist and Philippa Sokol, Archaeologist both of RPS. The survey was conducted on foot (pedestrian). The Project Area comprises the proposed activity area for the MWSD and associated infrastructure. A section of the pipeline and powerline easement was not covered by this visual inspection but was previously surveyed by White (2003) for the Wambo Development Project. No Aboriginal heritage sites were recorded by White (2003) in this area.

The objective of the due diligence survey was to identify whether there were any Aboriginal objects or sites in the area of the proposed ground disturbance works associated with the construction of the MWSD.

Survey units were described for the survey area, in particular, exposure and ground surface visibility were reported to ensure comparability of survey results between different areas of the local landscape, as well as, to contextualise survey results. Areas with high visibility and exposure generally have a lot of land surface disturbance, which can expose high quantities of archaeological material (particularly stone artefacts). Conversely, areas with low visibility and exposure particularly due to native vegetation coverage, are generally more intact (undisturbed) landscapes, while the identification of sites (particularly artefact scatters) in such areas are generally low, there is potential for intact archaeological deposits, which have been protected by vegetation coverage.

Survey observations were recorded using digital photography, a differential global positioning system (DGPS) and field notes. The ground surface was inspected to determine if there were any Aboriginal objects in the area of the proposed disturbance works and the soils were inspected to identify if there were any areas with intact A horizon soils and potential for *in situ* deposit. In accordance with the DECCW guidelines photographic recording was undertaken of landforms, survey units, Aboriginal cultural material, areas of archaeological or cultural sensitivity, levels of disturbance, as well as, other areas/items of interest. Photographs were scaled as appropriate.

The Project Area had been severely disturbed by previous farming practices including extensive land clearing, fencing, dam construction, contour and erosion bank construction works, formed tracks and motor vehicle access tracks, power line easements, piping, ploughing and livestock grazing. A few mature trees remained along the upper part of a nearby tributary of North Wambo Creek but most of the land had been extensively cleared and was highly disturbed. Visibility was high and exposures were estimated at 60%. The land sloped to the north east. Sheet wash erosion had exposed the B horizon across much of the area although there was some re-deposition of A horizon soils. Further to the north east there was evidence of extensive creek diversion works associated with a section of North Wambo Creek.



WARNING
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

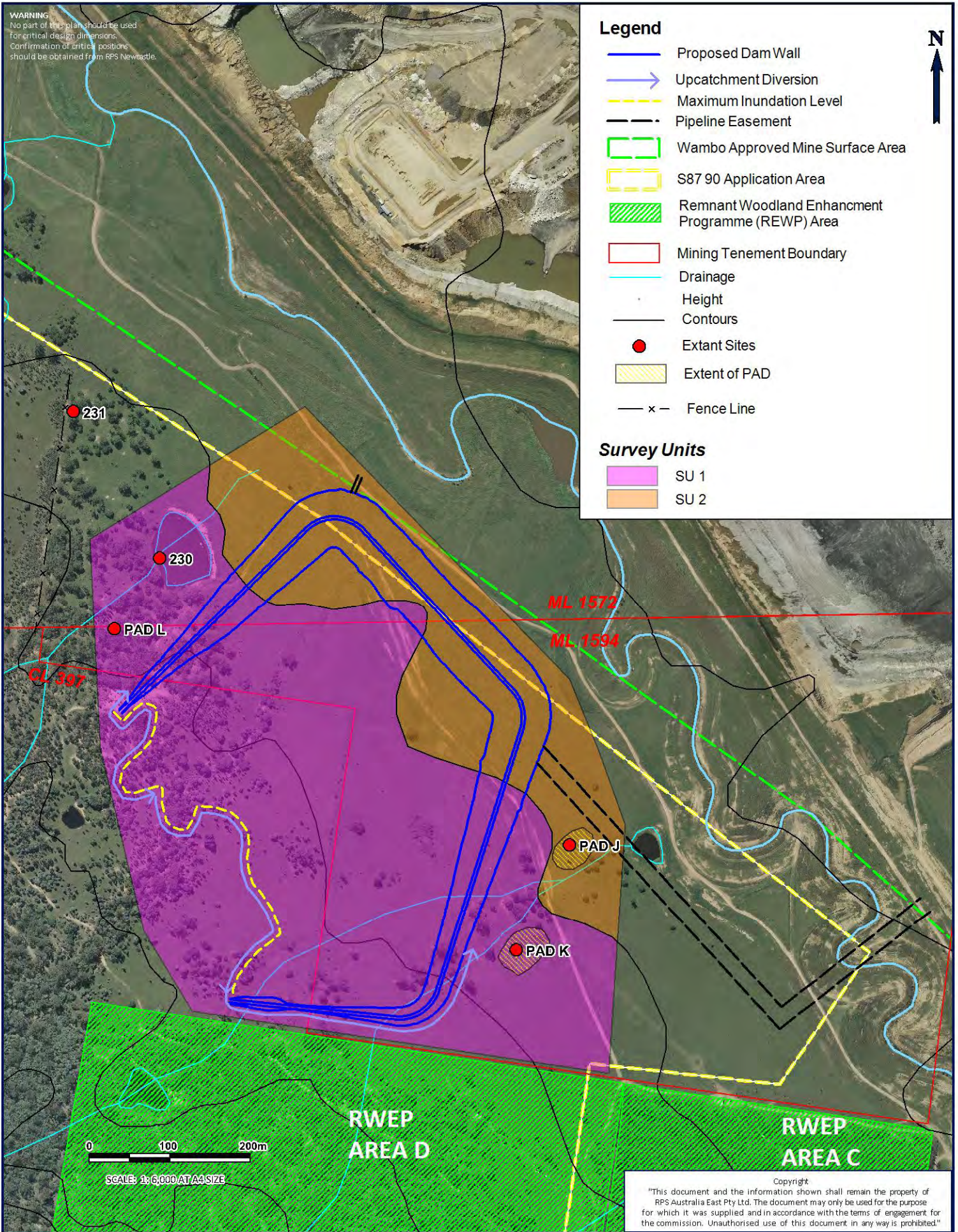
Legend

-  Proposed Dam Wall
-  Upcatchment Diversion
-  Maximum Inundation Level
-  Pipeline Easement
-  Wambo Approved Mine Surface Area
-  S87 90 Application Area
-  Remnant Woodland Enhancement Programme (REWP) Area
-  Mining Tenement Boundary
-  Drainage
-  Height
-  Contours
-  Extant Sites
-  Extent of PAD
-  Fence Line



Survey Units

-  SU 1
-  SU 2



0 100 200m
 SCALE: 1:6,000 AT A4 SIZE

Copyright
 "This document and the information shown shall remain the property of RPS Australia East Pty Ltd. The document may only be used for the purpose for which it was supplied and in accordance with the terms of engagement for the commission. Unauthorised use of this document in any way is prohibited."

TITLE: FIGURE 3: SURVEY UNITS 29-30/05/2012	LOCATION: WAMBO	DATUM: (GDA 94) PROJECTION: MGA ZONE 56	DATE: 27/6/2012 PURPOSE: HERITAGE	LAYOUT REF: J:\JCS\Wambo\Wambo Mapping Database\Archaeology VERSION (PLAN BY): A4(GG-NW)
--	-----------------	--	--------------------------------------	---

4.1.1 Survey Unit 1 Mid Slope Area

This survey unit comprised the gently to moderately sloping, north east facing mid slopes below the talus and screed slopes of the Wambo and Jerrys Plains Ridge (Plates 1 to 6). The proposed activity area was to the south west of North Wambo Creek. The area had been highly disturbed from previous farming practices (Plate 1) and had been extensively cleared and fenced to form grassy paddocks for grazing of livestock (Plate 2). Major creek diversion works were evident to the north east (Plate 3). Due to the extensive land clearing there were only a few mature trees evident in the area but a number of small saplings occurred in small patches of regrowth (Plate 4). The area had been bisected by a number of dirt farm tracks (Plate 5) and much of this part of the survey area was comprised of eroded, exposed soils from extensive sheet wash erosion (Plate 6), and disturbed soils due to tilling and grazing by hoofed animals. Visibility in this part of the survey area was fair to good (55%) and exposures were approximately 50%. There were two unnamed tributaries of North Wambo Creek; one to the east and one to the north west of the proposed MWSD. The mid slope area was separated from the lower slope area by a formed dirt access track which ran along the break in slope parallel to North Wambo Creek (Plate 7).

No artefacts or Aboriginal objects were found on the surface of the area comprising mid slope area.

4.1.2 Survey Unit 2 Lower Slope Area

Survey Unit 2 comprised the gentle lower slopes to the south west of North Wambo Creek. A dirt access track bisected the lower slope areas from the mid slope area (Plate 7 and Plate 8) following the break in slope (Plate 8 and Plate 9). The lower slopes were to the south west of extensive North Wambo Creek Diversion works (Plate 10). The B horizon had been exposed across this area by sheet wash erosion, previous farming practices and vehicular access for mine traffic. There were a number of exposures with pebble laterite on the surface of the B horizon (Plate 11). Visibility in Survey Unit 2 was excellent due to the highly disturbed nature of the area with B horizon soils exposed across much of the slope. There was an unnamed tributary to the east of the Project Area (Plate 12 and Plate 13). This creek line was comprised of two ephemeral first order creeks which joined to form a second order creek that had been dammed just to the south of the North Wambo Creek diversion works.

No artefacts or Aboriginal objects were found on the surface of the area comprising mid slope area.

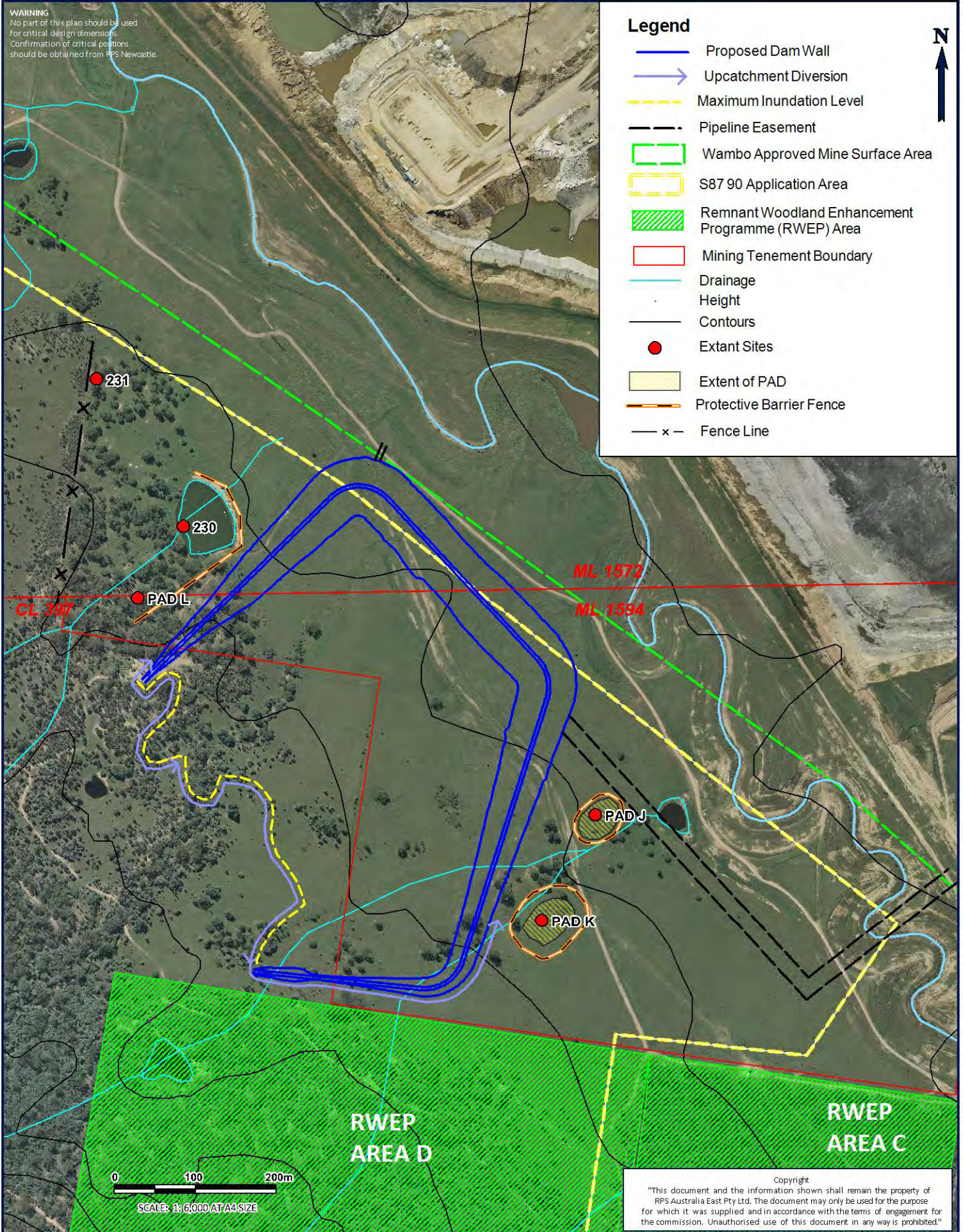
As a precautionary measure, WCPL wished to ensure that sites not within the activity area but in the surrounding area were protected from inadvertent impact and that no Aboriginal objects were harmed by mine vehicles crossing through the area. Therefore as part of the due diligence process the recorded sites to the east and north west of the proposed MWSD activity area were inspected and suitable locations for the installation of protective barrier fencing were identified (Figure 4). There were unnamed tributaries to the north west and east of the MWSD activity area. PAD J was just to the north west of a second order tributary on a small rise (Plate 14) and PAD K was to the south east of the same unnamed tributary close to the confluence of two ephemeral first order streams on a small knoll (Plate 15). There was a second unnamed creek system to the north west of the proposed activity area. This area had also been dammed and Wambo Site 230 was an isolated find on the south eastern wall of the small dam (Plates 16 to 18). PAD L was to the south of this on a small rise between two ephemeral first order tributaries (Plates 19 to 20) and Wambo Site 231 was to the north west on a severely eroded slope with extensive B horizon soils exposed (Plates 21 to 22).

The areas of PAD (PAD J, PAD K and PAD L) and Wambo Site 230 were inspected, photographed and recorded with a DGPS.

WARNING
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Legend

-  Proposed Dam Wall
-  Upcatchment Diversion
-  Maximum Inundation Level
-  Pipeline Easement
-  Wambo Approved Mine Surface Area
-  S87 90 Application Area
-  Remnant Woodland Enhancement Programme (RWEPP) Area
-  Mining Tenement Boundary
-  Drainage
-  Height
-  Contours
-  Extant Sites
-  Extent of PAD
-  Protective Barrier Fence
-  Fence Line



TITLE: FIGURE 4: PROPOSED ACTIVITY AREA AND PROTECTIVE BARRIERS
 LOCATION: WAMBO
 29-30/05/2012

DATUM: (GDA 94)
 PROJECTION: MGA ZONE 56

DATE: 27/6/2012
 PURPOSE: HERITAGE

LAYOUT REF: J:\JOBS\Wambo\Wambo Mapping Database\Archaeology
 VERSION (PLAN BY): A4(GG-NW)

CLIENT: WAMBO COAL
 JOB REF: 113210

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
 241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
 T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au



PAD J (AHIMS #37-5-0551) was on a north east facing, lower slope area adjacent to and to the west of an unnamed second order tributary of North Wambo Creek.

PAD K (AHIMS #37-5-0552) was on a north east facing, mid slope area to the south east of an unnamed first order tributary, close to the confluence of two unnamed first order tributaries and directly to the south east of PAD J.

Wambo Site 230 (AHIMS #37-5-0353) was located on a gently sloping, north east facing foot slope on the edge of a dam. This site had been identified as an isolated find during the course of the EIS (White 2003) survey works. The water level in the dam was found to be deeper than the level shown on photo attached to the site card. One rhyolite flake was found on the surface of the dam wall.

Wambo Site 231 (AHIMS #37-5-0354) was also located on a gentle north east facing slope. Sheet wash erosion had removed all topsoil leaving the B horizon exposed. There was some leaf litter and a large ants' nest. A mudstone flake was identified on the surface of the B horizon in the area of Wambo Site 231 which had been recorded as an artefact scatter during the EIS works in 2003 (White 2003).

PAD L (AHIMS #37-5-0553) had also been identified by White in 2003 as having the potential for archaeological deposit. The area for PAD L was found to be a small strip of land between two ephemeral drainage lines. No artefacts were located on the surface of the PAD and there was no evidence of intact A horizon soils due to the extensive sheet wash erosion.

A buffer was placed around the PADs and artefact site and the area marked out with flags in order that a protective barrier could be erected to ensure that there would be no risk of mine vehicles or infrastructure causing harm to the sites (Figure 4).

4.2 Visual Inspection Summary

The overall Project Area had been severely disturbed by previous farming practices including extensive land clearing, fencing, dam construction, contour and erosion bank construction works, formed tracks and motor vehicle access tracks, power line easements, ploughing and livestock grazing. There were a few mature trees along the upper part of the second order creek line but most of the land had been extensively cleared and was highly disturbed. Visibility was high and exposures were estimated at 60%. The B horizon was exposed across much of the area although there was some re-deposition of A horizon soils. Further to the north east there was evidence of extensive creek diversion works associated with a section of North Wambo Creek.

A number of mature trees remained close to a nearby ephemeral creek line and the area of PAD K. These trees were inspected for cultural scarring but there was no scarring present. There was no outcropping sandstone suitable for grinding in the vicinity. No artefacts were found on the surface of the soils.

A high visibility barrier is to be erected to prevent vehicles and other mine infrastructure causing harm whilst using this area for access and to ensure that any potential *in situ* artefacts would not be harmed. The protective barrier will ensure that the sites will not be harmed by any mine works in the area (Figure 3).

4.2.1 Results

There were no sites identified in the proposed activity area of the MWSD although a number of sites were identified outside of the boundary of the proposed development works.

As such it was considered that there were no archaeological constraints for ground disturbance works to proceed for the installation of the Montrose Water Storage Dam in the area inspected. As a precautionary measure, Wambo Site 230 (AHIMS #37-5-0353), PAD J (AHIMS #37-5-0551) and PAD K (AHIMS #37-5-0552) and PAD L (AHIMS #37-5-0553) will have a protective barrier fence placed around the extent of the sites, in order to ensure that there is no risk of mine vehicles or associated mine works or infrastructure inadvertently impacting or harming these Aboriginal objects or sites. There is already a fence to the west of Wambo Site 231 which will prevent vehicles impacting on this site.

4.2.2 Conclusion

There were no sites in the immediate area of the ground disturbance works for the MWSD and as such no Aboriginal objects will suffer harm. A number of sites identified outside of the boundary of the proposed development works will have a protective barrier fence placed around them, in order to ensure that there is no risk of mine vehicles or associated mine works or infrastructure inadvertently impacting or harming Aboriginal objects or sites in these surrounding areas.

5.0 Impact Assessment and Mitigation

The purpose of a due diligence report is to identify whether Aboriginal objects are present, or likely to be present, in the Project Area; to determine whether proposed activities are likely to harm Aboriginal objects (if present) and to determine whether an Aboriginal Heritage Impact Permit (AHIP) is required.

No Aboriginal objects or sites were identified in the area of the proposed activity.

However, as there were a number of recorded sites in the surrounding area, WCPL must ensure that machinery and equipment utilizing this area for access do not impact on any of the nearby recorded sites. As a precautionary measure, WCPL will install protective barrier fencing around them in order to protect them from inadvertent harm from mine vehicles traversing the area (Figure 4).

6.0 Conclusions and Recommendations

Although these studies identified a number of sites in both the local and regional area there were no sites identified in the proposed Project area. A number of sites were identified outside of the boundary of the proposed development works.

No Aboriginal objects were identified in the Project area and therefore there is no identified risk of harm to Aboriginal objects.

There are Aboriginal objects adjacent to the activity area and therefore as a precautionary measure WCPL will place a protective barrier fence around the recorded sites to ensure that these locations are avoided by mine personnel or infrastructure works (Figure 4).

RECOMMENDATIONS

Mine vehicles will utilise an existing access track currently in use by the WCM whilst constructing MWSD and associated infrastructure which includes the installation of power poles and the laying of pipes on the surface of the soil within the defined power and pipeline easements. In order to ensure that there is no risk of mine vehicles or associated mine works or infrastructure inadvertently impacting or harming any recorded sites in the surrounding area, WCPL intends to place a protective barrier fence around the sites Wambo Sites 230, PAD J, PAD K and PAD L. Wambo Site 231 is already protected by a fence.

Recommendations 1 to 5

The numbered recommendations below have been provided specifically for the proposed activity.

Recommendation 1

Aboriginal objects adjacent to the proposed activity area must be avoided and WCPL must advise all onsite personnel of the location of any archaeologically sensitive area and any Aboriginal site locations within the vicinity of any proposed works and instructed to avoid them.

Recommendation 2

WCPL is to construct a protective, high visibility barrier around Wambo Sites 230, PAD J, PAD K and PAD L in order to ensure that there is no vehicular access across the archaeologically sensitive area.

Recommendation 3

Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 4

If additional ground surface disturbance works fall outside of the areas inspected as part of this project WCPL are advised to have those areas investigated by a qualified archaeologist with additional due diligence survey undertaken.

Recommendation 5

If WCPL is uncertain of the potential risk of impact to archaeological and cultural heritage sites, they should contact a suitably qualified archaeologist to investigate the area prior to impact.

Recommendations A to D

Recommendations A to D must also be followed for undertaking the activity (the construction works). These recommendations provide contingency procedures should unexpected Aboriginal objects or skeletal remains be identified during the activity (construction).

Recommendation A

All relevant WCPL staff and contractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.

Recommendation B

This due diligence report must be kept by WCPL so that it can be presented, if needed, as a defence from prosecution.

Recommendation C

If Aboriginal objects are identified in the Project Area during works, then all works in that area should cease and the area should be cordoned off. If the Aboriginal sites cannot be avoided OEH must be notified. Some works may not be able to be resumed until an AHIP has been granted.

Recommendation D

In the event that skeletal remains are uncovered, work must cease immediately in that area and the area should be cordoned off. WCPL must contact the NSW Police with no further action taken until written advice is provided by the Police. If determined to be Aboriginal, OEH must be notified and a management plan prior to works re-commencing must developed in consultation with the relevant Aboriginal stakeholders.

7.0 References

- Attenbrow, V. (2003). Sydney's Aboriginal Past: Investigating the Archaeological and Historical Records, UNSW Press.
- Attenbrow, V. (2006). What's Changing: Population Size or Land-Use Patterns? The archaeology of Upper Mangrove Creek, Sydney Basin. Canberra, Australian National University.
- Brayshaw, H. (1986). Aborigines of the Hunter Valley: A Study of Colonial Records, Scone and Upper Hunter Historical Society.
- Brayshaw, H. (2003). Looking for the Bora Ground in the Wallaby Scrub near Bulga, NSW, Helen Brayshaw Heritage Consultants Pty Ltd.
- Bureau of Meteorology. (2010). "Climate Average - Newstan." 2010.
- DECCW (2010). Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.
- Department of Environment and Climate Change (New South Wales) (2008). Private Native Forestry Code of Practice. Department of Environment and Climate Change.
- Department of Industry and Investment (New South Wales) (2001). Plantations and Reafforestation (Code) Regulation. Department of Industry and Investment. Orange, NSW.
- Department of Mines, S. (1969). Singleton Mapsheet 1:250,000 Geological Series S156-1. Sydney, VCN Blight Government Printer NSW.
- Doelman, T., R. Torrence, et al. (2008). "Source selectivity: An assessment of Volcanic Glass Sources in the Southern Primorye Region, Far East Russia." Geoarchaeology: An International Journal **23**: 243-273.
- Forests NSW (2010). Operational Guidelines for Aboriginal Cultural Heritage Management (A due diligence Code of Practice). Forests NSW.
- Galloway, R., W. (1963). Geomorphology of the Hunter Valley. . General report on the land of the Hunter Valley, Land Research Series. R. Story, GALLOWAY, R,W.,Graff, R,H., M van de, and Tweedie,A.D. Melbourne, CSIRO. **8**: 90 - 102.
- Keith, D. (2002). A Compilation Map of Native Vegetation for New South Wales: NSW Biodiversity Strategy.
- Keith, D. (2006). Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT. Sydney, Department of Environment and Conservation NSW.
- Kempff, J. (2010). Aboriginal Objects Due Diligence Code For Plantation Officers Administering the Plantations & Reafforestation (Code) Regulation 2001 D. o. I. a. I. N. S. Wales).
- Koettig, M. (1987). Monitoring Excavations at Three Locations along the Singleton to Glennies Creek Pipeline Route, Hunter Valley: third report on archaeological investigations along this route, NSW Department of Public Works.
- Kovac, M. and J. Lawrie (1991). Soil Landscapes of the Singleton 1:250 000 Sheet. Sydney, Soil Conservation of NSW.
- Minerals Council (2010). NSW Mining Industries Due Diligence Code of Practice for the Protection of Aboriginal Objects New South Wales Minerals Council, New South Wales Minerals Council Ltd Miningenuity.

-
- Moore, D. R. (1970). "Results of an Archaeological Survey for the Hunter River Valley, New South Wales, Australia Part I: The Bondaian Industry." Records of the Australian Museum **28**: 25-64.
- Mulvaney, K. and J. Kamminga (1999). Prehistory of Australia. Sydney, Allen and Unwin.
- National Parks and Wildlife Service NSW (2009). National Parks and Wildlife Regulation.
- RPS (2009-2012). Archaeological Reports to Wambo Mine, Wambo Coal Mine Pty Ltd.
- Short (2000). 'Sydney's Dynamic Landscape' in Sydney - Emergence of a World City. Melbourne, Oxford University Press.
- Sniffin, M. J., G. R. McIlveen, et al. (1988). Doyles Creek 1:25,000 Geological Map 9032-I-N. Sydney, Geological Survey of New South Wales.
- Story, R., R. W. Galloway, et al. (1963). Land Systems of the Hunter Valley. General Report on the Land of the Hunter Valley. Land Research Series No. 8. Melbourne, CSIRO: 13 - 61.
- White, E. (2003). Aboriginal Heritage Assessment, Appendix D, Volume 3 of Wambo Development Environmental Impact Statement, Wambo Coal Mine Pty Ltd.

8.0 Plates



Plate 1: Survey Unit 1 - View to north showing south western part of the mid slope area and the highly disturbed cleared paddock.



Plate 2: Survey Unit 1 - View to south showing cleared paddock and unnamed tributary to the west of the Project Area.



Plate 3: Survey Unit 1 - View north east showing modified contour bank and North Wambo Creek Diversion works near the open cut mine area.



Plate 4: Survey Unit 1 - View showing previously cleared paddock and small stands of saplings.



Plate 5: Survey Unit 1 - View to east showing existing access track and unnamed tributary to east of Project Area.



Plate 6: Survey Unit 1 - Western bank of unnamed tributary to east of the Project area showing extensive sheet wash erosion and B horizon soils.



Plate 7: Survey Unit 2 - View to east showing mid slope (Survey Unit 1) and lower slope (Survey Unit 2) areas bisected by existing dirt track and contour bank.



Plate 8: Project Area - View to east showing access track.



Plate 9: Break in slope between mid slope (Survey Unit 1) and lower slope (Survey Unit 2) areas.



Plate 10: Survey Unit 2 - View north east showing modified contour bank and North Wambo Creek Diversion works.



Plate 11: Survey Unit 2 - Pebbles on surface of B horizon.



Plate 12: Survey Unit 2 - View to north east showing unnamed tributary to east of Project area.



Plate 13: View to north west showing upper part of same unnamed tributary to east of Project area.



Plate 14: PAD J - View to north east showing area of PAD J to west of an unnamed tributary of North Wambo Creek.



Plate 15: PAD K - View to north showing PAD K and small crest to east of an unnamed tributary of North Wambo Creek



Plate 16: Wambo Site 230 – View to west showing dam at Wambo Site 230.



Plate 17: Wambo Site 230 - View to west, dam wall with artefact on surface



Plate 18: Wambo Site 230 - Rhyolite flake.



Plate 19: View showing drainage line to west of Project Area



Plate 20: PAD L - view to south west



Plate 21: Wambo Site 231 – view to north showing sheet wash erosion and B horizon soils.



Plate 22: Wambo 231 - mudstone flake

Appendix I Legislative Requirements

Summary of Statutory Controls

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

COMMONWEALTH

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHIP Act Amendment 2006)

The purpose of this Act is to preserve and protect all heritage places of particular significance to Aboriginal and Torres Strait Islander people. This Act applies to all sites and objects across Australia and in Australian waters (s4).

It would appear that the intention of this Act is to provide national baseline protection for Aboriginal places and objects where State legislation is absent. It is not to exclude or limit State laws (s7(1)). Should State legislation cover a matter already covered in the Commonwealth legislation, and a person contravenes that matter, that person may be prosecuted under either Act, but not both (s7(3)).

The Act provides for the preservation and protection of all Aboriginal objects and places from injury and/or desecration. A place is construed to be injured or desecrated if it is not treated consistently with the manner of Aboriginal tradition or is or likely to be adversely affected (s3).

The Australian Heritage Commission Act 1975

The Australian Heritage Commission Act (1975) established the Australian Heritage Commission which assesses places to be included in the National Estate and maintains a register of those places. Places maintained in the register are those which are significant in terms of their association with particular community or social groups and they may be included for social, cultural or spiritual reasons. The Act does not include specific protective clauses.

The Australian Heritage Council Act (2003) together with *The Environment Protection and Biodiversity Conservation Act (1999, amended)* includes a National Heritage List of places of National heritage significance, maintains a Commonwealth Heritage List of heritage places owned or managed by the Commonwealth and ongoing management of the Register of the National Estate.

STATE

It is incumbent on any land manager to adhere to state legislative requirements that protect Aboriginal Cultural heritage. The relevant legislation in NSW includes but is not limited to the summary below.

National Parks and Wildlife Act 1974 (NPW ACT)

The NPW Act provides statutory protection for all Aboriginal heritage, places and objects (not being a handicraft made for sale), with penalties levied for breaches of the Act. This legislation is overseen by the Office of Environment and Heritage (OEH), and specifically the Director-General of OEH. Part 6 of this Act is the relevant part concerned with Aboriginal objects and places, with Section 86 and Section 90 being the most pertinent. In 2010, this Act was substantially amended, particularly with respect to Aboriginal cultural heritage requirements. Relevant sections include:

Section 86

This section now lists four major offences:

- (4) A person must not harm an object that the person knows is an Aboriginal object;
- (5) A person must not harm an Aboriginal object;
- (6) For the purposes of s86, “circumstances of aggravation” include:
 - (g) The offence being committed during the course of a commercial activity; or
 - (h) That the offence was the second or subsequent offence committed by the person;
- (7) A person must not harm or desecrate an Aboriginal place.

Offences under s86 (2) and (4) are now strict liability offences, ie, knowledge that the object or place harmed was an Aboriginal object or place needs to be proven. Penalties for all offences under Part 6 of this Act have also been substantially increased, depending on the nature and severity of the offence.

Section 87

This section now provides defences to the offences of s86. These offences chiefly consist of having an appropriate Aboriginal Heritage Impact Permit (AHIP), not contravening the conditions of the AHIP or demonstrating that due diligence was exercised prior to the alleged offence.

Section 87A & 87B

These sections provide exemptions from the operation of s86; Section 87A for authorities such as the Rural Fire Service, State Emergency Services and officers of the National Parks & Wildlife Service in the performance of their duties, and s87B for Aboriginal people performing traditional activities.

Section 89A

If a person knows of the location of an Aboriginal object or place that has not been previously registered and does not advise the Director-General of that object or place within a reasonable period of time, then that person is guilty of an offence under this Section of the Act.

Section 90

This section authorises the Director-General to issue an AHIP.

Section 90A-90R

These sections govern the requirements relating to applying for an AHIP. In addition to the amendments to the Act, OEHL have issued three new policy documents clarifying OEHL's requirements with regards to Aboriginal archaeological investigations: *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* and *Code of Practice for Archaeological Investigations in NSW*. The Consultation Requirements formalise the consultation with Aboriginal community groups into four main stages, and includes details regarding the parties required to be consulted, advertisements inviting Aboriginal community groups to participate in the consultation process, requirements regarding the provision of methodologies, draft and final reports to the Aboriginal stakeholders and timetables for the four stages. The Due Diligence Code of Practice sets out the minimum requirements for investigation, with particular regard as to whether an AHIP is required. The Code

of Practice for Archaeological Investigation sets out the minimum requirements for archaeological investigation of Aboriginal sites.

Aboriginal Heritage Impact Permits (AHIP)

OEH encourages consultation with relevant Aboriginal stakeholders for all Aboriginal Heritage Assessments. However, if an Aboriginal Heritage Impact Permit (AHIP) is required for an Aboriginal site, then specific OEH guidelines are triggered for Aboriginal consultation.

Aboriginal Cultural Heritage Consultation Requirements for Proponents

In 2010, the Aboriginal Cultural Heritage Consultation Requirements for Proponents (ACHCR's) were issued by OEH (12th April 2010). These consultation requirements replace the previously issued Interim Community Consultation Requirements (ICCR) for Applicants (Dec 2004). These guidelines apply to all AHIP applications prepared after 12th April 2010; for projects commenced prior to 12th April 2010, transitional arrangements have been stipulated in a supporting document, Questions and Answers 2: Transitional Arrangements.

The ACHCR's 2010 include a four stage Aboriginal consultation process and stipulate specific timeframes for each stage. Stage 1 requires that Aboriginal people who hold cultural information are identified, notified and invited to register an expression of interest in the assessment. Stage 1 includes the identification of Aboriginal people who may have an interest in the project area and hold information relevant to determining the cultural significance of Aboriginal objects or places. This identification process should draw on reasonable sources of information including: the relevant OEH EPRG regional office, the relevant Local Aboriginal Land Council(s), the Registrar of Aboriginal Owners, Aboriginal Land Rights Act (1983), the Native Title Tribunal, Native Title Services Corporation Limited, the relevant local council(s), and the relevant catchment management authority. The identification process should also include an advertisement placed in a local newspaper circulating in the general location of the project area. Aboriginal organisations and/or individuals identified should be notified of the project and invited to register an expression of interest (Eoi) for Aboriginal consultation. Once a list of Aboriginal stakeholders has been compiled from the Eoi's, they need to be consulted in accordance with ACHCR's Stages 2, 3 and 4.

Environmental Planning & Assessment Act 1979 (EP&A Act)

This Act regulates a system of environmental planning and assessment for New South Wales. Land use planning requires that environmental impacts are considered, including the impact on cultural heritage and specifically Aboriginal heritage. Within the *EP&A Act*, Parts 3, 4 and 5 relate to Aboriginal heritage.

Part 3 regulates the preparation of planning policies and plans. Part 4 governs the manner in which consent authorities determine development applications and outlines those that require an environmental impact statement. Part 5 regulates government agencies that act as determining authorities for activities conducted by that agency or by authority from the agency. The National Parks & Wildlife Service is a Part 5 authority under the *EP&A Act*.

In brief, the NPW Act provides protection for Aboriginal objects or places, while the *EP&A Act* ensures that Aboriginal cultural heritage is properly assessed in land use planning and development.

The Heritage Act 1977

This Act protects the natural and cultural history of NSW with emphasis on non-indigenous cultural heritage through protection provisions and the establishment of a Heritage Council. Although Aboriginal heritage sites and objects are primarily protected by the *National Parks & Wildlife Act* (1974, as amended), if an Aboriginal site, object or place is of great significance, it may be protected by a heritage order issued by the Minister subject to advice by the Heritage Council.

Other legislation of relevance to Aboriginal cultural heritage in NSW includes the *NSW Local Government Act* (1993). Local planning instruments also contain provisions relating to indigenous heritage and development conditions of consent.

Appendix 2 AHIMS

RPS Australia East Pty Ltd -Hamilton
Accounts Payable Fortitude Valley PO Box 237
Brisbane Queensland 4006
Attention: Cheng-Yen Loo
Email: chengyen.loo@rpsgroup.com.au

Date: 21 June 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters. conducted by Cheng-Yen Loo on 21 June 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

91	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette](http://www.nsw.gov.au/gazette) (<http://www.nsw.gov.au/gazette>) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.



SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
37-5-0030	Wambo site 3 Wambo Estate	AGD	56	309000	6394800	Open site	Valid	Artefact : -	Open Camp Site	318,1971,1972
	Contact	Recorders	Len Dyall					Permits	2222	
37-5-0031	Wambo Estate NW 2	AGD	56	309030	6394900	Open site	Valid	Grinding Groove : -, Artefact : -	Axe Grinding Groove,Open Camp Site	318,1971,1972
	Contact	Recorders	Elizabeth Rich					Permits	2222	
37-5-0035	Horse Run;Jerrys Plains Ridge;	AGD	56	302426	6396665	Open site	Valid	Artefact : -	Open Camp Site	318
	Contact	Recorders	ASRSYS					Permits		
37-5-0036	Horse Run;Jerrys Plains Ridge;	AGD	56	300687	6396724	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	ASRSYS					Permits		
37-5-0037	Horse Run;Jerrys Plains Ridge;	AGD	56	302262	6395656	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	ASRSYS					Permits		
37-5-0038	Horse Run;Jerrys Plains Ridge;	AGD	56	302974	6396676	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	ASRSYS					Permits		
37-5-0039	Horse Run;Jerrys Plain Ridge;	AGD	56	303528	6396412	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Len Dyall					Permits		
37-5-0409	Wambo site 157	AGD	56	309122	6394328	Open site	Valid	Artefact : 1		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0410	Wambo site 160	AGD	56	309090	6395030	Open site	Valid	Artefact : 1		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0411	Wambo site 161	AGD	56	309170	6395140	Open site	Valid	Artefact : 6		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0412	Wambo site 162	AGD	56	309068	6395489	Open site	Valid	Artefact : 1		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0413	Wambo site 163	AGD	56	309068	6395614	Open site	Valid	Artefact : 1		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0414	Wambo site 164	AGD	56	308931	6395412	Open site	Valid	Artefact : 3		
	Contact	Recorders	Ms.Laila Haglund					Permits	2222	
37-5-0415	Wambo site 165	AGD	56	308867	6395207	Open site	Valid	Artefact : 1		
	Contact	Recorders	Ms.Laila Haglund					Permits	2222	
37-5-0442	Wambo site 235	AGD	56	307119	6395821	Open site	Valid	Artefact : 5		
	Contact	Recorders	Ms.Laila Haglund					Permits	2222	
37-5-0443	Wambo site 234	AGD	56	307171	6395802	Open site	Valid	Artefact : 1		

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters.Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0416	Wambo site 167	AGD	56	308641	6395268	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0417	Wambo site 168	AGD	56	308473	6395529	Open site	Valid	Artefact : 27		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0418	Wambo site 169	AGD	56	308380	6395450	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0419	Wambo site 170	AGD	56	308363	6395902	Open site	Valid	Artefact : 6		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0420	Wambo site 171	AGD	56	308588	6396022	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0421	Wambo site 172	AGD	56	308977	6396300	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0422	Wambo site 173	AGD	56	309076	6396222	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0423	Wambo site 174	AGD	56	309001	6396229	Open site	Valid	Artefact : -		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0424	Wambo site 175	AGD	56	309308	6396233	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0426	Wambo site 238	AGD	56	306963	6396134	Open site	Valid	Artefact : 12		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0427	Wambo site 237	AGD	56	307050	6396050	Open site	Valid	Artefact : 11		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0428	Wambo site 236	AGD	56	307200	6396100	Open site	Valid	Artefact : 6		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0429	Wambo site 189	AGD	56	309251	6396878	Open site	Valid	Artefact : 3		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0430	Wambo site 188	AGD	56	309264	6396897	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0432	Wambo site 187	AGD	56	309328	6396895	Open site	Valid	Artefact : -		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0368	Wambo site 224	AGD	56	307700	6396530	Open site	Valid	Artefact : 1		
	Contact	Recorders		Helen Brayshaw				Permits	2222	

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters. Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.



SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
37-5-0339	Wambo site 219	AGD	56	308357	6396692	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0340	Wambo site 218	AGD	56	308380	6396500	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0341	Wambo site 217	AGD	56	308590	6396390	Open site	Valid	Artefact : 6		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0372	Wambo site 251	AGD	56	307529	6396890	Open site	Valid	Artefact : 1		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0373	Wambo site 250	AGD	56	307105	6396754	Open site	Valid	Artefact : 6		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0374	Wambo site 249	AGD	56	307150	6396670	Open site	Valid	Artefact : 11		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0375	Wambo site 245	AGD	56	306830	6396563	Open site	Valid	Artefact : 1		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0376	Wambo site 246	AGD	56	306629	6396676	Open site	Valid	Artefact : 1		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0378	Wambo site 244	AGD	56	306874	6396530	Open site	Valid	Artefact : 2		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0469	Wambo site 192	AGD	56	308834	6396992	Open site	Valid	Artefact : 3		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0470	Wambo site 191	AGD	56	308925	6396833	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0379	Wambo site 242	AGD	56	306548	6396358	Open site	Valid	Artefact : 2		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0381	Wambo site 243	AGD	56	306890	6396337	Open site	Valid	Artefact : 3		
	Contact	Recorders		K Calley				Permits	2222	
37-5-0337	Wambo site 220	AGD	56	308228	6396739	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0349	Wambo site 190	AGD	56	309105	6396901	Open site	Valid	Artefact : 4		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0353	Wambo site 230	AGD	56	307455	6394990	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits		

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters.Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.



SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
37-5-0354	Wambo site 231	AGD	56	307348	6395172	Open site	Valid	Artefact : 5		
	Contact	Recorders		Ms.Laila Haglund				Permits		
37-5-0355	Wambo site 232	AGD	56	307395	6395461	Open site	Valid	Artefact : 2		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0393	Wambo site 145	AGD	56	308876	6393732	Open site	Valid	Artefact : 2		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0394	Wambo site 146	AGD	56	308754	6393850	Open site	Valid	Artefact : 1		99288
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0395	Wambo site 147	AGD	56	308365	6393870	Open site	Valid	Artefact : 5		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0397	Wambo site 148	AGD	56	308418	6394050	Open site	Valid	Artefact : 9		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0357	Wambo site 233	AGD	56	307329	6395845	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0358	Wambo site 239	AGD	56	306770	6395950	Open site	Valid	Artefact : 148		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0359	Wambo site 240	AGD	56	306468	6396030	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits		
37-5-0360	Wambo site 241	AGD	56	306331	6396087	Open site	Valid	Artefact : 8		
	Contact	Recorders		Elizabeth White				Permits		
37-5-0361	Wambo site 225	AGD	56	307559	6396271	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0399	Wambo site 149	AGD	56	308375	6394266	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0401	Wambo site 150	AGD	56	308276	6394309	Open site	Valid	Artefact : 1		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0403	Wambo site 151	AGD	56	308663	6394488	Open site	Valid	Artefact : 1		
	Contact	Recorders		Elizabeth White				Permits	2222	
37-5-0453	Wambo site 222	AGD	56	307718	6396936	Open site	Valid	Artefact : 2		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	
37-5-0455	Wambo site 223	AGD	56	307691	6396890	Open site	Valid	Artefact : 2		
	Contact	Recorders		Ms.Laila Haglund				Permits	2222	

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters.Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
37-5-0363	Wambo site 226	AGD	56	307757	6396136	Open site	Valid	Artefact : 7		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0364	Wambo Site 227	AGD	56	307704	6395978	Open site	Valid	Artefact : 60		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0365	Wambo site 228	AGD	56	307494	6396003	Open site	Valid	Artefact : 3		
	Contact	Recorders	Ms.Laila Haglund					Permits	2222	
37-5-0366	Wambo site 229	AGD	56	307822	6395252	Open site	Valid	Artefact : 8		
	Contact	Recorders	Ms.Laila Haglund					Permits	2222	
37-5-0463	Wambo site 248	AGD	56	306423	6396972	Open site	Valid	Artefact : 45		
	Contact	Recorders	K Calley					Permits	2222	
37-5-0464	Wambo site 247	AGD	56	306436	6396988	Open site	Valid	Artefact : 45		
	Contact	Recorders	K Calley					Permits	2222	
37-5-0468	Wambo site 193	AGD	56	308841	6397093	Open site	Valid	Artefact : 1		
	Contact	Recorders	Elizabeth White					Permits	2222	
37-5-0549	Wambo PAD H	GDA	56	309044	6393641	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Ms.Gillian Goode					Permits		
37-5-0550	Wambo PAD I	GDA	56	309124	6393711	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Ms.Gillian Goode					Permits		
37-5-0551	Wambo PAD J	GDA	56	308034	6394841	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Ms.Gillian Goode					Permits		
37-5-0552	Wambo PAD K	GDA	56	308004	6394691	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Ms.Gillian Goode					Permits		
37-5-0553	Wambo PAD L	GDA	56	307504	6395091	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Ms.Gillian Goode					Permits		

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters.Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
37-5-0554	Wambo PAD M	GDA	56	308304	6394991	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact									Permits
37-5-0555	Wambo PAD N	GDA	56	308554	6395691	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact									Permits
37-5-0556	Wambo PAD O	GDA	56	308404	6396591	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact									Permits
37-5-0557	Wambo PAD P	GDA	56	308204	6396791	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact									Permits
37-5-0558	Wambo PAD Q	GDA	56	308024	6396261	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact									Permits
37-5-0559	Wambo PAD R	GDA	56	306904	6396341	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact									Permits
37-5-0578	Wambo site 324 St 1	GDA	56	307124	6395449	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact									Permits
37-5-0585	Toorale-Nulty Fence 10	GDA	56	307825	6393822	Open site	Deleted	Artefact : -		
	Contact									Permits
37-5-0590	WAMBO SITE 296	GDA	56	307825	6393822	Open site	Valid	Grinding Groove : 1		
	Contact									Permits
37-5-0591	WAMBO SITE 297	GDA	56	307758	6393803	Open site	Valid	Artefact : 1		
	Contact									Permits
37-5-0592	WAMBO SITE 298	GDA	56	305238	6396955	Open site	Valid	Artefact : 15		
	Contact									Permits

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters.Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports	
37-5-0602	WAMBO SITE 308	GDA	56	305330	6395133	Open site	Valid	Artefact : 2			
	<u>Contact</u>	<u>Recorders</u>	Ms.Gillian Goode,RPS Australia East Pty Ltd -Hamilton						<u>Permits</u>		
37-5-0603	WAMBO SITE 309	GDA	56	305347	6395196	Open site	Valid	Artefact : 2			
	<u>Contact</u>	<u>Recorders</u>	Ms.Gillian Goode,RPS Australia East Pty Ltd -Hamilton						<u>Permits</u>		
37-5-0604	WAMBO SITE 310	GDA	56	305240	6395159	Open site	Valid	Artefact : 35			
	<u>Contact</u>	<u>Recorders</u>	Ms.Gillian Goode,RPS Australia East Pty Ltd -Hamilton						<u>Permits</u>		
37-5-0605	WAMBO SITE 311	GDA	56	306382	6396192	Open site	Valid	Artefact : 24			
	<u>Contact</u>	<u>Recorders</u>	Ms.Gillian Goode,RPS Australia East Pty Ltd -Hamilton						<u>Permits</u>		

Report generated by AHIMS Web Service on 06/12/2011 for Ali Byrne for the following area at Datum :GDA, Zone : 56, Eastings : 300711 - 309475, Northings : 6393640 - 6397287 with a Buffer of 0 meters.Additional Info : archaeological survey and assessment. Number of Aboriginal sites and Aboriginal objects found is 91

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Appendix 3 Site Types

Glossary of Site Types

The following is a brief description of most Aboriginal site types. Most of these do not occur in the immediate project area although are provided for regional context.

Artefact Scatters

Artefact scatters are defined by the presence of two or more stone artefacts in close association (i.e. within fifty metres of each other). An artefact scatter may consist solely of surface material exposed by erosion, or may contain sub-surface deposit of varying depth. Associated features may include hearths or stone-lined fireplaces, and heat treatment pits.

Artefact scatters may represent:

- camp sites: involving short or long-term habitation, manufacture and maintenance of stone or wooden tools, raw material management, tool storage and food preparation and consumption;
- hunting or gathering activities;
- activities spatially separated from camp sites (e.g. tool manufacture or maintenance); or
- transient movement through the landscape.

The detection of artefact scatters depends upon conditions of surface visibility, including vegetation cover, ground disturbance and recent sediment deposition. Unfavourable conditions obscure artefact scatters and prevent their detection during surface surveys.

Bora Grounds

Bora grounds are a ceremonial site associated with initiations. They are usually comprise two circular depressions in the earth, and may be edged with stone. Bora grounds generally occur on soft sediments in river valleys, although they may also be located on high, rocky ground in association with stone arrangements.

Burials

Human remains were often placed in hollow trees, caves or sand deposits and may have been marked by carved or scarred trees. Burials have been identified eroding out of sand deposits or creek banks, or when disturbed by development. The probability of detecting burials during archaeological fieldwork is extremely low.

Culturally Modified Trees

Culturally modified trees include scarred and carved trees. Scarred trees are caused by the removal of bark for use in manufacturing canoes, containers, shields or shelters. Notches were also carved in trees to permit easier climbing. Scarred trees are only likely to be present on mature trees remaining from original vegetation. Carved trees, the easiest to identify, are caused by the removal of bark to create a working surface on which engravings are incised. Carved trees were used as markers for ceremonial and symbolic purposes, including burials. Although, carved trees were relatively common in NSW in the early 20th century, vegetation removal has rendered this site type extremely rare. Modified trees, where bark was removed for often domestic use are less easily identified. Criteria for identifying modified trees include: the age of the tree; type of tree (the bark of many trees is not suitable, also introduced species would be unlikely subjects); axe marks (with the need to determine the type of axe - stone or steel – though Aborigines after

settlement did use steel); shape of the scar (natural or humanly scarred); height of the scar above the ground (reasonable working height with consideration given to subsequent growth).

Fish Traps

Fish traps comprised arrangements of stone, branches and/or wickerwork placed in watercourses, estuaries and along coasts to trap or permit the easier capture of sea-life.

Grinding Grooves

Grinding grooves are elongated narrow depressions in soft rocks (particularly sedimentary), generally associated with watercourses, that are created by the shaping and sharpening of ground-edge implements. To produce a sharp edge the axe blank (or re-worked axe) was honed on a natural stone surface near a source of water. The water was required for lubricating the grinding process. Axe grinding grooves can be identified by features such as a narrow short groove, with greatest depth near the groove centre. The grooves also display a patina developed through friction between stone surfaces. Generally a series of grooves are found as a result of the repetitive process.

Isolated Finds

Isolated finds occur where only one artefact is visible in a survey area. These finds are not found in apparent association with other evidence for prehistoric activity or occupation. Isolated finds occur anywhere and may represent loss, deliberate discard or abandonment of an artefact, or may be the remains of a dispersed artefact scatter. Numerous isolated finds have been recorded within the project area. An isolated find may flag the occurrence of other less visible artefacts in the vicinity or may indicate disturbance or relocation after the original discard.

Middens

Shell middens comprise deposits of shell remaining from consumption and are common in coastal regions and along watercourses. Middens vary in size, preservation and content, although they often contain artefacts made from stone, bone or shell, charcoal, and the remains of terrestrial or aquatic fauna that formed an additional component of Aboriginal diet. Middens can provide significant information on land-use patterns, diet, chronology of occupation and environmental conditions.

Mounds

Aboriginal mounds are places where people lived and reflect a record of that living space. Mounds may be places where Aboriginal people lived over long periods of time. Mounds often contain charcoal, burnt clay or stone heat retainers from cooking ovens, animal bones, shells, stone tools and occasionally Aboriginal burials.

Mythological / Traditional Sites

Mythological and traditional sites of significance to Aboriginal people may occur in any location, although they are often associated with natural landscape features. They include sites associated with dreaming stories, massacre sites, traditional camp sites and contact sites. Consultation with the local Aboriginal community is essential for identifying these sites.

Rock Shelters with Art and / or Occupation Deposit

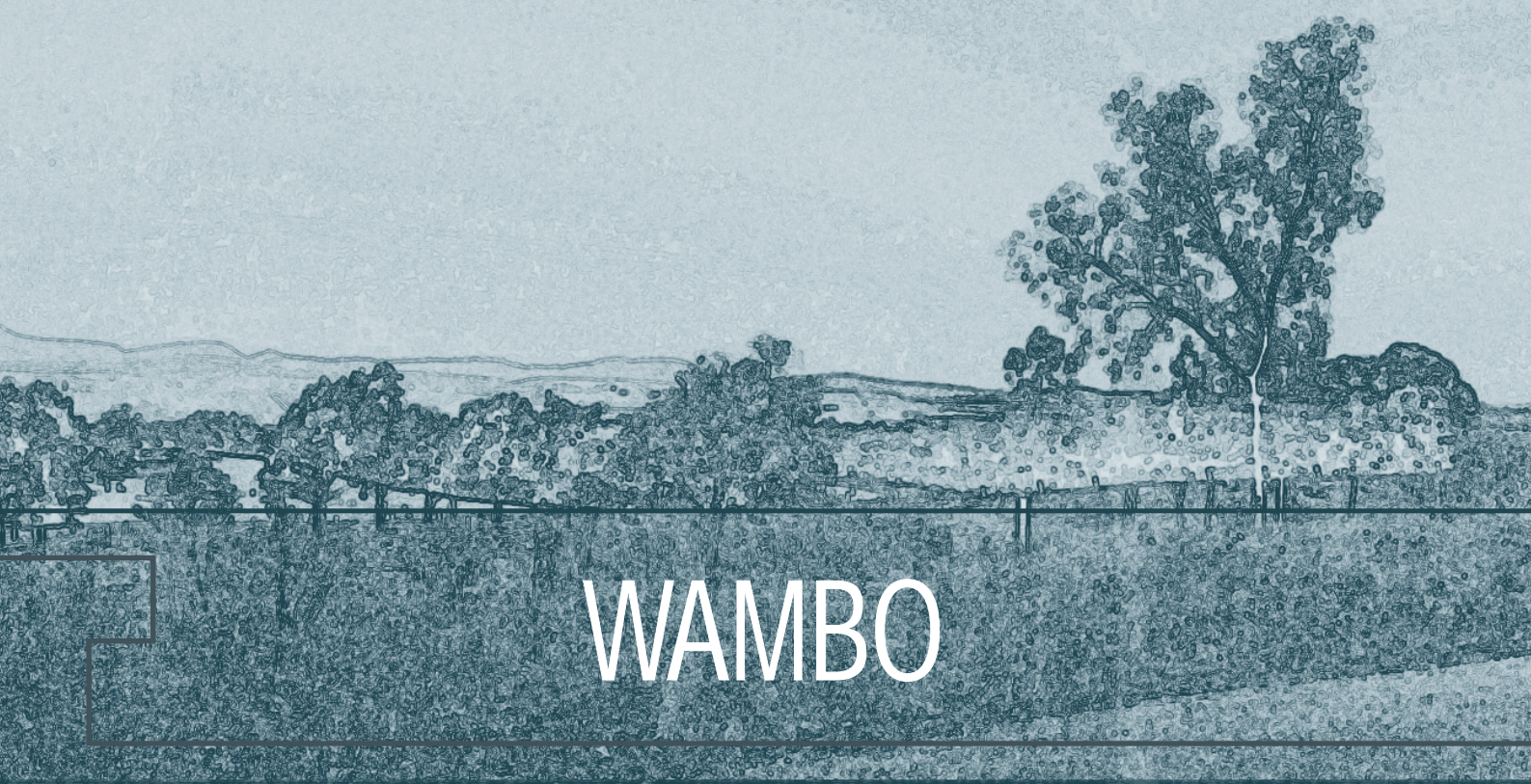
Rock shelters occur where geological formations suitable for habitation or use are present, such as rock overhangs, shelters or caves. Rock shelter sites generally contain artefacts, food remains and/or rock art and may include sites with areas of potential archaeological deposit, where evidence of rock-art or human occupation is expected but not visible. The geological composition of the project area greatly increases the likelihood for rock shelters to occur.

Stone Arrangements

Stone arrangements include lines, circles, mounds, or other patterns of stone arranged by Aboriginal people. These may be associated with bora grounds, ceremonial sites, mythological or sacred sites. Stone arrangements are more likely to occur on hill tops and ridge crests that contain stone outcrops or surface stone, where impact from recent land use practices has been minimal.

Stone Quarries

A stone quarry is a place at which stone resource exploitation has occurred. Quarry sites are only located where the exposed stone material is suitable for use either for ceremonial purposes (e.g. ochre) or for artefact manufacture.



WAMBO

MONTROSE WATER STORAGE MODIFICATION
ENVIRONMENTAL ASSESSMENT

APPENDIX B
FLORA ASSESSMENT



FLORASEARCH

**Montrose Water Storage Modification -
Flora Assessment**

**Prepared for Wambo Coal Pty Limited
by FloraSearch**

June 2012

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	ES-1
1 INTRODUCTION	1
1.1 SURVEY AND ASSESSMENT OBJECTIVES	1
1.2 DESCRIPTION OF THE PROJECT AREA AND SURROUNDS	1
1.2.1 Topography and Drainage	1
1.2.2 Geology, Geomorphology and Soils	1
1.2.3 Climate	2
1.2.4 Land Use	2
1.3 BOTANICAL/BIOGEOGRAPHIC REGIONS	2
1.4 PREVIOUS VEGETATION STUDIES	2
2 THREATENED SPECIES, POPULATIONS, ECOLOGICAL COMMUNITIES AND CRITICAL HABITAT	3
2.1 THREATENED FLORA SPECIES	3
2.2 THREATENED POPULATIONS	3
2.3 THREATENED ECOLOGICAL COMMUNITIES	3
2.4 CRITICAL HABITAT	4
3 METHODS	9
3.1 VEGETATION SAMPLING	9
3.1.1 Quadrat Sampling	9
3.1.2 Spot Sampling	9
3.1.3 Random Meanders	10
3.2 VEGETATION MAPPING	10
3.3 SPECIES LISTING	10
3.3.1 Rare or Threatened Australian Plants (ROTAP)	10
3.3.2 Regionally Significant Flora	10
4 RESULTS AND DISCUSSION	11
4.1 VEGETATION COMMUNITIES	11
4.2 FLORA SPECIES	13
4.3 INTRODUCED SPECIES AND WEEDS	14
4.4 THREATENED FLORA SPECIES	14
4.5 REGIONALLY SIGNIFICANT FLORA	14
4.6 THREATENED POPULATIONS	14
4.7 THREATENED PLANT COMMUNITIES	15
4.8 CONDITION OF THE VEGETATION	15
5 FLORA IMPACT ASSESSMENT	16
5.1 POTENTIAL IMPACTS OF PROJECT SURFACE ACTIVITIES ON FLORA	16
5.2 THREATENED FLORA	16
5.3 THREATENED ECOLOGICAL COMMUNITIES	17
5.4 ENDANGERED POPULATIONS	19
5.5 THREATENED FLORA SPECIES	22
5.5.1 Threatened Species Assessment	22

5.6	OVERALL CONCLUSION OF THE FLORA ASSESSMENT	28
6	REFERENCES	29

LIST OF TABLES

Table 1	Threatened Plant Species Targeted During Flora Surveys
Table 2	Threatened Plant Populations Targeted During Flora Surveys
Table 3	Potential Threatened Plant Communities on the Project Area
Table 4	Modified Braun-Blanquet Cover Abundance Rating Scale
Table 5	Vegetation Communities Identified within the Project Area
Table 6	Numbers and Percentages of Native and Introduced Vascular Plant Species Identified in the Broader Distribution of the Vegetation Communities that Occur within the Project Area
Table 7	Study Area Plant Species Listed as Rare or Uncommon in the Hunter Rare Plants Database
Table 8	Threatened Flora Species Considered in this Assessment

LIST OF FIGURES

Figure 1	Project Location
Figure 2	Flora Sampling Locations in the Wider Survey Area
Figure 3	Vegetation Communities in the Project Area and Surrounds

LIST OF APPENDICES

Appendix A	Figures
Appendix B	Flora Species List for the Broader Distribution of the Vegetation Communities that Occur in the Project Area

EXECUTIVE SUMMARY

Flora Survey Findings

Flora Communities and Species

- The Project area and surrounds was found to support small remnants of three vegetation communities comprising Central Hunter Box – Ironbark Woodland, Narrabeen Foothills Slaty Box Woodland and Secondary Native Grassland.
- A total of 264 plant species were identified in the broader distribution of the three communities that occur on or near the Project area. Of these, 233 (88.3%) are native to the natural communities of the study area and 31 (11.7%) are introduced.
- The plant families with the highest numbers of species were the Grasses, Poaceae (57 species); Daisies, Asteraceae (25 species); the saltbushes and bluebushes, Chenopodiaceae (14 taxa); the Pea Flowers, subfamily Faboideae (13 species); the Wattles, subfamily Mimosoideae (9 species) and the Eucalypts and related genera in the family Myrtaceae (8 species). In all, some 68 plant families or sub-families were represented.
- The highest proportions of introduced species and weeds were in the cleared pasture areas.

Condition of the Vegetation

- The native vegetation within the Project area is in poor condition relative to the original native vegetation that would have occurred there. The whole area has been highly disturbed historically by clearing, logging and grazing. However, the relatively poor soils have restricted invasion by introduced species.

Threatened Species

- No flora species listed in the schedules of the New South Wales *Threatened Species Conservation Act, 1995* or the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* were found in the targeted searches conducted over the study area.

Threatened Vegetation Communities

- Two threatened ecological communities, listed in the schedules of the *Threatened Species Conservation Act, 1995* occur on or adjacent to the disturbance area, viz.:
 - *Central Hunter Grey Box – Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions Endangered Ecological Community*; and
 - *Hunter Valley Foothills Slaty Box Woodland in the Sydney Basin Bioregion Vulnerable Ecological Community*.

Conclusions of Assessment

Potential Impacts of the Project on Flora

- Some 1.8 ha of Central Hunter Grey Box – Ironbark Woodland and 0.8 ha of Hunter Valley Foothills Slaty Box Woodland would be cleared for the Project.

Assessment of Significance

- A Seven Part Test of Significance was conducted to assess the potential impacts of the Project on Central Hunter Grey Box – Ironbark Woodland. The main impact of the Project is the clearing of 1.8 ha the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* Endangered Ecological Community.
- Seven Part Tests of Significance were also conducted to assess the potential impacts of the Project on one endangered flora population and seven threatened flora species that may potentially occur on the Project area, but were not found by flora surveys of the broader study area. The assessment found that the Project is unlikely to have a significant impact on the *Cymbidium canaliculatum R. Br. in the Hunter Catchment endangered population*, or on the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta*.

1 INTRODUCTION

FloraSearch was commissioned by Wambo Coal Pty Limited (WCPL) to conduct a flora assessment for the construction of a new water storage dam (the Project), located approximately 15 kilometres (km) west of Singleton and 80 km north-west of Newcastle in the Hunter Valley, New South Wales (NSW) (Figure 1 in Appendix A).

A detailed description of the Project is provided in Section 3 of the Environmental Assessment.

1.1 SURVEY AND ASSESSMENT OBJECTIVES

The objectives of the survey and assessment were to:

- develop a list of threatened plant species, populations, ecological communities or critical habitat, listed in the schedules of the NSW *Threatened Species Conservation Act, 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act), those considered to be Rare or Threatened Australian Plants (ROTAP) by Briggs and Leigh (1996), that could potentially occur in the Project area;
- undertake detailed analysis of the potential impacts of the proposed project on flora and their habitats;
- discuss avoidance and mitigation measures to minimise impacts on threatened flora; and
- using existing survey data, assess the impact of the Project on threatened flora by consideration of the seven factors of assessment in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (NSW Department of Environment and Climate Change [DECC], 2007).

1.2 DESCRIPTION OF THE PROJECT AREA AND SURROUNDS

1.2.1 Topography and Drainage

The Project area lies on land owned by WCPL to the south of North Wambo Creek on the lower slopes of the foothills north of the Wollemi National Park escarpment (Figure 2 in Appendix A). The aspect of the Project area is north north-east and altitudes range from 65 metres (m) Australian Height Datum (AHD) to approximately 105 m AHD.

1.2.2 Geology, Geomorphology and Soils

The Project area is situated within the Late Permian age coal measures of the Singleton Supergroup which, in addition to coal, comprise mainly shale, sandstone, siltstone, mudstone and conglomerate. The Project area lies within the Bulga Soil Landscape (Kovac and Lawrie, 1991), which occurs on gently undulating terrain and is formed in colluvial material derived from the steep slopes of the adjoining Lees Pinch Soil Landscape. The underlying geological unit is the Singleton Coal Measures with overlying colluvium from Narrabeen Sandstone. It comprises sandstone, conglomerate, red and green claystone, shale, mudstone and coal. The soils, formed from weathered parent rock and derived colluvium, include soloths on upper slopes, solodic soils on mid slopes and brown earths on lower slopes.

1.2.3 Climate

Annual rainfall averages only 640 millimetres (mm) at Jerrys Plains, to the north-west of the Project area (www.bom.gov.au/climate). While significant rain may occur at any time of the year, on average it is summer dominant, with January being the highest rainfall month, similar to the north-west slopes. The total annual rainfall at Wambo between 2006-2007 and 2009-2010 has ranged between 564 and 787 mm. Evaporation is of the order of 1,600 mm per annum, or 2.5 times the annual rainfall, indicating a moderate degree of water stress in Australian terms. Relative humidities are comparatively high and do not vary greatly through the year reflecting the near coastal location of the Project area. In January the 9.00 am and 3.00 pm relative humidities average 67 and 47 percent (%), respectively, while the comparable figures for July are 78 and 50% (www.bom.gov.au/climate).

Summers are warm to hot with mean daily maximum temperatures of 31.7 degrees Celsius (°C) in January, the hottest month. July is the coldest month with a mean minimum temperature of 3.7°C. Frosts are common in winter; with July having an average lowest minimum temperature -4.5°C and an average of 5.2 days per annum with minimums below 0°C.

1.2.4 Land Use

The early 1820s saw widespread settlement of the area around Singleton following the awarding of land grants to free settlers, soldiers and freed convicts. The clearing of the Project area for farming would date from this time. A great variety of crops was grown in the Hunter in the 1800s, including wine grapes, which date from 1823 and continue to be a major industry. Currently, the main agricultural industry around the Project area is beef cattle production. Coal mining around Singleton began in the 1870s and is now the major local industry.

1.3 BOTANICAL/BIOGEOGRAPHIC REGIONS

The Project area lies in the north of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995) and in the south west corner of the North Coast Botanical Division (Anderson, 1968; Harden, 2002). It is close to the southern boundary of the Brigalow Belt South Bioregion (Thackway and Cresswell, 1995) and just outside the eastern boundary of the Central Western Slopes Botanical Division (Anderson, 1968; Harden, 2002). The Project area lies just within the North Coast Botanical Division close to the junction of the North and Central Coast Botanical Divisions. Botanically therefore, the Project area can be expected to comprise a mix of Central Western Slopes, Central Coast and North Coast plants.

1.4 PREVIOUS VEGETATION STUDIES

The vegetation of the Central Hunter Valley, including the study area, has been surveyed, classified and mapped as part of the Central Hunter Remnant Vegetation Project of the Hunter – Central Rivers Catchment Authority (Peake, 2006). A large number of more localised studies have been conducted for environmental assessment purposes in the coal mining industry, including Orchid Research (2003) which included the Project area. The classification of Peake (2006) has been adopted for this study.

2 THREATENED SPECIES, POPULATIONS, ECOLOGICAL COMMUNITIES AND CRITICAL HABITAT

Lists of threatened species, populations, ecological communities and critical habitat that are known, or have potential to occur in the Project area were derived by consulting the following sources. Database searches were conducted within a 20 × 20 km square centred on the Project area. The databases were accessed in April 2012.

- BioNet website incorporating searches of the databases of the Atlas of NSW Wildlife, the Royal Botanic Gardens and Domain Trust Sydney (RBGDS), Forests NSW and the Australian Museum.
- Protected Matters Search Tool (Commonwealth Department of Sustainability, Environment, Water, Population and Communities).
- Schedules of the TSC Act and the EPBC Act.
- Preliminary and Final Determinations of the NSW Scientific Committee.

2.1 THREATENED FLORA SPECIES

Table 1 shows threatened plant species listed in the schedules of the TSC Act and the EPBC Act that are considered possible occurrences within the Project area or surrounds. These species were specifically targeted during the surveys conducted for this study.

Of the threatened species selected for targeted searches, one is a climber, six are shrubs or trees, four are herbs and one is a grass (Table 1). The presence of the trees, shrubs and climber can be detected at any time of the year and in any seasonal conditions, although identification is usually easier when flowering or fruiting material is present. However, detection of the herbs and grass depend on flowering time and seasonal conditions.

2.2 THREATENED POPULATIONS

Twenty-four endangered populations are currently (April 2012) listed in Schedule 1 of the TSC Act. Three of the populations may potentially occur on the Project area, viz.

- *Acacia pendula* population in the Hunter Catchment;
- *Eucalyptus camaldulensis* population in the Hunter Catchment; and
- *Cymbidium canaliculatum* population in the Hunter Catchment.

Table 2 discusses the likelihood of these three populations being represented in the Project area or surrounds. These populations were specifically targeted during the surveys on which this study is based.

2.3 THREATENED ECOLOGICAL COMMUNITIES

Seven Endangered Ecological Communities (EECs) listed in the schedules of the TSC Act are considered possible occurrences within the Project area, viz.

- *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions;*
- *Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions;*

- *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions;*
- *Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions;*
- *Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion.* This community is also listed under the EPBC Act as the *Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley Critically Endangered Ecological Community;*
- *Warkworth Sands Woodland in the Sydney Basin Bioregion;* and
- *White Box – Yellow Box – Blakely’s Red Gum Woodland.* This community is also listed under the EPBC Act as the *White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Grassland Critically Endangered Ecological Community.*

One Vulnerable Ecological Community (VEC) listed in the schedules of the TSC Act is considered a possible occurrence within the Project area, viz.

- *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion*

Table 3 summarises the known distributions and characteristics of each of the above EECs and VEC with an assessment of their likelihood of occurring on the Project area.

2.4 CRITICAL HABITAT

No Critical Habitat for flora has been declared on or near the Project area under the TSC Act or the EPBC Act.

Table 1
Threatened Plant Species Targeted During Flora Surveys

Family Name	Scientific Name	Conservation Status		Likelihood of Occurrence	Comment
		TSC Act ¹	EPBC Act ²		
Araucariaceae	<i>Wollemia nobilis</i>	E	E	Nil	A pine-like tree that grows to 40 m tall, often multi-stemmed at the base. The bark is thin and fragile and in older trees becomes densely covered with soft and spongy nodules. The side branches terminate in a male or female cone (Department of Environment and Conservation [DEC], 2005a).
Apocynaceae	<i>Cynanchum elegans</i>	E	E	Low	Small slender climber, twining stems to 1m, opposite broad acute leaves, milky sap, oval 6 to 10 centimetres (cm) long seed pod, seeds with silky hairs. Mainly rainforest, but also woodland, coast to escarpment. Wollongong to Qld border (DEC, 2005b).
Asteraceae	<i>Olearia cordata</i>	V	V	Nil	Shrub to 2 m; alternate, narrow-lanceolate, finely mucronate, entire, sessile leaves with revolute margins and glandular concolorous surfaces; flower heads terminal, solitary with purple ray florets. Dry sclerophyll forest and woodland on sandstone. Wiseman's Ferry to Wollombi (DEC, 2005c).
Fabaceae	<i>Dillwynia tenuifolia</i>	V	-	Low	Shrub to 1 m; stems hairy; linear leaves to 12 mm with recurved acuminate apex; yellow and red 'egg and bacon' flowers axillary or terminal, usually solitary; pod 4 to 5 mm long, seeds reticulate. Dry sclerophyll woodland on sandstone, shale or laterite. Cumberland Plain and Blue Mountains to Howes Valley (DEC, 2005d).
Myrtaceae	<i>Eucalyptus glaucina</i>	V	V	Medium	Tree to 30 m, red gum bark, juvenile leaves ovate, glaucous; adult leaves lanceolate to 18 x 3 cm, green or grey-green, concolorous; umbellasters 7-flowered, buds glaucous; fruit ovoid to globose, to 10x10 mm, disc raised, valves exserted. On deep, fertile soils. Taree to Broke, Casino (DEC, 2005e).
	<i>Melaleuca groveana</i>	V	-	Nil	Small tree to 5 m or more; bark fibrous and papery. Leaves narrow-elliptic, to 55 x 8 mm, acute, apiculate, glabrous; spikes to 30 mm with few to many white flowers; fruit 4 to 7 mm diameter, barrel-shaped, sepals non-persistent. Heath on rocky outcrops in higher areas. Port Stephens to Queensland (DEC, 2005f).
Orchidaceae	<i>Prasophyllum</i> sp. Wybong	-	CE	Low	A terrestrial orchid that grows to approximately 30 cm high. It has a single, tubular, fleshy, dull-green leaf and a single flower spike with numerous fragrant flowers (Commonwealth Department of Sustainability, Environment, Water, Populations and Communities [SEWPaC], 2009). Grows in Woodlands on good soils.
	<i>Pterostylis gibbosa</i>	E	E	Low	Herb to 45 cm high. Greenhood of the 'rufa' group. Prostrate rosette of 4 to 7 elliptic to ovate basal leaves to 11 x 25 mm, margins entire; flowers 2 to 7, bright green, shiny, semi-erect, labellum broad oblong-obovate, brownish-black, deeply grooved. In grassy sclerophyll forest. Wollongong to Nowra and disjunct populations near Milbrodale and Weston in the Hunter Valley (DEC, 2005g).
Poaceae	<i>Digitaria porrecta</i>	E	E	Nil	A loosely tufted grass growing to 60 cm tall with grey leaves 2 - 3 mm wide and sharp hairs along the middle. The flowers are clustered in long spikes that spread stiffly from the flowering stem, with the lower spikes arranged in a whorl of four to six, each up to 30 cm long (DEC, 2005h).

Table 1 (Continued)
Threatened Plant Species Targeted During Flora Surveys

Family Name	Scientific Name	Conservation Status		Likelihood of Occurrence	Comment
		TSC Act ¹	EPBC Act ²		
Rhamnaceae	<i>Pomaderris brunnea</i>	V	V	Nil	A shrub to 3 m tall with hairy stems, comprising a layer of long brownish hairs above a thick white hairy under-coat. The leaves are up to 4 cm long and 1.5 cm wide with the leaf veins extending to the toothed margins. The upper leaf surface is hairless; the lower surface is densely hairy like the stem. The small, yellowish flowers have no petals and form dense clusters at the ends of the branches (DEC, 2005i). Watercourses and alluvial soils.
Santalaceae	<i>Thesium australe</i>	V	V	Low	A small, straggling herb to 40 cm tall with pale green to yellow-green, somewhat succulent leaves, 1 - 4 cm long and 0.5 - 1.5 mm wide. Flowers are minute, white and emerge from the leaf axils. The fruit is small and nut-like (DEC, 2005j). Grows in <i>Themeda australis</i> grasslands.
Scrophulariaceae	<i>Euphrasia arguta</i>	CE	CE	Low	An erect, semi-parasitic annual herb growing up to 45 cm high. The branches are very hairy with recurved stiff, non-glandular hairs. The plant has 18–30 pairs of sessile, opposite, toothed leaves along the stem. The white to pinkish-lilac flowers are numerous in racemes that contain a number of flowers on lateral stalks with the oldest at the base and the youngest at the top (SEWPaC, 2011).

¹ NSW *Threatened Species Conservation Act, 1995.*

² Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999.*

E Endangered.

CE Critically Endangered

V Vulnerable.

Table 2
Threatened Plant Populations Targeted During Flora Surveys

Family Name	Scientific Name	Conservation Status		Likelihood of Occurrence	Comment
		TSC Act ¹	EPBC Act ²		
Mimosoideae	<i>Acacia pendula</i>	E	-	High	<i>A. pendula</i> (Weeping Myall) is a small tree to 13 m high that is widespread in inland NSW. It occurs as a disjunct population in the central and upper Hunter Valley on six known sites, including two close to the Project area; Jerrys Plains cemetery and east of the Project area on WCPL owned land. The total population in the Hunter Valley is estimated at less than 1,000 (DEC 2005k). Potential habitat occurs within the Project area.
Myrtaceae	<i>Eucalyptus camaldulensis</i>	E	-	Nil	Occurs as a disjunct population on the major floodplains of the Hunter River and large tributaries, including Wollombi Brook and the Goulburn River. It is estimated that only 600 to 1,000 mature or semi-mature trees remain (DEC, 2005l). No major floodplains occur within the Project area.
Orchidaceae	<i>Cymbidium canaliculatum</i>	E	-	High	<i>C. canaliculatum</i> (Tiger Orchid) is a large epiphytic orchid that grows in the forks of branches of overmature trees with rotting core wood, mainly eucalypts, but also <i>Angophora floribunda</i> (Rough-barked Apple) and <i>Acacia salicina</i> (Cooba). A small population (as few as 90 plants) in the Hunter Valley is at the south eastern extremity of the species' range (DEC, 2006). Suitable hosts and habitat occur within the Project area.

¹ NSW *Threatened Species Conservation Act, 1995.*

² Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999.*

E Endangered.

Table 3
Potential Threatened Plant Communities on the Project Area

EECs	Conservation Status		Dominant Species	Known Distribution	Potential Habitats	Likelihood of Occurrence
	TSC Act ¹	EPBC Act ²				
Central Hunter Grey Box - Ironbark Woodland	E	-	<i>Eucalyptus crebra</i> – <i>Brachychiton populneus</i> – <i>E. moluccana</i>	Singleton to Muswellbrook area of the Central Hunter Valley.	Gently undulating hills, slopes and valleys, occasionally on rocky knolls, Permian lithology (NSW Department of Environment, Climate Change and Water [DECCW], 2010a).	High
Central Hunter Ironbark - Spotted Gum - Grey Box Forest	E	-	<i>E. crebra</i> – <i>Corymbia maculata</i> – <i>E. moluccana</i>	Mainly Maitland to Muswellbrook in the central Hunter Valley.	Undulating terrain on low rises and slopes. Permian clays and colluvium and alluvium in valleys (DECCW, 2010b).	High
Hunter Floodplain Red Gum Woodland	E	-	<i>E. camaldulensis</i> – <i>E. tereticornis</i> – <i>E. melliodora</i> – <i>Angophora floribunda</i>	Hunter Valley including Local Government Areas (LGAs) of Maitland, Mid-Western, Muswellbrook, Singleton, and Upper Hunter.	Major floodplains and floodplain rises (DECCW 2010c). No major floodplains occur on the Project area.	Nil
Hunter Lowland Redgum Forest	E	-	<i>E. tereticornis</i> – <i>E. punctata</i> ± <i>E. moluccana</i> , <i>Angophora costata</i> , <i>C. maculata</i> or <i>E. crebra</i>	Hunter Valley LGAs of Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton.	Gently sloping depressions and drainage flats of the Hunter Valley floor (DEC, 2005m).	Nil
Hunter Valley Weeping Myall Woodland	E	CE	<i>Acacia pendula</i> – <i>E. crebra</i> – <i>Acacia salicina</i>	Singleton and Muswellbrook LGAs in the central Hunter Valley.	Occurs on heavy Permian clay soils (DEC 2005n). There are two known occurrences close to the Project area; Jerrys Plains cemetery and east of the Project area on WCPL owned land.	Medium
Warkworth Sands Woodland	E	-	<i>Angophora floribunda</i> – <i>Banksia integrifolia</i>	Limited to the Warkworth area in the Singleton LGA of the central Hunter Valley.	Restricted to aeolian sand deposits along Wollombi Brook, north and south of Warkworth (NSW National Parks and Wildlife Service [NPWS] 2002a). Although the known occurrences of this community are relatively close (9 km) to the Project area, suitable soil types are absent from it.	Nil
White Box - Yellow Box - Blakely's Red Gum Woodland	E	CE	<i>E. albens</i> - <i>E. melliodora</i> – <i>E. blakelyi</i>	Tablelands and western slopes of New South Wales and the upper Hunter Valley.	Deep fertile soils on undulating terrain (DEC, 2005o). Occurs on the footslopes of the Narrabeen Sandstone escarpments of the upper Hunter Valley. Not considered to have potential to occur on the study area by the NSW BioNet database, but was returned by the EPBC Act Protected Matters search.	Nil
Hunter Valley Footslopes Slaty Gum Woodland	V	-	<i>E. dwyeri</i> – <i>E. moluccana</i> ± <i>A. salicina</i> , <i>Allocasuarina luehmannii</i>	South side of the Hunter Valley from Bulga to the Bylong / Goulburn River National Park area in the Singleton, Muswellbrook and Upper Hunter LGAs.	Occurs mainly on colluvium derived from Triassic sandstones and conglomerates over Permian lithology (DECCW 2010d). Suitable environments occur in the Project area.	High

¹ NSW *Threatened Species Conservation Act, 1995*.

² Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*.

E Endangered.

CE Critically Endangered.

V Vulnerable.

3 METHODS

The native vegetation of the Project area was classified and mapped as part of a survey of the western parts of WCPL-owned land carried out over 14 days in the periods 19 to 27 January, 16 to 19 February and 7 to 8 July, 2010.

3.1 VEGETATION SAMPLING

Three methods of documenting the vegetation on WCPL owned land were employed; quadrat sampling, spot sampling and random meanders.

3.1.1 Quadrat Sampling

A total of twenty-five 20 × 20 m (0.04 hectare [ha]) flora quadrat sites were sampled over the survey area, five of which were between North Wambo Creek and the escarpment, close to the Project area (Figure 2 in Appendix A). Within each plot the dominant species in each vegetation stratum were recorded, with an estimate of the percentage of the ground surface covered by their canopies. A list of all vascular plant species present within the quadrat was also made with each being assigned a cover abundance rating using a modified Braun-Blanquet scale (Table 4). Details recorded for each site included its Global Positioning System (GPS) position, landform, physiography, soil characteristics, disturbance, vegetation structural formation and general comments. Plots were stratified across all vegetation communities in proportion to their representation on the wider survey area.

Table 4
Modified Braun-Blanquet Cover Abundance Rating Scale

Rating	Percent Ground Cover
1	<1
2	1 to 5
3	6 to 25
4	26 to 50
5	51 to 75
6	76 to 100

3.1.2 Spot Sampling

In addition to the quadrat samples, and in order to comprehensively list the flora over the survey area, 31 spot samples were conducted, two of which are close to the Project area (Figure 2 in Appendix A). Spot samples listed all vascular plants within a 15 m radius of the central point at which a GPS reading was taken. The dominant tree species were noted to allow classification of the site according to community. Brief notes were taken on site characteristics, the condition of the vegetation and any disturbance. Samples were stratified across communities in proportion to their representation in the wider survey area and surrounds.

3.1.3 Random Meanders

Random meanders were used to search for threatened flora species and populations (DEC, 2004). The random meanders in this survey were targeted to the known habitats described in fact sheets and profiles of threatened species published on the websites of the NSW Office of Environment and Heritage (OEH) and the Commonwealth SEWPaC, as well as on the website of the Royal Botanic Gardens and Domain Trust Sydney. The species and populations targeted are given in Tables 1 and 2. Eight random meanders were conducted in the larger survey area by a team of two people walking approximately 10 m apart through blocks of bushland. One meander was conducted in the bushland south west of the proposed dam.

3.2 VEGETATION MAPPING

The distribution of each vegetation community was mapped onto high resolution colour aerial photographs of the Project area during field surveys. Some communities, for example Paperbark Soak Woodlands, which intergrade with other communities, could only be reliably mapped by walking the community perimeter and recording the track in a hand held GPS unit.

3.3 SPECIES LISTING

All observed plant species were recorded, whether identified on formal sample sites or not. Some less common plants were only observed on one occasion whilst moving between sample sites. Where plants could not be quickly identified in the field, a sample was taken for later examination. Samples were preserved in a plant press and identified later using a binocular microscope and flora keys. The principal reference was the *Flora of New South Wales* (Ed. G. Harden 1990-2002), and it is used as the basis for nomenclature in this report along with any updates on the PlantNet web site of the RBGDS. Any specimens that could not be conclusively identified were sent to the RBGDS for specialist diagnosis.

3.3.1 Rare or Threatened Australian Plants (ROTAP)

All plants found in the surveys were checked for their status in the ROTAP (Briggs and Leigh, 1996) classification.

3.3.2 Regionally Significant Flora

The Rare Plants Committee of the Hunter Region Botanic Gardens has compiled a Preliminary List of Regionally Significant Plants (Bell *et al.*, in prep), comprising 1,217 species. The status of most species on the list is yet to be finally determined. All species found in the surveys of the Project area and surrounds were checked for their presence on the list and this data is presented in the results.

4 RESULTS AND DISCUSSION

4.1 VEGETATION COMMUNITIES

The survey revealed the presence of three vegetation communities on the Project area (Table 5). These three communities are discussed further below. The distribution of each community located in and around the Project area is shown on Figure 3 (Appendix A). Other vegetation communities were identified outside of the proposed Project area and are shown on Figure 3 but are not discussed further below.

Table 5
Vegetation Communities Identified within the Project Area

Community Number (this report)	Community Number (Peake 2006)	Common Names	Scientific Names
1	MU10	Central Hunter Box – Ironbark Woodland	<i>E. crebra</i> – <i>E. moluccana</i> – <i>Allocasuarina luehmannii</i>
2	MU7	Hunter Valley Foothills Slaty Box Woodland	<i>E. dawsonii</i> – <i>E. moluccana</i> – <i>Acacia salicina</i>
3	NA ¹	Secondary Native Grassland	<i>Panicum effusum</i> – <i>Sporobolus creber</i> – <i>Bothriochloa decipiens</i>

¹ Not mapped by Peake (2006)

The following sections provide descriptions of each plant community within the Project area.

Community 1. Central Hunter Box – Ironbark Woodland

Community 1 is dominated by Narrow-leaved Ironbark, *Eucalyptus crebra*, and Buloke, *Allocasuarina luehmannii*. Some Grey Box, *Eucalyptus moluccana*, and Black Cypress Pine, *Callitris endlicheri*, may also be present. The shrub layer is often sparse on drier sites, but can be quite dense, especially after bushfires (Orchid Research, 2003). The shrub layer is frequently dominated by Kangaroo Thorn, *Bursaria spinosa*, Wedge-leaf Hop-bush, *Dodonaea viscosa* subsp. *cuneata* and Native Olive, *Notelaea microcarpa* var. *microcarpa*. A wide variety of other shrubs may occur including several wattle species; Fan Wattle, *Acacia amblygona*; Coast Myall, *Acacia binervia*; Hickory, *Acacia implexa*; Sickie Wattle, *Acacia falcata* and Cooba, *Acacia salicina*; Gorse Bitter-pea, *Daviesia ulicifolia*; Eastern Cotton Bush, *Maireana microphylla*; Fishweed, *Einadia trigonos* subsp. *stellulata*; a Grevillea, *Grevillea montana*; Sticky Daisy-bush, *Olearia elliptica*; a Bertya, *Bertya oleifolia*; a Pimelea, *Pimelea curviflora* var. *divergens*; Cunningham's Everlasting, *Cassinia cunninghamii*; Cough Bush, *Cassinia quinquefaria* and Bead Bush, *Spartothamnella juncea*.

Common grasses and herbs include; Blue Flax Lily, *Dianella revoluta*, Many-flowered Matrush; *Lomandra multiflora*, Wattle Matrush, *Lomandra filiformis* subsp. *filiformis*; Wire Lily, *Laxmannia gracilis*; a Fuzzweed, *Vittadinia sulcata*; Slender Tick-trefoil, *D. gunnii*; Large Tick-trefoil, *Desmodium brachypodium*; two Glycines, *Glycine clandestina* and *G. tabacina*; Purple Burr-daisy, *Calotis cuneifolia*; Yellow Burr-daisy, *Calotis lappulacea*; Trailing Speedwell, *Veronica plebeia*; Blue Trumpet, *Brunoniella australis*; a Goodenia, *Goodenia rotundifolia*; Slender Plantain, *Plantago debilis*; Kidney Weed, *Dichondra repens*; Bristly Cloak Fern, *Cheilanthes distans*; Flannel Weed, *Abutilon oxycarpum*; Spiked Sida, *Sida subspicata*; Corrugated Sida, *Sida corrugata*; Common Saw Sedge, *Gahnia aspera*; Slender Flat-sedge, *Cyperus gracilis*; Weeping Grass, *Microlaena stipoides*; Tall Windmill Grass, *Chloris ventricosa*; Clustered Lovegrass, *Eragrostis elongata*; Barbwire Grass, *Cymbopogon refractus*; a Paspalum, *Paspalum criniforme*; Wiry Panic, *Entolasia stricta*; Two-colour Panic, *Panicum simile*; Purple Wiregrass, *Aristida personata* and Threeawn Speargrass, *Aristida vagans*.

Weeds are relatively few and include Prickly Pear, *Opuntia stricta*; Tiger Pear *O. aurantiaca*; Cotton Bush, *Gomphocarpus fruticosus*; Fireweed, *Senecio madagascariensis*; Flatweed, *Hypochaeris radicata* and Cobbler's Peg, *Bidens pilosa*.

Community 2 Narrabeen Foothills Slaty Box Woodland

Narrabeen Foothills Slaty Box Woodland is dominated by Slaty Box, *Eucalyptus dawsonii*, a tall straight tree that may form extensive monospecific stands, although usually has Narrow-leaved Ironbark, *Eucalyptus crebra*, as a less common associate. Buloke, *Allocasuarina luehmannii* and Cooba, *Acacia salicina*, occur commonly, but sparsely, as low trees, while Coast Myall, *Acacia binervia*, is a common tall shrub.

Other tree species associated less frequently with this community than the two dominants are Coast Grey Box, *Eucalyptus moluccana*; Grey Gum, *Eucalyptus punctata* and Kurrajong, *Brachychiton populneus*. Low trees and tall shrubs were relatively few and sparsely distributed, except in some low gullies and steep slopes where thickets may occur, and included Black Cypress Pine, *Callitris endlicheri* (sometimes in dense stands on ridges); occasional Drooping Sheoak, *Allocasuarina verticillata*; Brush Wilga, *Geijera salicifolia* and Hairy Clerodendrum, *Clerodendrum tomentosum*, and more commonly Native Olive, *Notelaea microcarpa* var. *microcarpa*. Community 2 often has dense stands of medium height shrubs (1 to 3 m approximately) comprising various combinations of Blackthorn, *Bursaria spinosa*; a Bertya, *Bertya oleifolia*; Coffee Bush, *Breynia oblongifolia*; White Sour Bush, *Choretrum candollei*; a Hop-bush, *Dodonaea triangularis* and Wedge-leaf Hop-bush, *Dodonaea viscosa* subsp. *cuneata*.

Low shrubs are also common and diverse, including Sticky Daisy-bush, *Olearia elliptica*; Cunningham's Everlasting, *Cassinia cunninghamii*; Australian Indigo, *Indigofera australis*; Fan Wattle, *Acacia amblygona*; Bead Bush, *Spartothamnella juncea*; Straggly Lantern-bush, *Abutilon oxycarpum*; Tubular Lantern-bush, *Oxycarpum tubulosum*; Hill Hibiscus, *Hibiscus sturtii* var. *sturtii*; Amulla, *Eremophila debilis*, a Grevillea, *Grevillea montana*; Small-leaf Wax-flower, *Eriostemon difformis* subsp. *smithiana*; Violet Nightshade, *Solanum brownii* and Curved Rice-flower, *Pimelea curviflora* var. *divergens*. Twiners and vines include Common Devil's Twine, *Cassytha pubescens*; Native Grape, *Cayratia clematidea* and Wombat Berry, *Eustrephus latifolius*.

The ground cover in this community is generally quite open with bare ground and leaf litter predominant. The main herbaceous species present include Poison Rock Fern, *Cheilanthes sieberi*; Blue Trumpet, *Brunoniella australis*; Yellow Burr-daisy, *Calotis lappulacea*; a Fuzzweed, *Vittadinia sulcata*; Red Berry Saltbush, *Einadia hastata*; Climbing Saltbush, *Einadia nutans* subsp. *nutans*; Fishweed, *Einadia trigonos* subsp. *stellulata*; Ruby Saltbush, *Enchylaena tomentosa*; Native Wandering Jew, *Commelina cyanea*; Kidney Weed, *Dichondra repens*; Large Tick-trefoil, *Desmodium brachypodum*; Slender Tick-trefoil, *Desmodium gunnii*; Variable Glycine, *Glycine tabacina*; a Goodenia, *Goodenia rotundifolia*; Corrugated Sida, *Sida corrugata*; Slender Plantain, *Plantago debilis* and Trailing Speedwell, *Veronica plebeia*.

A variety of sedges, mat-rushes, lilies and grasses are also sparsely distributed, including Slender Flat-sedge, *Cyperus gracilis*; Common Saw-sedge, *Gahnia aspera*; a Mat-rush, *Lomandra confertifolia* subsp. *pallida*; Wattle Mat-rush, *Lomandra filiformis* subsp. *filiformis*; Many-flowered Mat-rush, *Lomandra multiflora*; Hooky Grass, *Ancistrachne uncinulata*; Purple Wiregrass, *Aristida personata*; Threeawn Speargrass, *Aristida vagans*; Speargrass, *Austrostipa scabra* subsp. *falcata*; Slender Bamboo grass, *Austrostipa verticillata*; Barbwire Grass, *Cymbopogon refractus*; Curly Windmill Grass, *Enteropogon acicularis*; Wiry Panic, *Entolasia stricta*; Long-leaved Wallaby Grass, *Notodanthonia longifolia*; Two coloured Panic, *Panicum simile* and Slender Panic, *Paspalidium gracile*.

Introduced species are uncommon in Community 2. The most prominent are Fireweed, *Senecio madagascariensis*; Common Prickly Pear, *Opuntia stricta*; Spiked Malvastrum, *Malvastrum*

americanum and African Lovegrass, *Eragrostis curvula*, although all form only a very small proportion of the biomass.

Community 3. Secondary Native Grassland

The cleared grazing paddocks within the Project area and surrounds are secondary native grasslands dominated by a variety of native grasses. The grasslands also support generally small numbers of a range of resilient native herbs, and an array of introduced grasses and herbs. Owing to a lack of grazing over the last decade or so, there is regeneration of some of the original native trees and shrubs including Narrow-leaved Ironbark, *Eucalyptus crebra*; Cooba, *Acacia salicina*; Buloke, *Allocasuarina luehmanii* and Mock Olive, *Notelaea microcarpa*.

The dominant native species on the survey area are Hairy Panic, *Panicum effusum*; Slender Rat's Tail Grass, *Sporobolus creber*; and Redleg Grass, *Bothriochloa decipiens*. Other native species include Couch, *Cynodon dactylon*; Weeping Grass, *Microlaena stipoides*; Cotton Panic Grass, *Digitaria brownii*; Tall Chloris, *Chloris ventricosa*; Clustered Lovegrass, *Eragrostis elongata* and Weeping Lovegrass, *Eragrostis parviflora*. The main introduced grasses are Paspalum, *Paspalum dilatatum*; Kikuyu, *Pennisetum clandestinum* and Pale Pigeon Grass, *Setaria pumila*.

A range of native herbs and other ground covers persist in the paddocks despite a long history of grazing including Rough Raspwort, *Haloragis heterophylla*; Tufted Bluebell, *Wahlenbergia communis*; Common Everlasting, *Chrysocephalum apiculatum* and Knob sedge, *Carex inversa*. Prominent introduced species include *Schkuhria pinnata* var. *abrotanoides*, Fireweed, *Senecio madagascariensis*; Purpletop, *Verbena bonariensis*; Paddys Lucerne, *Sida rhombifolia*; Spear Thistle, *Cirsium vulgare* and Tall Fleabane, *Conyza sumatrensis*.

4.2 FLORA SPECIES

A total of 264 plant species was identified in the broader distribution of the three communities that occur within the Project area (Table 6). Of these, 233 (88.3%) are native to the natural communities of the study area and 31 (11.7%) are introduced. The numbers of species found in each community generally varied according to the sampling intensity (Table 6). The largest number of species was found in Communities 1 and 2, with 153 and 198, respectively.

The plant families with the highest numbers of species (Appendix B) were the Grasses, Poaceae (57 species); Daisies, Asteraceae (25 species); the saltbushes and bluebushes, Chenopodiaceae (14 taxa); the Pea Flowers, subfamily Faboideae (13 species); the Wattles, subfamily Mimosoideae (9 species) and the Eucalypts and related genera in the family Myrtaceae (8 species). In all, some 68 plant families or sub-families were represented.

**Table 6
Numbers and Percentages of Native and Introduced Vascular Plant Species
Identified in the Broader Distribution of the Vegetation Communities that Occur within the
Project Area**

Community	Number of Samples	Total Plant Species	Number of Native Species	% of Native Species	Number of Introduced Species	% Introduced Species
1	6	153	142	92.8	11	7.2
2	17	198	183	92.4	15	7.6
3	3	88	67	76.1	21	23.9
Total	30	264	233	88.3	31	11.7

4.3 INTRODUCED SPECIES AND WEEDS

The number of introduced species is relatively low (31) (11.7%) (Table 6). The highest proportion of introduced species (23.9%) was found in the secondary native grassland (Community 3). Two of the introduced species recorded in this survey are regarded as noxious weeds in the Singleton Shire, the Prickly Pears, *Opuntia* spp. (class 4¹). However, neither was abundant within the wider survey area, although *Opuntia stricta* is widespread (Appendix B).

4.4 THREATENED FLORA SPECIES

No flora species listed in the schedules of the TSC Act or EPBC Act was found in the targeted searches or other sampling conducted over the wider survey area.

4.5 REGIONALLY SIGNIFICANT FLORA

Some six species listed in the *Hunter Rare Plants Database* that occur in the broader distribution of the three communities that occur within the Project area, are considered to be rare or uncommon within the Hunter Valley (Bell *et al.*, in prep). These are listed in Table 7, along with an assessment by Bell *et al.* (in prep.) of their rarity, and the Project area communities in which they are known to occur. While none of these species is listed as rare or threatened in NSW or nationally, their occurrences in the Hunter Valley are limited.

Table 7
Study Area Plant Species Listed as Rare or Uncommon
in the Hunter Rare Plants Database¹

Family	Species	Listing Status	Vegetation Communities
Celastraceae	<i>Maytenus silvestris</i>	U	1, 3
Chenopodiaceae	<i>Enchylaena tomentosa</i>	U	3
Euphorbiaceae	<i>Bertya oleifolia</i>	U	3
Fabaceae: Mimosoideae	<i>Acacia decora</i>	T	3
Myrtaceae	<i>Melaleuca decora</i>	D	1
Poaceae	<i>Ancistrachne uncinulata</i>	DUR	1, 3

¹ Bell *et al.* (in prep). Hunter Rare Plants Database.

D Disjunct in the Hunter region, widespread and uncommon.

R Rare in the Hunter region.

T Threatened in the Hunter region.

U Uncommon in the Hunter region.

4.6 THREATENED POPULATIONS

No occurrence of any threatened populations was found in the broader survey area.

¹ For class 4 noxious weeds, 'the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant must not be sold, propagated or knowingly distributed.'

4.7 THREATENED PLANT COMMUNITIES

Two threatened ecological communities listed in the schedules of the TSC Act were identified within the the Project area by the survey, viz.:

- *Central Hunter Grey Box – Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions* Endangered Ecological Community; and
- *Hunter Valley Foothills Slaty Box Woodland in the Sydney Basin Bioregion* Vulnerable Ecological Community.

No threatened ecological communities listed under the EPBC Act occur on the Project area.

4.8 CONDITION OF THE VEGETATION

Historic disturbance factors on the Project area have included clearing of native vegetation; grazing by livestock and introduced feral herbivores such as rabbits; construction of tracks, fencing and other infrastructure; wildfires, with the most recent being in 1994, and mining. Most of the land has been used mainly for grazing in recent decades, but may have been cropped historically. The cleared grazing paddocks are currently secondary native grassland with a predominance of native grass species. The paddocks retain scattered remnant trees typical of Central Hunter Box – Ironbark Woodland, which is considered likely to have originally covered most of the Project area. Some 21 ha (86.8%) of the Project area has been cleared and the remainder is highly disturbed. The overall condition of the Project area is considered to be poor relative to the original native vegetation that would have occurred there.

5 FLORA IMPACT ASSESSMENT

5.1 POTENTIAL IMPACTS OF PROJECT SURFACE ACTIVITIES ON FLORA

Excavation of the site and construction and filling of the water storage would remove 21 ha of secondary native grassland, 1.8 hectares of Central Hunter Box – Ironbark Woodland and 0.8 hectares of Narrabeen Foothills Slaty Box Woodland.

The Project would also involve the construction of a powerline and water pipeline. Surface disturbance associated with the powerline would be limited to the installation of the individual powerpoles which would be located in cleared land. The water pipeline would be located above ground and require no additional surface disturbance. Therefore the focus of the following impact assessment is on the dam wall and inundation area.

5.2 THREATENED FLORA

The likelihood of the Project significantly affecting threatened flora species, populations or ecological communities or their habitats listed under the TSC Act is assessed below in accordance with Section 5A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) and the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC, 2007).

The following factors (Seven Part Test of Significance) are considered in order to determine the likelihood of a significant impact:

- (a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
- (b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*
- (c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
 - (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*
 - (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*
- (d) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*
- (e) *In relation to the habitat of a threatened species, population or ecological community:*
 - (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed;*
 - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and*
 - (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*
- (f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*
- (g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

Evaluations are conducted for threatened flora that are known to occur or may potentially occur on the Project area and immediate surrounds i.e. suitable habitat is considered to occur on or near the Project area (Tables 1 to 3).

5.3 THREATENED ECOLOGICAL COMMUNITIES

One Endangered Ecological Community (EEC) and one Vulnerable Ecological Community (VEC) were found on the Project disturbance area by the survey. The NSW TSC Act and the NSW EP&A Act do not require the application of a Seven Part Test of Significance in the case of VECs. Accordingly, the following assessment of impact considers only the potential Project impact on the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*.

This community occurs on Permian sediments in the Hunter Valley in the Local Government Areas of Cessnock, Singleton and Muswellbrook (DECCW, 2010a). The community occurs on gently undulating hills, slopes and valleys, and occasionally on rocky ridges (DECCW, 2010a). Within the Project area it is mapped as Community 1 (Figure 3 in Appendix A). Threats to the EEC are considered to be grazing by domestic livestock, weed invasion, and clearing and fragmentation for agriculture, development and mining (DECCW, 2010a).

(a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*

Not applicable.

(b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*

Not applicable.

(c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*

(ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Approximately 1.8 ha of young regenerating Central Hunter Box – Ironbark Woodland would be removed by the Project (Figure 3 in Appendix A). However, significant remnants of this EEC that would not be affected by mining occur to the south east of the Project area on WCPL property. Some of these remnants comprise offset areas set aside by previous mining approvals on WCPL-owned land. The remainder of the remnants are uncommitted.

It is concluded that the Project would reduce the availability of habitat for Central Hunter Box – Ironbark Woodland EEC.

(c) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

Critical habitat, as defined by the TSC and EPBC Acts, has not been declared for the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*. There is no critical habitat listed on the NSW Critical habitat register (OEH, 2012a) or the Commonwealth Register of Critical Habitat (SEWPaC, 2012) for this EEC in the Project area or surrounds.

- (e) In relation to the habitat of a threatened species, population or ecological community:**
- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;**
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The Project would result in the removal of 1.8 ha of the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC. However, this habitat loss would not result in an increase in existing habitat fragmentation or isolation, since the disturbance area is on the margins of an existing large continuous habitat block. The habitat to be removed is considered unlikely to be critical to the long term survival of the Central Hunter Box – Ironbark Woodland EEC in the local area, given the presence of the adjoining large block to the south east, of which some is protected in the long term as an offset area.

- (f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.**

No recovery plans have been written for the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC. However, recommended recovery actions for the community are included in its community profile on the OEH website (accessed February 2012). The recovery actions comprise the following:

- Prevent further clearing of remnants.
- Exclude grazing by domestic stock.
- Prevent removal of bush rock and dead timber.
- Control invasive weed species.
- Apply appropriate fire regimes.
- Protect remnants through mechanisms such as covenanting or management plans.
- Improve connectivity between remnants by revegetation / regeneration programs.

The proposed Project is inconsistent with the first recovery action, viz, '*prevent further clearing of remnants*'. The remaining recovery actions have not been specifically applied to the Project area as part of the recovery of this EEC, and consequently the Project is not inconsistent with them.

- (g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

Threats to the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC are included in its community profile on the OEH website (accessed February 2012). The Key Threatening Processes relevant to these threats comprise the following (OEH, 2012b):

- Bush rock removal.
- Clearing of native vegetation.
- High frequency fire.
- Removal of dead wood and dead trees.

As indicated above, the proposed project would clear 1.8 ha of the Central Hunter Grey Box – Ironbark Woodland EEC. Consequently, the Project would slightly increase the impact of the Key Threatening Process; ‘*Clearing of native vegetation*’.

Bush rock and timber removal are controlled by restrictions on public access to the Project area and this would continue during the Project.

There is a small risk of higher fire frequencies resulting from the Project due to increased movements by WCPL personnel, contractors and vehicles in the Project area, e.g. by the ignition of dry vegetation by petrol vehicle exhaust pipes and cigarette butts. WCPL personnel and contractors are required to use diesel vehicles to minimise fire risks, and to dispose of cigarette butts correctly. These and other protocols for bushfire management would be implemented to manage the behaviour of people in the Project area, making it unlikely there would be an increase in fire frequency resulting from Project related human activities. In addition, the presence of WCPL personnel on the Project area would provide early warning of any fires lit by lightning with rapid suppression activities being implemented. The water stored in the proposed dam could also be used for fighting fires.

Conclusion

The above assessment shows the Project would have a small adverse effect on the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC through the loss of 1.8 ha of this community.

5.4 ENDANGERED POPULATIONS

The Hunter Valley populations of Weeping Myall, *Acacia pendula* and River Red Gum, *Eucalyptus camaldulensis* that were considered possible occurrences within the Project area and surrounds (Table 2) were not detected by the survey. Both Weeping Myall and River Red Gum are large conspicuous species that would have been detected if they were present. They are therefore not considered further here.

In contrast, one species that is part of a population listed as endangered under the TSC Act; *Cymbidium canaliculatum* R. Br. in the Hunter Catchment, may potentially have been missed on the Project area during the surveys of the area. The potential impact of the Project on the Hunter Catchment population of *C. canaliculatum* is assessed below.

***Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population**

C. canaliculatum is a conspicuous epiphytic orchid that grows in the forks of branches of mainly rough-barked trees, including White Box, *Eucalyptus albens*; Coast Grey Box, *E. moluccana*; Narrow-leaved Ironbark, *E. crebra*; Rough-barked Apple, *Angophora floribunda*; Cooba, *Acacia salicina*; and Slaty Gum, *E. dawsonii* in the Hunter Valley (DEC, 2006). One colony of *C. canaliculatum* is known to occur on WCPL owned land to the north west of the study area in a fork of a large Cooba tree in the south of ‘Montrose’ property.

(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

The Project might adversely affect the Hunter Valley *C. canaliculatum* population by removal of actual and potential host trees through clearing. However, the majority of the site is cleared grazing land with only a few scattered remnant mature trees that may potentially support colonies of *C. canaliculatum*. Consequently, the proposed action is considered unlikely to remove any colonies of *C. canaliculatum* on the Project area.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

(c) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Critical habitat, as defined by the TSC and EPBC Acts, has not been declared for the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population. There is no critical habitat for the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population listed on the NSW Critical habitat register (OEH, 2012a) or the Commonwealth Register of Critical Habitat (SEWPaC, 2012).

(e) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The Project may result in the removal of a few remnant mature paddock trees that are potential habitat for the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population.

As these paddock trees are already isolated in the landscape, their removal would not significantly increase the isolation or fragmentation of habitat for *C. canaliculatum*. In addition, *C. canaliculatum* disperses by wind-blown seed that may travel relatively long distances to a new host, such that habitat fragmentation may be less important for this species. The main constraint on establishment of *C. canaliculatum* colonies is likely to be the availability of mature and overmature host trees within seed dispersal range of a colony. In contrast, habitat fragmentation may have deleterious effects on the populations of pollinators for *C. canaliculatum*. However, the affected trees are already isolated by cleared grassland from the continuous forest habitat to the south that may harbour pollinator populations.

The trees to be removed are considered to have a low level of importance for the long term survival of the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population because they are not known to host *C. canaliculatum*, there are no known colonies of *C. canaliculatum* in the near vicinity and they have already been isolated by past clearing.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plans or recovery actions have been written for the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population (OEH, 2012c). Accordingly, the Project does not contravene any known recovery action for this endangered population.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Threats to the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population are listed in the Final Determination of the NSW Scientific Committee (DEC, 2006) and include land clearing and associated habitat fragmentation, on-going removal of remnant trees and illegal collecting. The Key Threatening Processes (KTP) relevant to these threats (OEH, 2012b) are:

- Clearing of native vegetation.
- Removal of dead wood and dead trees.

The Project involves the removal of mature trees that are potential habitat for *C. canaliculatum*. Accordingly, the Project would increase the impact of the KTP 'clearing of native vegetation' for this threatened population.

Timber removal is controlled by restrictions on public access to the Project area and this would continue during the Project.

Conclusion

The above assessment indicates that the Project is unlikely to have a significant impact on the *Cymbidium canaliculatum* R. Br. in the Hunter Catchment Endangered Population. However, it would remove a few mature paddock trees resulting in a small reduction of potential habitat for the population.

5.5 THREATENED FLORA SPECIES

The baseline flora survey targeted 12 threatened flora species for field searches. The targeted species included all threatened flora known or considered to have potential to occur within a 20 × 20 km square centred on the Project area (Table 1). Five of these species are considered highly unlikely to occur, or to have once occurred, on the Project area because suitable habitat for them is absent (Table 1, Table 8). The assessment in this section is confined to the seven remaining species that have potential habitat within the Project area.

Table 8
Threatened Flora Species Considered in this Assessment

Family Name	Scientific Name	Justification for Exclusion from Assessment
Araucariaceae	<i>Wollemia nobilis</i>	Occurs only in sandstone gorges in the west of Wollemi National Park (DEC, 2005a).
Apocynaceae	<i>Cynanchum elegans</i>	Included.
Asteraceae	<i>Olearia cordata</i>	Occurs on steep slopes and sandstone outcrops (DEC, 2005c).
Fabaceae	<i>Dillwynia tenuifolia</i>	Included.
Myrtaceae	<i>Eucalyptus glaucina</i>	Included.
	<i>Melaleuca groveana</i>	Steep slopes and sandstone outcrops (DEC, 2005f).
Orchidaceae	<i>Prasophyllum</i> sp. Wybong	Included.
	<i>Pterostylis gibbosa</i>	Included.
Poaceae	<i>Digitaria porrecta</i>	No records east of the Great Dividing Range (NSW Atlas of Wildlife, accessed February 2012). Grows on inland floodplains (DEC, 2005h).
Rhamnaceae	<i>Pomaderris brunnea</i>	Occurs mainly in sandstone gorges and also riparian areas (DEC, 2005i).
Santalaceae	<i>Thesium australe</i>	Included.
Scrophulariaceae	<i>Euphrasia arguta</i>	Included.

5.5.1 Threatened Species Assessment

Seven threatened flora species with potential to occur on the immediate Project area may occur in habitats on the more fertile Permian clay soils associated with the valley floor. None of these species have been recorded by surveys within or near the Project area, or more widely on WCPL owned land east of Wollombi Brook.

White-flowered Wax Plant (*Cynanchum elegans*)

The White-flowered Wax Plant is a climber with white, tubular flowers that appear between August and May (NPWS, 2002b; DEC, 2005b). The slow-developing fruit, a dry pointed pod, takes up to six months to mature. It is considered unlikely that this species has a soil seed bank (*ibid.*). The White-flowered Wax Plant typically occurs on the edge of dry rainforest, although the species may occur in other vegetation types (*ibid.*). Threats relevant to the White-flowered Wax Plant include loss and fragmentation of habitat through clearing, habitat degradation resulting from grazing, weed invasion, inappropriate fire management, rubbish dumping and track construction or widening (*ibid.*).

The White-flowered Wax Plant occurs from the far North Coast of NSW (Brunswick Heads) to the Illawarra region. In the Hunter Valley it extends west to Sandy Hollow and Cassilis. The nearest records to the study area are near Broke to the south east. The Project area is within the known distribution of the White-flowered Wax Plant.

Dillwynia tenuifolia

Dillwynia tenuifolia is a low spreading shrub to 1 m high, with small narrow untwisted leaves having a recurved acute tip, and one or two flowers on short peduncles (to 3 mm) in the terminal leaf axils (Weston and Jobson, 2002). Plants are killed by hot fires with regeneration from the soil seed bank (DEC, 2005d). The life span is thought to be 20 to 30 years and seed production commences after 3 to 4 years (*ibid.*). Habitats are dry woodlands and forests on clay, alluvium or sandstone soils (*ibid.*). Threats include clearing of habitat, inappropriate fire regimes, rubbish dumping and vehicle movements.

Dillwynia tenuifolia occurs on the Cumberland Plain west of Sydney, the lower Blue Mountains, Yengo, Howes Valley and the Bulga area in the Hunter Valley. The closest records to the Project area are to the south and west of Bulga. If *D. tenuifolia* was to occur on the Project area it would be an extension of its range to the north.

Slaty Red Gum (*Eucalyptus glaucina*)

The Slaty Red Gum is a tree to 30 m tall, with smooth mottled white to grey bark, conspicuously glaucous oval leaves, and glaucous fruits and buds (DEC, 2005e). The fruits are large, up to 10 mm long and 10 mm in diameter. It favours grassy woodlands and eucalypt forests on deep, well-watered, moderately fertile soils (*ibid.*). Threats include clearing of habitat, logging and suppression of regeneration by grazing (*ibid.*).

The Slaty Red Gum has two centres of distribution; around Casino on the far North Coast and in the Taree to Broke area on the lower North Coast. In the Hunter Valley the distribution extends from Dungog and Stroud in the east to Warkworth in the west, and Pokolbin and Broke in the south. Two Warkworth records in the Wallaby Scrub are closest to the Project area.

***Prasophyllum* sp. Wybong (C. Phelps ORG 5269)**

Prasophyllum sp. Wybong (C. Phelps ORG 5269) is a terrestrial orchid that grows to approximately 30 cm high. It has a single, tubular, fleshy, dull-green leaf and a single flower spike with numerous fragrant flowers (SEWPaC, 2009). *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is endemic to New South Wales. *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is a perennial orchid, appearing as a single leaf over winter and spring. The species flowers in spring and dies back to a tuber over summer and autumn. *Prasophyllum* sp. Wybong (C. Phelps ORG 5269) is known to occur in open eucalypt woodland and grassland. The main threats to the species include weed invasion, vehicle traffic, inappropriate disturbance regimes and habitat clearance. Chemical drift from agricultural properties, illegal collection, trampling by people and climate change are considered potential threats (SEWPaC, 2009).

It is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. If the species occurred on the Project area, it would represent an extension of the known range to the south south east of Muswellbrook.

Illawarra Greenhood (*Pterostylis gibbosa*)

The Illawarra Greenhood Orchid is a perennial renascent herb with an annually renewed underground tuberoid, which gives rise to a flat rosette of leaves (each to 35 mm long) at the soil surface in late summer. A single flower stem shoots from the middle of the rosette in spring growing to 45 cm high and bearing up to seven translucent bright green flowers in late spring. The flowers are characterised by a dark protruding brownish black lip. The above ground parts of the plant die back in summer. The habitat is flat to gently sloping, poorly drained land on Permian clay soils (DEC, 2005g). A population near Milbrodale in the southern Hunter Valley grows with Narrow-leaved Ironbark, *Eucalyptus crebra*, Forest Red Gum, *Eucalyptus tereticornis* and Black Cypress Pine, *Callitris endlicheri*, in the overstorey (*ibid.*). Threats to the Illawarra Greenhood Orchid include loss of habitat for agriculture and residential development, invasion of sites by introduced grasses and blackberry, inappropriate fire regimes and habitat degradation by unrestricted vehicle and pedestrian access (*ibid.*).

Pterostylis gibbosa occurs as disjunct populations from near Nowra and the Illawarra region on the NSW South Coast to two locations in the Hunter Valley; Milbrodale and Weston. The closest population to the Project area is at Milbrodale, south of Bulga. If the species occurred on the Project area, it would represent an extension of the known range to the north west of Milbrodale.

Austral Toadflax (*Thesium australe*)

Austral Toadflax (*Thesium australe*) is a perennial pale green or yellow-green herb with 1-30 branched stems up to 60 cm long (Scarlett *et al.*, 2003). The leaves are sessile, linear and acute, mostly 1-3 cm long with a decurrent midrib. The whitish flowers are solitary in the leaf axils, borne on a peduncle (1-3 mm long) which is united with the leaf bases. The fruit is a globose, slightly fleshy drupe 2 mm in diameter, crowned with the persistent tepals. The dry drupe has a markedly reticulate-striate surface. The Austral Toadflax is a member of the Santalaceae (Sandalwood Family) and, like many members of this genus, is hemiparasitic on the roots of other plants, notably *Themeda triandra* (Kangaroo Grass). Collections in Australian herbaria indicate that Austral Toadflax was widespread in eastern Australia, from the Bunya Mountains in Queensland south to eastern Tasmania. The Austral Toadflax has a wide ecological tolerance having been recorded from subtropical, temperate and sub-alpine climates, and on soils derived from sedimentary, igneous and metamorphic rocks as well as recent alluvium. However, it is largely confined to grasslands, grassy woodlands or sub-alpine grassy heathlands. While Austral Toadflax is usually associated with Kangaroo Grass and (less frequently) with *Poa* spp., it will grow with other hosts, at least in the glasshouse (Scarlett *et al.*, 2003). Threats to the Austral Toadflax include loss or degradation of habitat through land clearing, grazing, invasion by exotic weeds and road works (DEC, 2005j).

Although there are no records of the Austral Toadflax from the Hunter Valley, it is likely to have occurred there pre European settlement, given its former wide distribution and ecological tolerance.

Euphrasia arguta

Euphrasia arguta is an erect, semi-parasitic annual herb growing up to 45 cm high (SEWPaC, 2011). The branches have dense recurved stiff, non-glandular hairs. The plant has 18–30 pairs of opposite, sessile leaves along the stem with alternate pairs arranged at right angles. Leaves are 7–15 mm long with long slender 'tooth-like' projections and may be smooth or rough to the touch. The plant has numerous white to pinkish-lilac flowers in racemes. Both the petals and sepals are tubular. The upper lip of the petals is hooded with two downward curved lobes. The fruit is a capsule 4–8 mm long containing many minute seeds (SEWPaC, 2011). Actual and potential threats to *E. arguta* include grazing, road works and logging.

Until recently, *E. arguta* was thought to be extinct. However, several populations were found in 2008 in the Nundle area of the Nandewar Bioregion. Known distribution records include Bathurst, Nundle, Walcha and the type area on the Paterson and Williams Rivers in the Hunter Valley.

(a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The proposed action has the potential to place local populations of the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta* at risk of extinction, if they were to occur on the Project area. However, all of these species are sensitive to habitat disturbances including grazing. The past history of land use on the Project area makes it unlikely that populations of any of these species remain, if indeed they were ever present. The former habitat on the Project area was dry woodland on relatively infertile soil with a sparse understorey of grasses and shrubs. Most of the threatened species are considered unlikely to have occurred in such environments. Slaty Red Gum, the Illawarra Greenhood and *Euphrasia arguta* occur on moist fertile soils, *Prasophyllum* sp. Wybong and Austral Toadflax favour grassy woodlands and fertile soils, while the White-flowered Wax Plant favours moister environments. *Dillwynia tenuifolia* may occur in similar habitats to those on the Project area, but is a conspicuous species that has not been recorded on WCPL-owned land by extensive surveys.

It is concluded that the Project is unlikely to affect the lifecycle of these threatened species such that a viable local population is likely to be placed at risk of extinction, if they were present.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

(c) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Critical habitat, as defined by the TSC and EPBC Acts, has not been declared for the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta*. There is no critical habitat for these species listed on the NSW Critical habitat register (OEH, 2012a) or the Commonwealth Register of Critical Habitat (SEWPaC, 2012).

(e) In relation to the habitat of a threatened species, population or ecological community:

- (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;**
- (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**
- (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The Project is considered unlikely to result in the removal or modification of any potential habitat for the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta* (see answer to question (a) above).

Since the Project area is predominantly cleared land, it would not result in the fragmentation or isolation of potential habitat for these species.

The habitat to be removed is considered unlikely to affect the long term survival of the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta* in the locality of the Project area, since it is unlikely there are extant populations or that they ever occurred there.

(f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plans have been written for the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta*. However, a range of recovery actions has been recommended for each species in their profiles on the OEH and SEWPaC websites (accessed February 2012). The recovery actions are summarised as follows:

- Determine and implement appropriate fire management practices.
- Consider off-site impacts in the assessment of nearby developments.
- Prevent inappropriate water run-off entering sites.
- Prevent rubbish and fill dumping, and weed invasion.
- Install fencing to exclude livestock and machinery, and control access where required.
- Protect areas of known and potential habitat from road works, clearing, further fragmentation, timber harvesting and canopy thinning.
- Identify populations of high conservation priority.
- Restore degraded habitat using bush regeneration techniques, including linking populations where possible.
- Monitor populations for changes in numbers and health status.
- Mark sites and potential habitat onto maps used for planning maintenance work.
- Map known sites and conduct searches of potential habitat for new sites.
- Support and provide information to landholders regarding appropriate management
- Establish covenants to protect populations on private land where possible.
- Educate the public and encourage landholders to conserve populations on private land.
- Undertake seed collection and storage

All of the above recovery actions relate to known populations of the species. No populations of any of the species were detected during the field surveys of the area. Except for the Slaty Red Gum, none of these species have been found on WCPL owned land by numerous previous surveys. The Slaty Red Gum has been recorded twice in the Wallaby Scrub area across the Wollombi Brook to the east of the Project area (NSW Atlas of Wildlife, accessed February 2012). Slaty Red Gum is a conspicuous large tree that would have been detected by the survey if present on the wider survey area.

In the absence of any populations of the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta* on the study area, the above recovery actions are not directly relevant. Accordingly, the Project is not inconsistent with the recovery actions for these species.

(g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Threats to the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, Illawarra Greenhood and Austral Toadflax are listed in the species profiles on the OEH website (accessed February 2012), and those for *Prasophyllum* sp. Wybong and *Euphrasia arguta* are listed in their conservation advices on the SEWPaC website (accessed February 2012). Threats include:

- Land clearing and associated habitat fragmentation.
- Habitat degradation and suppression of regeneration through changes in community structure (loss of tree canopy), logging and timber harvesting, weed invasion, grazing, rubbish dumping, landfill, urban run-off and road works.
- Inappropriate fire regimes.
- Loss of small populations through natural catastrophes, climate change or genetic decline.
- Uncontrolled access by people and vehicles to sensitive sites.
- Illegal collection (orchids).
- Chemical drift from agricultural activities.

The Key Threatening Processes relevant to these threats are the following (OEH, 2012b):

- Anthropogenic climate change.
- Clearing of native vegetation.
- Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*).
- High frequency fire.
- Invasion of native plant communities by exotic perennial grasses.

The issue of anthropogenic climate change is discussed in the main text of the Environmental Assessment and will not be considered separately here.

Clearing of native vegetation would take place for the Project. However, this is not relevant to the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta* as these species are unlikely to have extant populations on the Project area, or to have ever occurred there.

There is a small risk of higher fire frequencies resulting from the Project due to increased movements by WCPL personnel, contractors and vehicles in the Project area, e.g. by the ignition of dry vegetation by petrol vehicle exhaust pipes and cigarette butts. WCPL personnel and contractors are required to use diesel vehicles to minimise fire risks, and to dispose of cigarette butts correctly. These and other protocols for bushfire management would be implemented to manage the behaviour of people in the Project area, making it unlikely there would be an increase in fire frequency resulting from Project related human activities. In addition, the presence of WCPL personnel on the Project area would provide early warning of any fires lit by lightning with rapid suppression activities being implemented. The water storage resulting from the Project would assist in fire suppression.

Feral European rabbits and noxious weeds are controlled on WCPL land under the existing Wambo Coal Mine Flora and Fauna Management Plan and this would continue for the duration of the Project.

Conclusion

The above assessment indicates that the Project is unlikely to have a significant impact on the White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta*.

5.6 OVERALL CONCLUSION OF THE FLORA ASSESSMENT

It is concluded from the above assessments that the proposed Project would result in a small reduction in habitat for the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC, and would result in a small reduction in potential habitat for the *Cymbidium canaliculatum R. Br. in the Hunter Catchment Endangered Population*. The Project is considered unlikely to have any impact on the threatened species; White-flowered Wax Plant, *Dillwynia tenuifolia*, Slaty Red Gum, *Prasophyllum* sp. Wybong, Illawarra Greenhood, Austral Toadflax or *Euphrasia arguta*.

6 REFERENCES

- Anderson, R.H. (1968). *The Trees of New South Wales*. Fourth Edition. New South Wales Department of Agriculture, Sydney.
- Bell, S.A.J., Peake, T., Tame, T., Simpson, J., & Curran, T. (in prep.). *Regionally significant vegetation of the Hunter Valley and Central Coast, New South Wales: A working register*. Version 1. Hunter Rare Plants Committee, Hunter Region Botanic Gardens. January 2003.
- Briggs, J.D. and Leigh, J.H. (1996). *Rare or Threatened Australian Plants*. CSIRO, Canberra.
- Department of Environment and Conservation (2004). *Threatened Species Survey and Assessment: Guidelines for Developments and Activities*. Working Draft. Department of Environment and Conservation (NSW), Hurstville.
- Department of Environment and Conservation (2005a). *Wollemi Pine - profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10840>
Date accessed: February 2012.
- Department of Environment and Conservation (2005b). *White-flowered Wax Plant – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10196>
Date accessed: February 2012.
- Department of Environment and Conservation (2005c). *Olearia cordata – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10576>
Date accessed: February 2012.
- Department of Environment and Conservation (2005d). *Dillwynia tenuifolia – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10226>
Date accessed: February 2012.
- Department of Environment and Conservation (2005e). *Slaty Red Gum – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10295>
Date accessed: February 2012.
- Department of Environment and Conservation (2005f). *Grove's Paperbark – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10516>
Date accessed: February 2012.
- Department of Environment and Conservation (2005g). *Illawarra Greenhood – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10701>
Date accessed: February 2012.
- Department of Environment and Conservation (2005h). *Finger Panic Grass – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10222>
Date accessed: February 2012.
- Department of Environment and Conservation (2005i). *Brown Pomaderris – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10647>
Date accessed: February 2012.
- Department of Environment and Conservation (2005j). *Austral toadflax – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10802>
Date accessed: February 2012.

- Department of Environment and Conservation (2005k). *Acacia pendula (a tree) in the Hunter catchment – endangered population listing*. Final Determination. NSW Scientific Committee.
Website: <http://www.environment.nsw.gov.au/determinations/AcaciaPendulaHunterCatchmentEndangere dpop.htm>
Date accessed: February 2012.
- Department of Environment and Conservation (2005l). *Eucalyptus camaldulensis (a tree) in the Hunter catchment – endangered population listing*. Final Determination. NSW Scientific Committee.
Website: <http://www.environment.nsw.gov.au/determinations/EucalyptusCamaldulensisHunterEndangere dpop.htm>
Date accessed: February 2012.
- Department of Environment and Conservation (2005m). *Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions - profile*. Department of Environment and Climate Change. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10416>
Date accessed: February 2012.
- Department of Environment and Conservation (2005n). *Hunter Valley Weeping Myall Woodland of the Sydney Basin Bioregion- endangered ecological community listing*. Final Determination. NSW Scientific Committee. Website: <http://www.environment.nsw.gov.au/determinations/HunterValleyWeepingMyallWoodlandEndSp Listing.htm>
Date accessed: February 2012.
- Department of Environment and Conservation (2005o). *White Box Yellow Box Blakely's Red Gum woodland – profile*. Website: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10837>
Date accessed: February 2012.
- Department of Environment and Conservation (2006). *Cymbidium canaliculatum R. Br. – endangered population listing*. Final Determination. NSW Scientific Committee.
Website: <http://www.environment.nsw.gov.au/determinations/CymbidiumCanaliculatum EndSpListing.htm>
Date accessed: February 2012.
- Department of Environment and Climate Change (2007). *Threatened Species Assessment Guidelines: The Assessment of Significance*.
- Department of Environment, Climate Change and Water (2010a). *Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions - endangered ecological community listing*. Final Determination, NSW Scientific Committee.
Website: <http://www.environment.nsw.gov.au/determinations/centralhuntergreyboxFD.htm>
Date accessed: February 2012.
- Department of Environment, Climate Change and Water (2010b). *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions - endangered ecological community listing*. Final Determination, NSW Scientific Committee.
Website: <http://www.environment.nsw.gov.au/determinations/centralhunterironbarkFD.htm>
Date accessed: February 2012.

- Department of Environment, Climate Change and Water (2010c). *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions - endangered ecological community listing*. Final determination, NSW Scientific Committee. Website: <http://www.environment.nsw.gov.au/determinations/hunintervalleyfloodplainFD.htm>
Date accessed: February 2012.
- Department of Environment, Climate Change and Water (2010d). *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion - vulnerable ecological community listing*. Final determination, NSW Scientific Committee. Website: <http://www.environment.nsw.gov.au/determinations/hunintervalleyfootslopesFD.htm>
Date accessed: February 2012).
- Department of Sustainability, Environment, Water, Population and Communities (2009). *Approved Conservation Advice for Prasophyllum sp. Wybong (C. Phelps ORG 5269) (a leek orchid)*. Website: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/81964-conservation-advice.pdf>
Date accessed: February 2012.
- Department of Sustainability, Environment, Water, Population and Communities (2011). *Commonwealth Listing Advice on Euphrasia arguta (Threatened Species Scientific Committee)*. Website: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/4325-listing-advice.pdf>
Date accessed: February 2012.
- Department of Sustainability, Environment, Water, Population and Communities (2012). *Register of Critical Habitat*. Website: <http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl>
Date accessed: February 2012.
- Harden, G.J. (Ed.) (1990 - 2002). *Flora of New South Wales*, Volumes 1 to 4 and revisions. University of New South Wales Press, Sydney.
- Kovac, M. and Lawrie, J.W. (1991). *Soil Landscapes of the Singleton 1:250,000 Sheet*. Soil Conservation Service of NSW.
- National Parks and Wildlife Service (2002a). *Warkworth Sands woodland in the Sydney Basin Bioregion - endangered ecological community listing*. Final Determination, NSW Scientific Committee. Website: <http://www.environment.nsw.gov.au/determinations/WarkworthSandsWoodlandSydneyEndComListing.htm>
Date accessed: February 2012.
- National Parks and Wildlife Service (2002b). *Cynanchum elegans. Threatened Species Information*. NSW. Website: <http://www.environment.nsw.gov.au/resources/nature/tsprofileCynanchumElegans.pdf>
Date accessed: February 2012.
- Office of Environment and Heritage (2012a). *Critical habitat protection*. Website: <http://www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtection.htm>
Date accessed: February 2012.
- Office of Environment and Heritage (2012b). *List of Key Threatening Processes*. Website: <http://www.environment.nsw.gov.au/threatenedspecies/KeyThreateningProcessesByDoctype.htm>
Date accessed: February 2012.

Office of Environment and Heritage (2012c). *Cymbidium canaliculatum* population in the Hunter Catchment - Profile. Website:
<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=20049>
Date accessed: February 2012.

Orchid Research (2003). *Wambo Development Project Flora Assessment*. Appendix HA of the Wambo Development Project Environmental Impact Statement. Prepared for Resource Strategies and Wambo Coal Pty Ltd.

Peake, T.C. (2006). *The Vegetation of the Central Hunter Valley, New South Wales*. A report on the findings of the Hunter Remnant Vegetation Project. Hunter-Central Rivers Catchment Management Authority, Paterson.

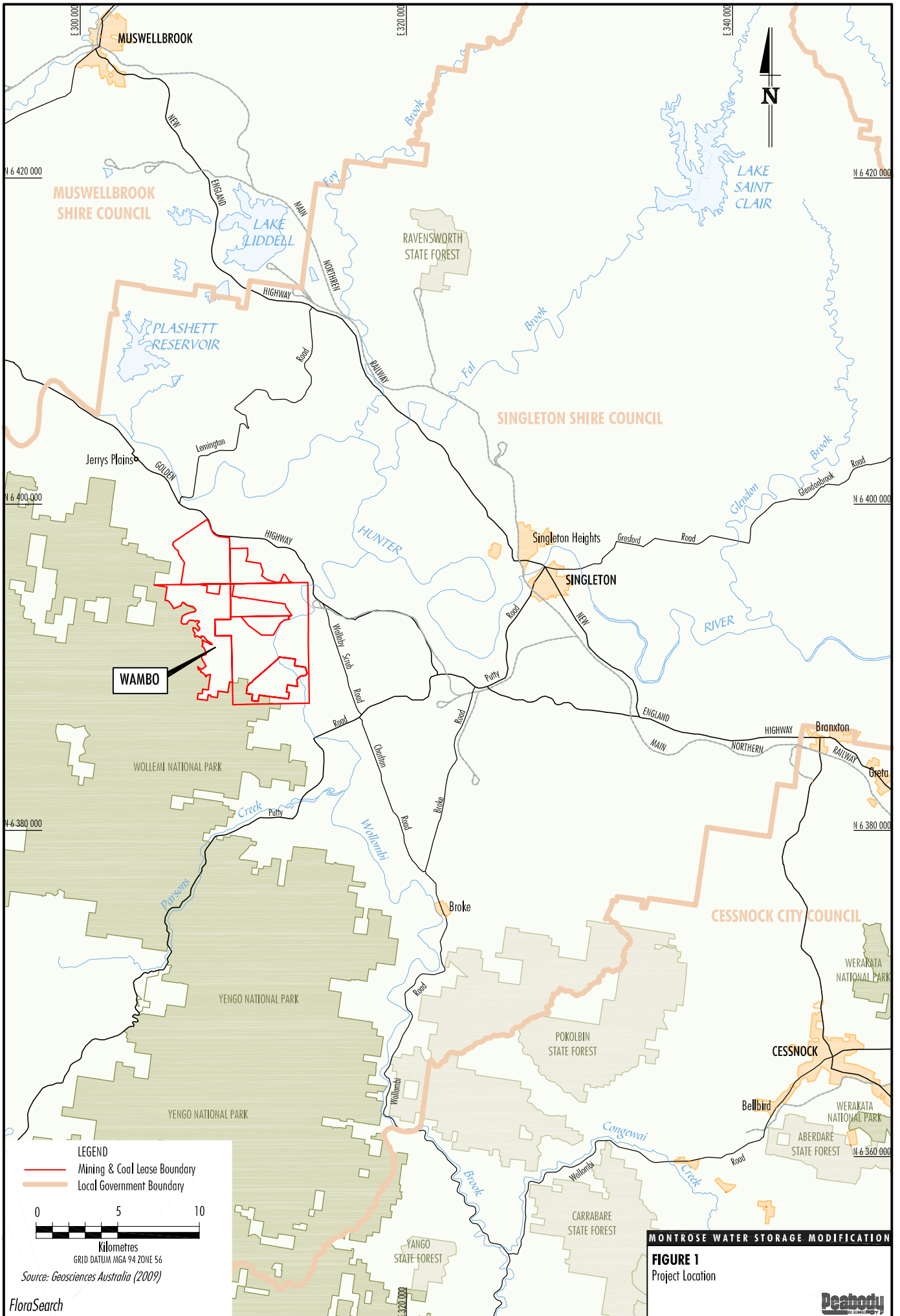
Scarlett, N., Bramwell, M. and Earl, G. (2003). *Austral Toad Flax – Thesium australe*. Flora and Fauna Guarantee Action Statement 56. Department of Sustainability and Environment, Victoria.

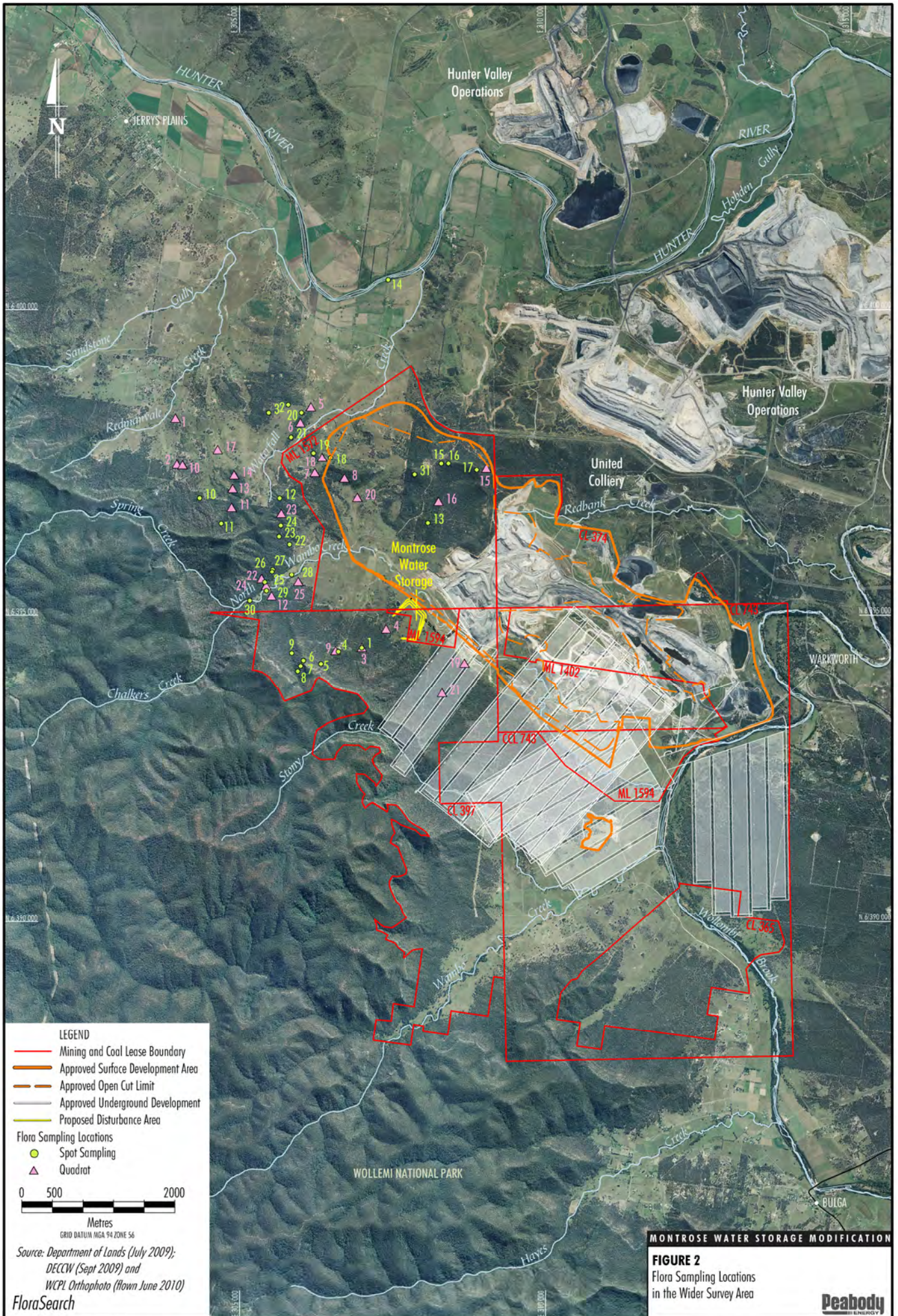
Thackway, R. and Cresswell, I.D. (eds) (1995). *An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves*. Version 4.0. Australian Nature Conservation Agency: Canberra

Weston, P. H and Jobson, P. C. (2002). *Dillwynia*: In Harden, G.J. (Ed.) (1990 - 2002) *Flora of New South Wales*, Volume 2. University of New South Wales Press, Sydney.

APPENDIX A

FIGURES





LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- Approved Open Cut Limit
- Approved Underground Development
- Proposed Disturbance Area

Flora Sampling Locations

- Spot Sampling
- ▲ Quadrat

0 500 2000
Metres
GRID DATUM MGA 94 ZONE 56

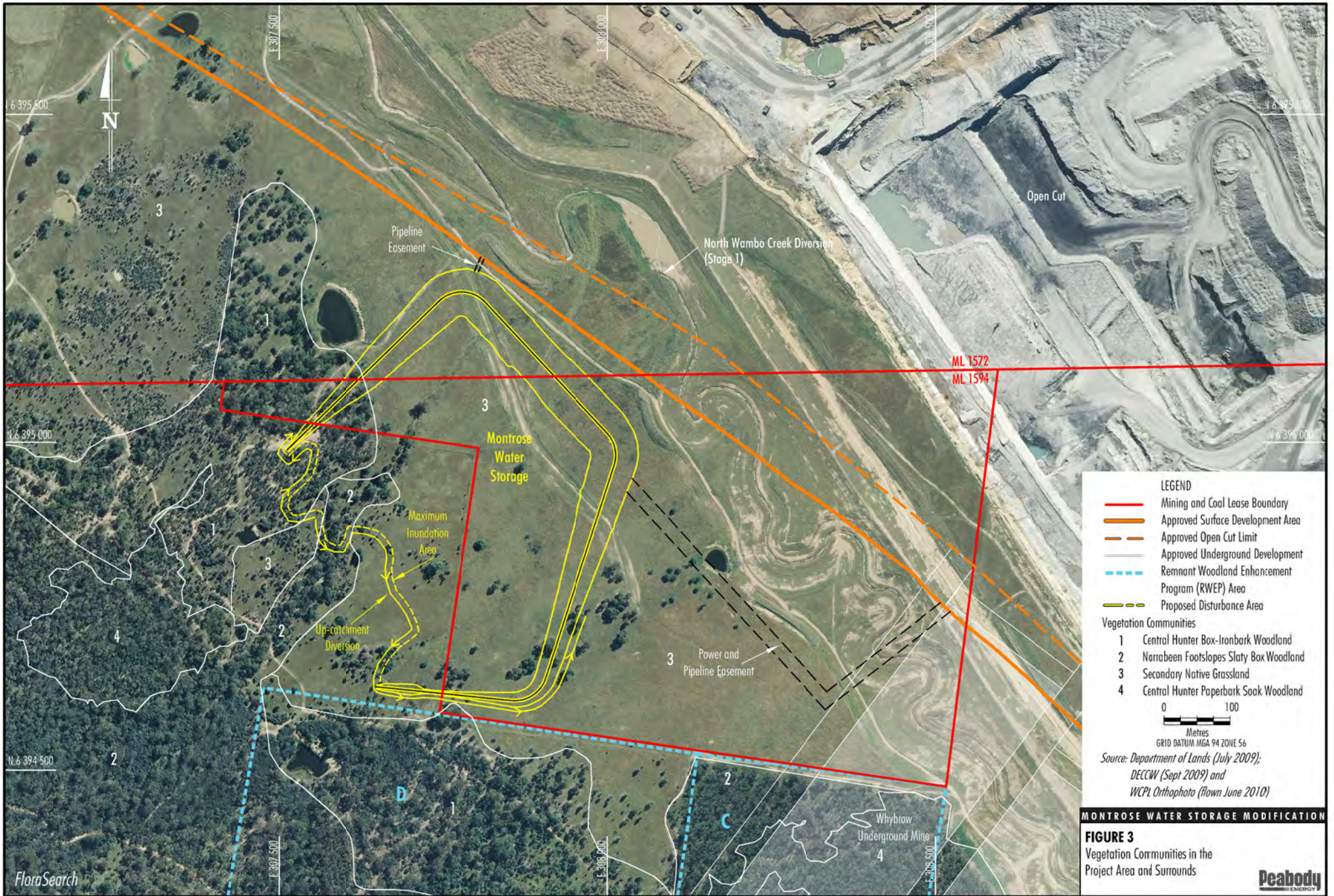
Source: Department of Lands (July 2009);
DECCW (Sept 2009) and
WCPL Orthophoto (flown June 2010)

FloraSearch

MONTROSE WATER STORAGE MODIFICATION

FIGURE 2
Flora Sampling Locations
in the Wider Survey Area

Peabody
ENERGY



APPENDIX B

FLORA SPECIES LIST FOR THE BROADER DISTRIBUTION OF THE VEGETATION COMMUNITIES THAT OCCUR IN THE PROJECT AREA

APPENDIX B. FLORA SPECIES LIST FOR EACH VEGETATION COMMUNITY

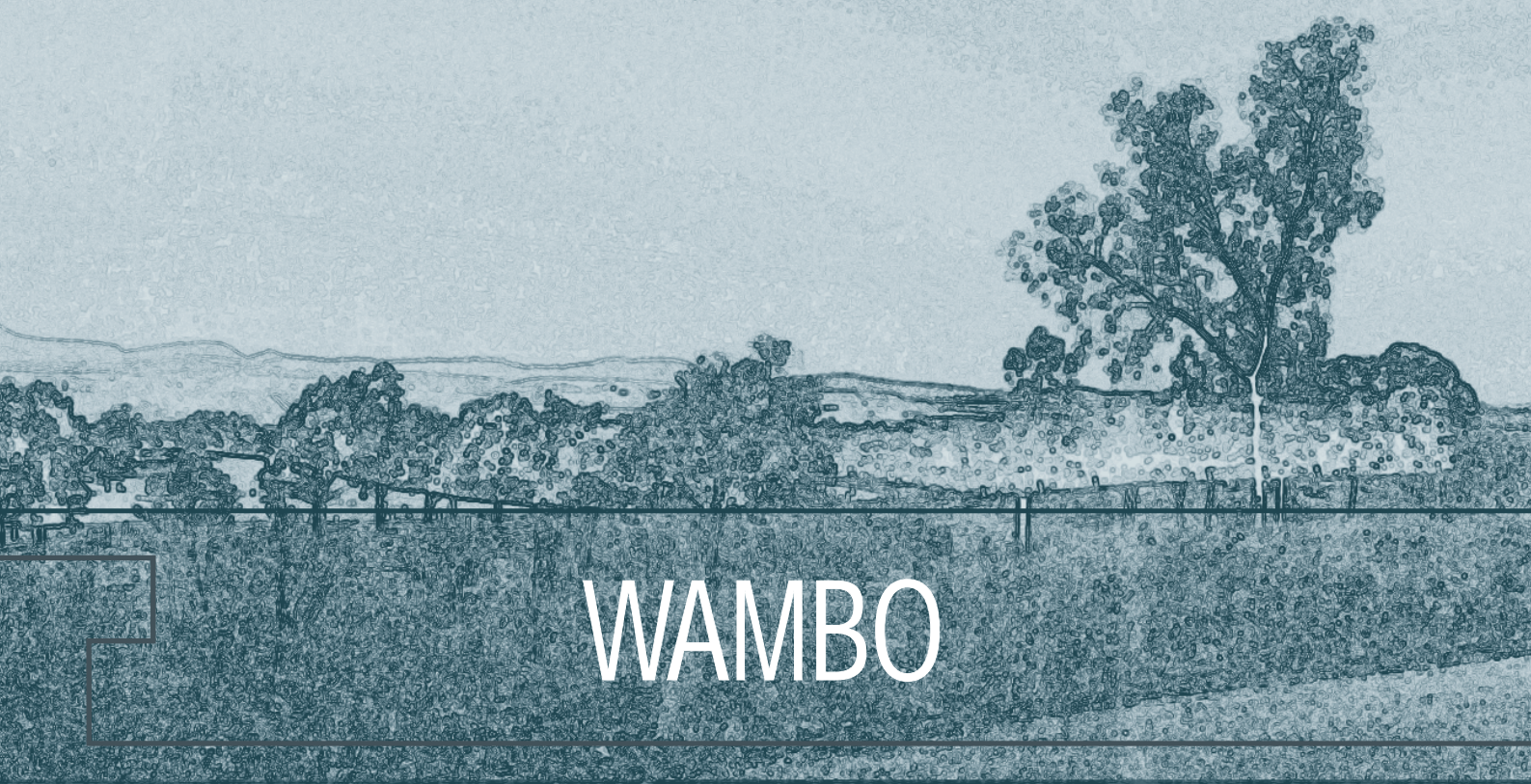
Family	Scientific Name	Common Name	Community		
			1	2	3
CLASS FILICOPSIDA					
Adiantaceae	<i>Cheilanthes austrotenuifolia</i>	Rock Fern		•	
	<i>Cheilanthes distans</i>	Bristly Cloak Fern	•	•	
	<i>Cheilanthes sieberi</i>	Poison Rock Fern	•	•	•
	<i>Pellaea falcata</i>	Sickle Fern		•	
Aspleniaceae	<i>Asplenium flabellifolium</i>	Necklace Fern		•	
CLASS CYCADOPSIDA					
Zamiaceae	<i>Macrozamia concinna</i>	A Macrozamia		•	
	<i>Macrozamia reducta</i>	A Macrozamia		•	
CLASS CONIFEROPSIDA					
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine		•	
CLASS MAGNOLIOPSIDA					
SUBCLASS MAGNOLIIDAE					
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet	•	•	
	<i>Rostellularia adscendens</i> var. <i>adscendens</i>	Pink Tongues	•	•	•
Aizoaceae	* <i>Galenia pubescens</i>	Galenia	•	•	•
Apiaceae	<i>Platysace ericoides</i>	Heathy Platysace		•	
Apocynaceae	* <i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	•	•	•
	<i>Marsdenia viridiflora</i>	Native Pear	•	•	
	<i>Parsonia lanceolata</i>	Rough Silkpod		•	
Asteraceae	* <i>Bidens pilosa</i>	Cobblers Pegs		•	
	<i>Brachyscome multifida</i>	Cut-leaved Daisy	•		
	<i>Calotis cuneifolia</i>	Purple Burr-daisy	•	•	•
	<i>Calotis lappulacea</i>	Yellow Burr-daisy	•	•	•
	<i>Cassinia cunninghamii</i>	Cunninghams Everlasting	•	•	
	<i>Cassinia quinquefaria</i>	Cough Bush	•	•	
	<i>Chrysocephalum apiculatum</i>	Common Everlasting	•	•	•
	* <i>Conyza bonariensis</i>	Flaxleaf Fleabane		•	•
	<i>Glossocardia bidens</i>	Cobbler's Tack	•	•	
	* <i>Hypochaeris microcephala</i> var. <i>albiflora</i>	White Flatweed	•		
	<i>Minuria leptophylla</i>	Minuria		•	•
	<i>Olearia elliptica</i>	Sticky Daisy-bush	•	•	
	<i>Ozothamnus diosmifolius</i>	Rice Flower	•	•	
	* <i>Schkuhria pinnata</i> var. <i>abrotanoides</i>	Dwarf Marigold			•
	* <i>Senecio madagascariensis</i>	Fireweed	•	•	•
	<i>Senecio microbasis</i>	A Senecio		•	
	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	Indian Weed		•	
	* <i>Sonchus oleraceus</i>	Common Sowthistle		•	
	* <i>Verbesina encelioides</i>	Crownbeard		•	
	<i>Vernonia cinerea</i>	Vernonia	•	•	
	<i>Vittadinia cervicalis</i> var. <i>subcircularis</i>	A Fuzzweed			•
	<i>Vittadinia cuneata</i> var. <i>hirsuta</i>	Fuzzweed		•	
	<i>Vittadinia muelleri</i>	A Fuzzweed			•
<i>Vittadinia pustulata</i>	A Fuzzweed		•	•	
<i>Vittadinia sulcata</i>	A Fuzzweed	•	•		
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine		•	
Brassicaceae	* <i>Lepidium africanum</i>	A Peppercross			•
Cactaceae	* <i>Opuntia aurantiaca</i>	Tiger Pear	•	•	
	* <i>Opuntia stricta</i>	Common Prickly Pear	•	•	•
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell	•		•
	<i>Wahlenbergia gracilis</i>	Australian Bluebell		•	
Caryophyllaceae	* <i>Paronychia brasiliiana</i>	Brasilian Whitlow			•
Casuarinaceae	<i>Allocasuarina luehmannii</i>	Bulloak	•	•	•
	<i>Allocasuarina verticillata</i>	Drooping Sheoak		•	
Celastraceae	<i>Maytenus silvestris</i>	Narrow-leaved Orangebark	•	•	

Family	Scientific Name	Common Name	Community		
			1	2	3
Chenopodiaceae	<i>Atriplex semibaccata</i>	Creeping Saltbush		•	•
	<i>Chenopodium carinatum</i>	Keeled Goosefoot		•	
	<i>Chenopodium pumilio</i>	Small Crumbweed		•	•
	<i>Einadia polygonoides</i>	Knotweed Goosefoot			•
	<i>Einadia hastata</i>	Red Berry Saltbush	•	•	
	<i>Einadia nutans</i>	Climbing Saltbush	•	•	
	<i>Einadia nutans</i> subsp. <i>linifolia</i>	Climbing Saltbush	•	•	
	<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Saltbush		•	
	<i>Einadia trigonos</i> subsp. <i>stellulata</i>	Fishweed		•	
	<i>Enchylaena tomentosa</i>	Ruby Saltbush		•	
	<i>Maireana enchylaenoides</i>	Wingless Bluebush		•	
	<i>Maireana microphylla</i>	Small-leaf Bluebush	•		•
	<i>Rhagodia parabolica</i>	Fragrant Saltbush	•	•	
<i>Sclerolaena muricata</i>	Black Rolypoly			•	
Commelinaceae	<i>Commelina cyanea</i>	Scurvy Weed	•	•	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	•	•	•
	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	Evolvulus		•	
Dilleniaceae	<i>Hibbertia cistoidea</i>	A Guinea Flower		•	
Ericaceae - Styphelioideae	<i>Leucopogon muticus</i>	Blunt Beard-heath		•	
	<i>Melichrus urceolatus</i>	Urn-heath		•	
Euphorbiaceae	<i>Alchornea ilicifolia</i>	Native Holly		•	
	<i>Bertya oleifolia</i>	A Bertya		•	
	<i>Beyeria viscosa</i>	Pinkwood	•	•	
	<i>Chamaesyce drummondii</i>	Caustic Weed		•	
	<i>Euphorbia planiticola</i>	Plains Spurge	•	•	
Fabaceae - Caesalpinioideae	<i>Senna clavigera</i>	A Cassia		•	
	<i>Senna coronilloides</i>	A Cassia	•	•	
	<i>Senna</i> form taxon ' <i>zygophylla</i> '	A Cassia	•	•	
	* <i>Senna septemtrionalis</i>	Arsenic Bush		•	
Fabaceae: Faboideae	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	•		
	<i>Desmodium brachypodum</i>	Large Tick-trefoil	•	•	•
	<i>Desmodium gunnii</i>	Slender Tick-trefoil	•	•	
	<i>Desmodium varians</i>	Slender Tick-trefoil	•	•	
	<i>Glycine clandestina</i>	Love Creeper	•	•	
	<i>Glycine microphylla</i>	Small-leaf glycine			•
	<i>Glycine tabacina</i>	Variable Glycine	•	•	•
	<i>Hovea apiculata</i>	A Hovea		•	
	<i>Indigofera australis</i>	Australian Indigo	•	•	
	* <i>Medicago</i> sp.	A Medic			•
	<i>Pultenaea spinosa</i>	Spiny Bush-pea	•	•	
	<i>Rhynchosia minima</i>	Rhyncho		•	
	<i>Swainsona galegifolia</i>	Smooth Darling-pea	•	•	
	Fabaceae: Mimosoideae	<i>Acacia amblygona</i>	Fan Wattle	•	•
<i>Acacia binervia</i>		Coast Myall	•	•	
<i>Acacia cultriformis</i>		Knife-leaf Wattle		•	
<i>Acacia decora</i>		Western Silver Wattle		•	
<i>Acacia falcata</i>		Sickle Wattle	•		
<i>Acacia implexa</i>		Hickory Wattle	•	•	
<i>Acacia salicina</i>		Cooba	•	•	•
<i>Acacia verniciflua</i>		Varnish Wattle	•	•	
	<i>Neptunia gracilis</i> forma <i>gracilis</i>	Sensitive Plant			•
Geraniaceae	<i>Erodium crinitum</i>	Blue Storksbill			•
	<i>Geranium solanderi</i>	Native Geranium			•
Goodeniaceae	<i>Goodenia ovata</i>	Hop Goodenia	•	•	
	<i>Goodenia pinnatifida</i>	Scrambled Eggs			•
	<i>Goodenia rotundifolia</i>	A Goodenia	•	•	
Lamiaceae	<i>Ajuga australis</i>	Austral Bugle	•	•	

Family	Scientific Name	Common Name	Community		
			1	2	3
	<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum		•	
	<i>Mentha satuireioides</i>	Creeping Mint	•	•	•
	<i>Plectranthus parviflorus</i>	Cockspar Flower	•		
	<i>Scutellaria humilis</i>	Dwarf Skullcap	•		
	<i>Spartothamnella juncea</i>	Bead Bush	•	•	
Lauraceae	<i>Cassytha pubescens</i>	Common Devil's Twine	•	•	
Linaceae	<i>Linum marginale</i>	Native Flax			•
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot	•		
Loranthaceae	<i>Amyema miquelii</i>	Stalked Mistletoe	•		
Malvaceae	<i>Amyema pendulum</i> subsp. <i>pendulum</i>	Drooping Mistletoe		•	
	<i>Abutilon oxycarpum</i>	Straggly Lantern-bush	•	•	•
	<i>Abutilon tubulosum</i>	A Lantern-bush		•	
	<i>Hibiscus sturtii</i> var. <i>sturtii</i>	Hill Hibiscus		•	
	* <i>Malvastrum americanum</i>	Spiked Malvastrum		•	•
	* <i>Modiola caroliniana</i>	Red-flowered Mallow			•
	<i>Sida corrugata</i>	Corrugated Sida	•	•	•
	* <i>Sida rhombifolia</i>	Paddy's Lucerne	•	•	•
	<i>Sida subspicata</i>	Spiked Sida	•	•	•
<i>Sida trichopoda</i>	Hairy Sida	•	•		
Moraceae	<i>Ficus rubiginosa</i>	Port Jackson Fig	•	•	
Myoporaceae	<i>Eremophila debilis</i>	Amulla	•	•	
	<i>Myoporum montanum</i>	Western Boobialla		•	
	<i>Myoporum platycarpum</i> subsp. <i>platycarpum</i>	Sugarwood		•	
Myrtaceae	<i>Corymbia gummifera</i>	Red Bloodwood		•	
	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	•	•	
	<i>Eucalyptus dawsonii</i>	Slaty Gum		•	
	<i>Eucalyptus moluccana</i>	Grey Box	•	•	
	<i>Eucalyptus punctata</i>	Grey Gum	•	•	
	<i>Eucalyptus tereticornis</i>	Forest Red Gum	•		
	<i>Melaleuca decora</i>	A Honeymyrtle	•		
	<i>Melaleuca ericifolia</i>	Swamp Paperbark		•	
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine		•	
Oleaceae	<i>Jasminum volubile</i>	Stiff Jasmine	•		
	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	Native Olive	•	•	
Oxalidaceae	<i>Oxalis chnoodes</i>	An Oxalis		•	
	<i>Oxalis</i> sp.	An Oxalis	•		•
Phyllanthaceae	<i>Breynia oblongifolia</i>	Coffee Bush	•	•	
	<i>Phyllanthus virgatus</i>	A Phyllanthus	•	•	•
Pittosporaceae	<i>Bursaria spinosa</i>	Blackthorn	•	•	
Plantaginaceae	<i>Plantago debilis</i>	Slender Plantain	•	•	
	* <i>Plantago lanceolata</i>	Lamb's Tongue	•		
	<i>Veronica plebeia</i>	Trailing Speedwell	•	•	
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock		•	
Portulacaceae	<i>Portulaca oleracea</i>	Pig Weed			•
Proteaceae	<i>Grevillea montana</i>	A Grevillea	•	•	
	<i>Persoonia linearis</i>	Narrow-leaved Geebung		•	
Ranunculaceae	<i>Clematis glycinoides</i>	Headache vine	•	•	
Rubiaceae	<i>Galium binifolium</i>	A Bedstraw		•	
	<i>Galium leptogonium</i>	A Bedstraw		•	
	* <i>Galium tricornutum</i>	A Bedstraw		•	•
	<i>Pomax umbellata</i>	Pomax	•		
	<i>Psyrax odorata</i>	Shiny-leaved Canthium	•	•	
	* <i>Richardia stellaris</i>				•
Rutaceae	<i>Correa reflexa</i>	Native Fuchsia		•	
	<i>Geijera salicifolia</i>	Brush Wilga	•	•	
	<i>Philothea difformis</i> subsp. <i>smithiana</i>	Small-leaf Wax-flower	•	•	
Santalaceae	<i>Choretrum candollei</i>	White Sour Bush	•	•	

Family	Scientific Name	Common Name	Community		
			1	2	3
	<i>Choretrum</i> sp. A			•	
Sapindaceae	<i>Dodonaea triangularis</i>	A Hop-bush	•	•	
	<i>Dodonaea truncatiales</i>	Angular Hop-bush		•	
	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	Wedge-leaf Hop-bush		•	
Scrophulariaceae	* <i>Parentucellia latifolia</i>	Red Bartsia		•	
Solanaceae	<i>Nicotiana suaveolens</i>	Native Tobacco		•	
	<i>Solanum brownii</i>	Violet Nightshade	•	•	•
	<i>Solanum cinereum</i>	Narrawa Burr			•
Stackhousiaceae	<i>Stackhousia muricata</i>	Western Stackhousia	•	•	
Stereuliaceae	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	Kurrajong	•	•	
	<i>Lasiopetalum ferrugineum</i> var. <i>cordatum</i>	Rusty Velvet-bush		•	
Thymelaeaceae	<i>Pimelea curviflora</i> var. <i>divergens</i>	Curved Rice-flower	•	•	
Ulmaceae	<i>Trema tomentosa</i> var. <i>aspera</i>	Poison Peach		•	
Verbenaceae	* <i>Verbena hispida</i>	Rough Verbena			•
	* <i>Verbena quadrangularis</i>	A Verbena	•		•
	* <i>Verbena rigida</i>	Veined Verbena			•
Viscaceae	<i>Notothixos cornifolius</i>	Kurrajong Mistletoe	•	•	
Vitaceae	<i>Cayratia clematidea</i>	Native Grape		•	
SUBCLASS LILIIDAE					
Anthericaceae	<i>Arthropodium minus</i>	Small Vanilla Lily	•		
	<i>Arthropodium milleflorum</i>	Pale Vanilla Lily		•	
	<i>Laxmannia gracilis</i>	Slender Wire Lily	•		
Cyperaceae	<i>Carex inversa</i>	Knob Sedge	•	•	•
	<i>Cyperus gracilis</i>	Slender Flat-sedge	•	•	•
	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge	•	•	•
	<i>Gahnia aspera</i>	Common Saw-sedge	•	•	
	<i>Lepidosperma laterale</i>	Variable Sword-sedge	•	•	
	<i>Scleria mackaviensis</i>	Scleria	•	•	
Hypoxidaceae	<i>Hypoxis hygrometrica</i>	Golden Weather-grass			•
	<i>Hypoxis pratensis</i> var. <i>pratensis</i>	Golden Weather-grass	•		•
Juncaceae	<i>Juncus</i> sp.	A Rush	•	•	
	<i>Juncus subsecundus</i>	Finger Rush		•	
Lomandraceae	<i>Lomandra confertifolia</i> subsp. <i>pallida</i>	Mat-rush	•	•	
	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush	•		
	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush	•	•	
	<i>Lomandra glauca</i>	Pale Mat-rush	•	•	
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush		•	
	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	•	•	
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry	•	•	
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	Blue Flax Lily		•	
	<i>Dianella caerulea</i> var. <i>cinerascens</i>	Blue Flax Lily	•		
	<i>Dianella longifolia</i>	Blueberry Lily	•		
	<i>Dianella revoluta</i>	Spreading Flax-lily	•	•	
Poaceae	<i>Ancistrachne uncinulata</i>	Hooky Grass	•	•	
	<i>Aristida benthamii</i>	Three-awned spear grass	•		
	<i>Aristida calycina</i>	Dark Wiregrass	•		
	<i>Aristida personata</i>	Purple Wire-grass	•	•	•
	<i>Aristida ramosa</i>	Purple Wiregrass		•	
	<i>Aristida vagans</i>	Threeawn Speargrass	•	•	
	<i>Austrodanthonia bipartita</i>	Wallaby Grass	•	•	•
	<i>Austrodanthonia racemosa</i> var. <i>obtusata</i>	Wallaby Grass	•		•
	<i>Austrodanthonia richardsonii</i>	Straw Wallaby-grass	•	•	
	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass	•	•	
	<i>Austrostipa scabra</i>	Speargrass	•	•	•
	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	•	•	
	<i>Bothriochloa decipiens</i>	Red Grass			•
	<i>Bothriochloa macra</i>	Red Grass		•	

Family	Scientific Name	Common Name	Community		
			1	2	3
	<i>*Chloris gayana</i>	Rhodes Grass	•		
	<i>Chloris truncata</i>	Windmill Grass		•	•
	<i>Chloris ventricosa</i>	Plump Windmill Grass	•	•	•
	<i>Cleistochloa rigida</i>	A Grass	•		
	<i>Cymbopogon refractus</i>	Barbwire Grass	•	•	•
	<i>Cynodon dactylon</i>	Couch	•		•
	<i>Dichanthium sericeum</i>	Queensland Bluegrass			•
	<i>Dichelachne micrantha</i>	Shorthair Plumegrass	•	•	•
	<i>Digitaria breviglumis</i>	A Finger Grass	•		
	<i>Digitaria brownii</i>	Cotton Panic Grass	•	•	•
	<i>Digitaria diffusa</i>	Open Summer Grass	•		•
	<i>Digitaria divaricatissima</i>	Umbrella Grass			•
	<i>Digitaria ramularis</i>	A Finger Grass	•	•	
	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass	•		
	<i>*Eleusine tristachya</i>	Goose Grass			•
	<i>Enteropogon acicularis</i>	Curly Windmill Grass	•	•	•
	<i>Entolasia stricta</i>	Wiry Panic	•	•	
	<i>Eragrostis brownii</i>	Brown's Lovegrass	•	•	
	<i>*Eragrostis curvula</i>	African Lovegrass		•	•
	<i>Eragrostis elongata</i>	Clustered Lovegrass	•	•	•
	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	•	•	•
	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass	•	•	•
	<i>Leptochloa decipiens</i>	Slender Canegrass	•	•	
	<i>Microlaena stipoides</i>	Weeping Grass	•	•	•
	<i>Notodanthonia longifolia</i>	Long-leaved Wallaby Grass	•	•	
	<i>Oplismenus aemulus</i>	Basket Grass		•	
	<i>Panicum buncei</i>	Native Panic			•
	<i>Panicum effusum</i>	Hairy Panic		•	
	<i>Panicum queenslandicum</i> var <i>queenslandicum</i>	Coolibah Brass			•
	<i>Panicum simile</i>	Two Coloured Panic	•	•	•
	<i>Paspalidium albobillosum</i>	Pale Summer Grass	•		
	<i>Paspalidium breviflorum</i>	A Panic Grass			•
	<i>Paspalidium criniforme</i>	Fine Panic	•	•	
	<i>Paspalidium distans</i>	A Panic Grass	•	•	•
	<i>Paspalidium gracile</i>	Slender Panic	•	•	•
	<i>Paspalidium</i> sp.	A Panic Grass		•	
	<i>*Setaria pumila</i>	Pale Pigeon Grass			•
	<i>*Sporobolus africanus</i>	Parramatta Grass	•		
	<i>Sporobolus caroli</i>	Fairy Grass		•	
	<i>Sporobolus creber</i>	Slender Rat's Tail Grass		•	•
	<i>Themeda australis</i>	Kangaroo Grass	•		
	<i>Tragus australianus</i>	Small Burrgrass			•
	<i>*Urochloa panicoides</i>	Urochloa Grass			•
Xanthorrhoeaceae	<i>Xanthorrhoea glauca</i> subsp. <i>glauca</i>	Grass Tree		•	
	TOTAL NATIVE SPECIES	233	142	183	67
	TOTAL INTRODUCED SPECIES	31	11	15	21
	GRAND TOTAL SPECIES	264	153	198	88



WAMBO

MONTROSE WATER STORAGE MODIFICATION
ENVIRONMENTAL ASSESSMENT

APPENDIX C
FAUNA ASSESSMENT

WAMBO COAL MINE
MONTROSE WATER STORAGE MODIFICATION
TERRESTRIAL FAUNA ASSESSMENT

PREPARED BY
BIOSPHERE ENVIRONMENTAL CONSULTANTS PTY LTD

June 2012

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1 INTRODUCTION	1
1.1 SURVEY OBJECTIVES	1
1.2 BIOGEOGRAPHIC AND ZOOGEOGRAPHIC REGIONAL SETTING	1
1.2.1 Sydney Basin Bioregion	1
1.2.2 Zoogeographic Region	4
1.3 PREVIOUS FAUNA SURVEYS	4
1.4 DESCRIPTION OF THE STUDY AREA	5
1.4.1 General	5
1.4.2 Climate	5
1.4.3 Hydrology and Topography	5
1.4.4 Geology and Soils	5
1.4.5 Vegetation and Habitat Types	5
1.4.6 Possible Occurrences of Threatened Species	6
2 SURVEY METHODS	8
2.1 SURVEY TIMING AND CONDITIONS	8
2.2 FAUNA SURVEY SITES	8
2.3 FAUNA SURVEY TECHNIQUES	8
2.4 HABITAT ASSESSMENT	11
2.5 RELATIVE ABUNDANCE	12
3 SURVEY RESULTS	13
3.1 MAJOR FAUNA HABITAT TYPES	13
3.1.1 Open Pasture Land on Alluvial Plains	13
3.1.2 Farm Dams	14
3.1.3 Low Regenerating Woodland on Alluvium	14
3.1.4 Mixed Woodland and Heath on Low Talus	15
3.1.5 Conglomerate Exposures and Caves	15
3.2 FAUNA SPECIES DIVERSITY AND RELATIVE ABUNDANCE	15
3.2.1 Species Diversity Across Survey Sites	15
3.2.2 Species Composition and Abundance	16
3.2.2 Amphibians	16
3.2.3 Reptiles	16
3.2.4 Birds	16
3.2.5 Mammals	17
3.2.6 Introduced Fauna	17
3.3 THREATENED FAUNA SPECIES	17
4 FAUNA IMPACT ASSESSMENT	20
4.1 POTENTIAL IMPACTS OF THE PROJECT ON FAUNA AND THEIR HABITATS	20
4.1.1 Vegetation Clearance	20
4.1.3 Other Direct or Indirect Impacts	20
4.2 THREATENED FAUNA	21
5 REFERENCES	23

LIST OF TABLES

Table 1	Threatened Fauna Species Considered Possible Occurrences in the Study Area and Surrounds
Table 2	Temperatures, Total Rainfall and Moon Information for the Survey Period
Table 3	Fauna Survey Sites
Table 4	Distribution of Fauna Species Across Survey Sites
Table 5	Relative Abundance in Fauna Groupings
Table 6	Threatened Fauna Species Located During the Surveys

LIST OF FIGURES

Figure 1	Regional Location
Figure 2	Location of Fauna Survey Sites
Figure 3	Threatened Fauna Species Recorded During Surveys

LIST OF PLATES

Plate 1	Pasture Land in the Northern Area of the Study Area
Plate 2	Farm Dam near Site 4 with Regenerating Woodland in the Background

LIST OF ATTACHMENTS

Attachment A	Threatened Fauna Database Search
Attachment B	Survey Effort
Attachment C	Fauna Species Recorded During the Surveys

1 INTRODUCTION

Wambo Coal Pty Limited (WCPL) owns and operates the Wambo Coal Mine in the Hunter Valley, about 15 kilometres (km) west of Singleton in New South Wales (NSW) (Figure 1).

WCPL is seeking approval under section 75W of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) for the construction of a new water storage dam (the Project). The Project would also involve the construction of a water pipeline and powerline. The location of the proposed dam is shown on Figure 2. A more detailed description of the Project is provided in Section 3 of the Environmental Assessment.

Fauna surveys of the wider study area were undertaken by Biosphere Environmental Consultants in September 2010 (Figure 2). The data collected during these surveys has been used in the following fauna assessment for the Project.

1.1 SURVEY OBJECTIVES

The objectives of the fauna surveys were to:

- Conduct fauna surveys in the study area utilising recognised fauna survey techniques.
- Assess fauna species diversity (native and introduced) and their relative abundance.
- Identify and describe the range of habitats utilised by fauna.
- Conduct targeted surveys for threatened fauna species considered possible occurrences within the study area or surrounds (including those listed in the Schedules of the NSW *Threatened Species Conservation Act, 1995* [TSC Act] and the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* [EPBC Act]), and map the location of any threatened species identified.
- Report on the findings of the fauna surveys.

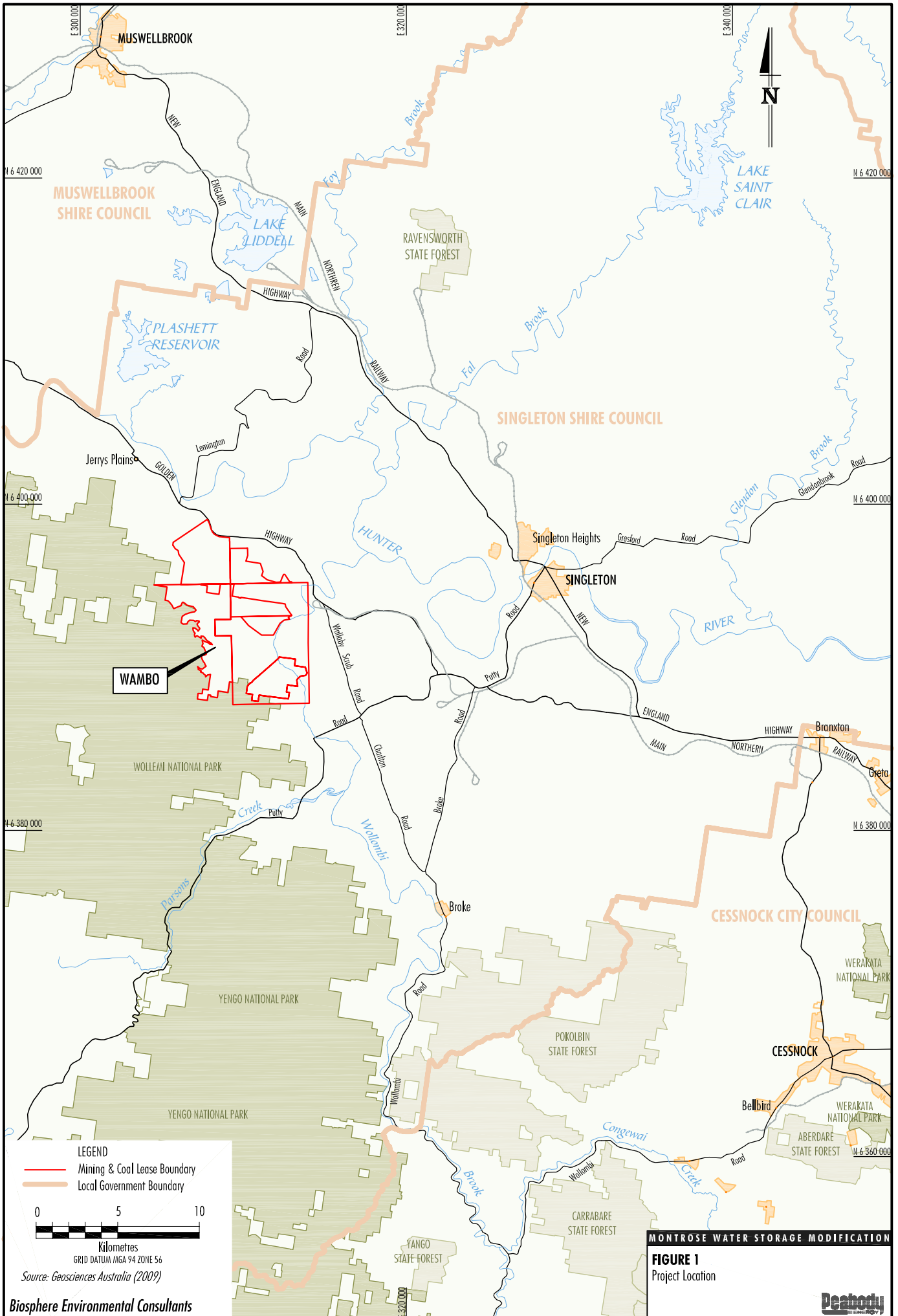
Fauna surveys were conducted in consideration of the *Draft Guidelines for Threatened Species Assessment* (NSW Department of Environment and Conservation [DEC] and NSW Department of Primary Industries [DPI], 2005) and *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004).

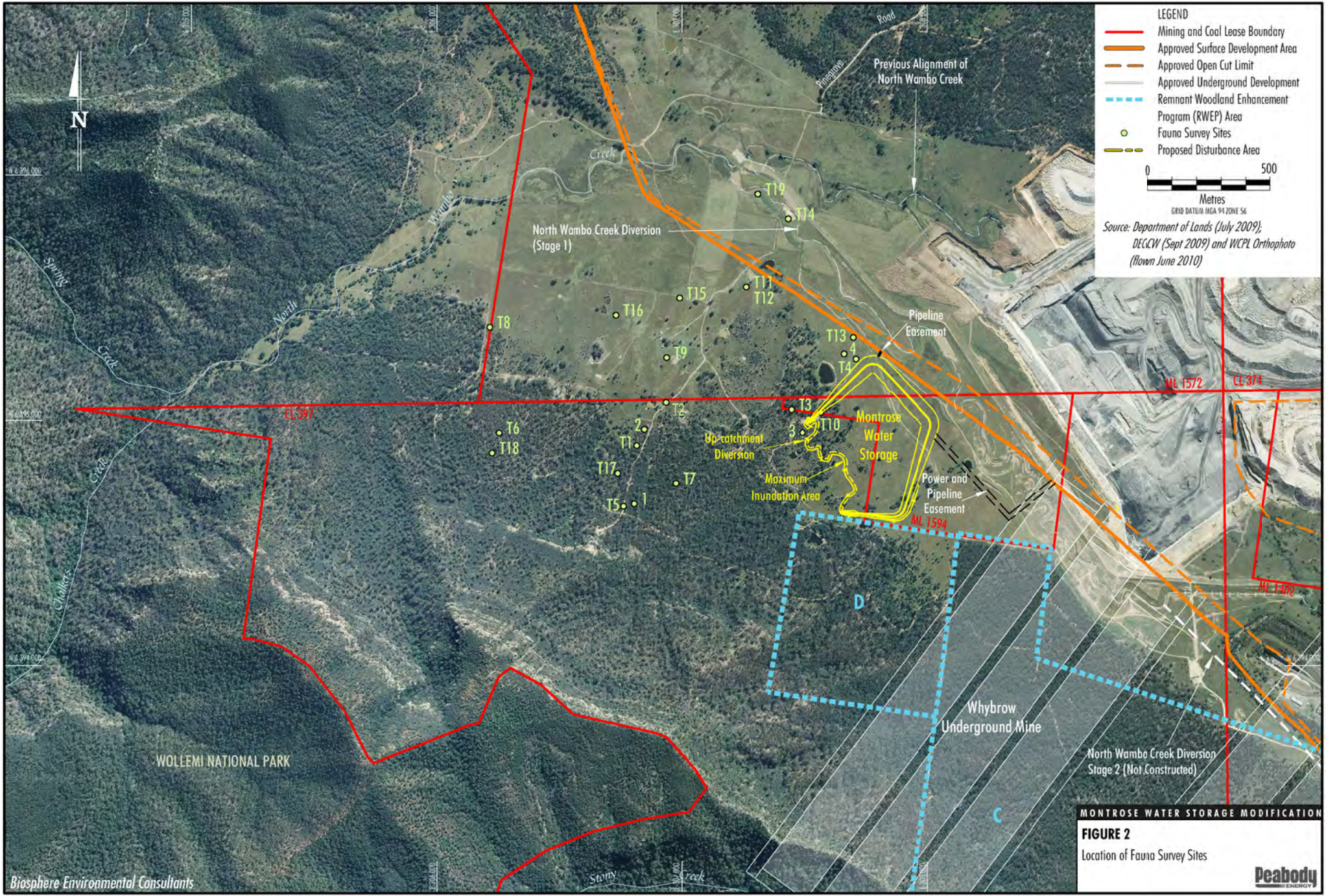
1.2 BIOGEOGRAPHIC AND ZOOGEOGRAPHIC REGIONAL SETTING

1.2.1 Sydney Basin Bioregion

Thackway and Cresswell (1995) describe a bioregion as a *complex land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout*. Bioregional descriptions seek to describe the dominant landscape scale attributes of climate, lithology, geology, landform and vegetation.

Bioregions provide a way of viewing landscape and biotic patterns in ecological terms, since they represent major structural geologies and climatic differences, particularly where geomorphology is the major driver of soil and vegetation (Morgan, 2001; Smart, 2002). Thackway and Cresswell (1995) argued that bioregions provide a relatively homogenous landscape with their associated biota, as well as linking ecosystems with relatively strong linkages compared with those found between bioregions.





MONTROSE WATER STORAGE MODIFICATION

FIGURE 2
Location of Fauna Survey Sites

As such, the boundaries of bioregions and sub-regions (where rainfall may over-ride geomorphology to some extent) (Smart, 2002):

- *Provide a fundamental framework within which finer scale assessments of biodiversity distribution, condition, priorities and monitoring should take place.*
- *Provide a basis for communicating this information and these finer priorities at a State, national and international level in a standard format.*

The study area and surrounds lie wholly within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion on the NSW central coast. The Sydney Basin bioregion covers an area of approximately 3,632,890 hectares (ha) and extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee (Commonwealth Department of the Environment, Water, Heritage and the Arts [DEWHA], 2007).

As in most parts of the Great Dividing Range, the coastal side of the divide along the Great Escarpment features deep gorges eroded by streams and cliff faces back into the uplifted block (DEWHA, 2007). The frontal slope of the Blue Mountains is formed along the Lapstone monocline. A secondary flexure and similar escarpments occur at the coast forming the Hornsby Plateau and the Illawarra escarpment. These structural features combine with different rock types and strong trends in joint patterns to control drainage patterns and the distribution of gorges and swamps (DEWHA, 2007). Much of the Basin landscape is elevated sandstone plateau with the exceptions being the Hunter Valley and the low-lying Cumberland Plain. In the south and west the Basin ends in cliff lines formed on sandstones and conglomerates of the basal Permian sediments (DEWHA, 2007).

The Sydney Basin bioregion is characterised by Mesozoic sandstones and shales, dissected plateaus, forests, woodlands and heaths, skeletal soils, sands and podzolics (Environment Australia, 2000).

1.2.2 Zoogeographic Region

The study area and surrounds are also located within the Bassian zoogeographic region proposed by Spencer (1896) (and modified by Schodde [1994]) (cited in Date *et al.* [2000]). The Bassian zoogeographic region (coastal zone) is a coarse but more useful predictor of faunal assemblages than the Sydney Basin IBRA bioregion. While IBRA bioregions have helped to rationalise our understanding of landscape patterns, fauna species tend to respond more to vegetation structure (i.e. grassland, woodland and forest) rather than to particular vegetation communities *per se*.

1.3 PREVIOUS FAUNA SURVEYS

A wider ranging fauna survey was carried out in 2003 (Mount King Ecological Services, 2003) as part of the preparation of the Environmental Impact Statement for the Wambo Development Project. Annual fauna surveys have also been conducted at Wambo (HLA-Envirosciences Pty Ltd, 2007; RPS Harper Somers O'Sullivan, 2007, 2008, 2009) as part of the ecological monitoring program for Remnant Woodland Enhancement Program. Based on the 2003, 2007, 2008, 2009 and Project specific 2010 surveys, the fauna attributes of the study area are well understood.

1.4 DESCRIPTION OF THE STUDY AREA

1.4.1 General

The study area includes areas of cleared grazing land and low, regenerating woodland within and immediately west of the approved open cut disturbance footprint. The majority of the study area is on flat, alluvial soil. The south-western portion of the study area backs onto a steep slope area that grades into a sandstone escarpment and then the Wollemi National Park. The extreme southern margins of the study area extend onto the low conglomerate foothills at the base of these escarpments. The escarpments and the Wollemi National Park lie outside of the boundaries of the study area and would not be affected by the Project.

1.4.2 Climate

Based on the long-term records at the Commonwealth Bureau of Meteorology weather station at Jerrys Plains Post Office, 10 km north-west of the Wambo Coal Mine, rainfall (across the study area and surrounds) ranges between approximately 230 and 1,200 millimetres (mm) per year. The total annual rainfall at Wambo between 2006-2007 and 2009-2010 has ranged between 564 and 787 mm.

1.4.3 Hydrology and Topography

Surface elevations in the study area range from approximately 100 metres (m) Australian Height Datum (AHD) to approximately 300 m AHD. There are no permanent creeks or streams in the study area, however there are eight existing small farm dams.

1.4.4 Geology and Soils

The study area is dominated by alluvial soils derived from the weathering of Narrabeen Group shales. The alluvial soils consist of silts and fine-grained sands. Towards the southern end of the study area, pebbles of quartzite and jasper become common in the soil from stones that have washed out from the exposed Widden Brook Conglomerate that form the lower foothills of the southern escarpment.

1.4.5 Vegetation and Habitat Types

Vegetation communities in the study area and surrounds have been mapped by FloraSearch (2012).

In general, the north-eastern half of the study area consists of cleared pasture while the south-western half of the study area contains regenerating woodland. The dominant woodland type in the study area is Narrabeen Foothills Slaty Box Woodland, dominated by dense copses of spindly, relatively-smooth-barked Slaty Gum (*Eucalyptus dawsonii*). In the far southern portion of the study area low stands of Acacia Exposed Heathland flourish on the conglomerate outcrops and talus. Along the eastern boundary of the sector are longitudinal rounded gullies that catch runoff from the nearby escarpment. The only other vegetation community of note occurs in isolated pockets in the north-eastern portion of the study area with a mixed woodland of ironbarks and Slaty Gum.

Vegetation units cannot necessarily be equated with vertebrate fauna habitats since vertebrate species respond primarily to a complex variety of factors including local climate, vegetation species, structure, vegetation formation and density, flowering timing and frequency, fire history, specialised habitats (including swamps and waterways), and topographic and geological variability.

1.4.6 Possible Occurrences of Threatened Species

A number of database and information sources were used to identify threatened species which may occur in the study area, including:

- The NSW Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife (DECCW, 2010) using a search area of a 15 km radius from a point centred on the study area.
- EPBC Act Protected Matters Report Search (DEWHA, 2010) using a search area of a 15 km radius from a point centred on the study area.
- Birds Australia database records (Birds Australia, 2010) using a search area of a 15 km radius from a point centred on the study area .
- Australian Museum database records (Australian Museum, 2010) using a search area of a 15 km from a point centred on the study area.
- Threatened fauna species previously considered possible occurrences at the Wambo Coal Mine or surrounds prior to the Wambo Development Project terrestrial fauna surveys (Greg Richards and Associates, 2003; Mount King Ecological Surveys, 2003).
- The threatened fauna species recorded at the Wambo Coal Mine or surrounds by Greg Richards and Associates (2003), Mount King Ecological Surveys (2003), HLA Envirosiences Pty Ltd (2007) and RPS Harpers Somers O'Sullivan (2007, 2008, 2009).

Threatened species database search results are presented in Attachment A. Threatened fauna species considered possible occurrences within the study area or immediate surrounds are listed in Table 1. Considering the poor quality of the fauna habitat present within the proposed disturbance footprint, this list is considered to be highly conservative. This list more accurately reflects the higher quality fauna habitats located outside of the proposed disturbance footprint along the escarpment and up into the Wollemi National Park.

Table 1
Threatened Fauna Species Considered Possible Occurrences
in the Study Area and Surrounds

Scientific Name	Common Name	Conservation Status ¹	
		TSC Act	EPBC Act
Amphibians			
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V
Birds			
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-
<i>Circus assimilis</i>	Spotted Harrier	V	-
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-
<i>Rostratula australis</i>	Australian Painted Snipe	E	V
<i>Calyptorhynchus lathami</i>	Glossy Black-cockatoo	V	-
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-
<i>Neophema pulchella</i>	Turquoise Parrot	V	-
<i>Lathamus discolor</i>	Swift Parrot	E	E
<i>Tyto tenebricosa</i>	Sooty Owl	V	-
<i>Tyto novaehollandiae</i>	Masked Owl	V	-
<i>Ninox strenua</i>	Powerful Owl	V	-
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-
<i>Pyrrholaemus saggitatus</i>	Speckled Warbler	V	-
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E
<i>Grantiella picta</i>	Painted Honeyeater	V	-
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-
<i>Petroica phoenicea</i>	Flame Robin	V	-
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-
<i>Pachycephala olivacea</i>	Olive Whistler	V	-
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-
Mammals			
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (SE mainland population)	V	E
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-
<i>Nyctophilus corbeni</i>	Greater Long-eared Bat (south-eastern form)	V	V
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-
<i>Scoteanax rueppelli</i>	Greater Broad-nosed Bat	V	-
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-

¹ Threatened species status listed under the TSC Act and EPBC Act (current as at June 2012).

V = Vulnerable

E = Endangered

CE = Critically Endangered

2 SURVEY METHODS

This section describes the methodology used during the fauna surveys including the survey timing and conditions (Section 2.1), selection of fauna survey sites (Section 2.2), fauna survey techniques (Section 2.3), habitat assessment methodology (Section 2.4) and criteria used for determining species relative abundance (Section 2.5). While the systematic survey locations are located immediately adjacent to the Project area, data collected by this and other fauna studies (Section 1.3) are considered to be representative of the habitats within the Project area. In addition, the results of the recent flora surveys (Florasearch, 2012) have also been used to describe fauna habitats present and their condition.

2.1 SURVEY TIMING AND CONDITIONS

Fauna surveys were conducted in the study area from 13 to 17 September 2010 by Biosphere Environmental Consultants Pty Ltd.

Moon phase, temperature and rainfall records during the survey period are provided in Table 2. Maximum temperatures ranged from 18.7 to 23.6 degrees Celsius (°C) and minimum temperatures from 7.0 to 12.5°C during the survey period (Table 2).

Table 2
Temperatures, Total Rainfall and Moon Information for the Survey Period

Date	Rainfall (mm)	Temperature (°C)		Moon Phase
		Minimum	Maximum	
13/9/10	0	11.2	23.6	-
14/9/10	6.7	12.5	21.9	-
15/9/10	0.4	8.8	22.8	First quarter
16/9/10	0	8.5	19.1	-
17/9/10	0	7.0	18.7	-

Source: Wambo Meteorological Station.

2.2 FAUNA SURVEY SITES

Four systematic survey sites (i.e. Sites 1 to 4) were established, with three sites located within areas of intact remnant vegetation and one site located in cleared agricultural land (Table 3, Figure 2). Systematic survey techniques (including trapping, direct observations and searches for tracks and scats) were carried out at each of the four sites. In addition, 19 targeted survey sites (i.e. Sites T1 to T19) were selected across the study area to maximise coverage of all fauna habitat types present (Table 3). Techniques undertaken at targeted survey sites were selected based on the habitat type present and included ultra-sonic bat recorders (ANABAT™) detectors, harp traps, spotlighting, herpetological searches, bird surveys, call playback and identification of tracks and traces. Opportunistic sightings were also recorded throughout the study area.

2.3 FAUNA SURVEY TECHNIQUES

The survey techniques utilised were based on DEC (2004) and DEC and DPI (2005) guidelines and are described below. The surveys were undertaken by a team of two people, led by Dr Arthur White. The survey effort implemented at each survey site is described in Attachment B.

Where necessary, species identifications were checked using the following references: Marchant and Higgins (1993); Cogger (2000); Barret *et al.* (2003); Menkhorst and Knight (2004); Morcombe (2004); Swan *et al.* (2004); Pizzey and Knight (2006); Churchill (2008); Van Dyke and Strahan (2008). Playback calls were selections from Stewart (1999a, 1999b) and mammalian tracks and traces were identified where possible using Triggs (2004).

**Table 3
Fauna Survey Sites**

Site	Eastings/Northings (AMG)		Site Location	Habitat Description
1	306701	6394471	Conglomerate slopes, south east corner of site	Woodland/heath
2	306742	6394774	Western side of central track	Woodland
3	307386	6394761	Eastern margin of site	Woodland
4	307556	6395082	North eastern margin of site	Woodland
T1	306711	6394708	Central track, south of perimeter fire trail	Narrabeen Slaty Box Woodland
T2	306830	6394884	Central track, north of perimeter fire trail	Narrabeen Slaty Box Woodland
T3	307341	6394855	Farm track, near Site 3	Gully Woodland
T4	307604	6395061	Farm track near Site 4	Central Hunter Box Woodland
T5	306658	6394461	Top conglomerate shelf, south end of site	Acacia Exposed Heathland
T6	306150	6394760	West end perimeter fire trail	Narrabeen Slaty Box Woodland
T7	306870	6394554	East end perimeter fire trail	Narrabeen Slaty Box Woodland
T8	306112	6395191	Farm track, south west paddock area	Narrabeen Slaty Box Woodland (5)
T9	306832	6395067	Dam C near central track, south of homestead	Narrabeen Slaty Box Woodland (5)
T10	307462	6394844	Dam D, near Site 3	Gully Woodland
T11	307157	6395355	Dam B, near central track	Cleared Pasture
T12	307157	6395355	Dam A near Site 4	Central Hunter Box Woodland
T13	307593	6395149	Dam E near front gate	Cleared Pasture
T14	307327	6395633	Old Homestead	Cleared Pasture
T15	306885	6395310	Dam G, south west paddock	Cleared Pasture
T16	306627	6395240	Dam F, near front gate	Cleared Pasture
T17	306634	6394595	Homestead dump site	Narrabeen Slaty Box Woodland
T18	306121	6394678	Lower foothills conglomerate south of perimeter fire trail	Narrabeen Slaty Box Woodland
T19	307204	6395734	Lower foothills conglomerate, south of perimeter fire trail	Cleared Pasture

Diurnal Herpetological Searches

Diurnal searches were conducted for reptiles and amphibians at all systematic survey sites (i.e. Sites 1 to 4) and at targeted survey sites where suitable habitat was available.

During the surveys, one person hour of diurnal herpetological searches was undertaken at all systematic survey sites over two days and one person hour of diurnal herpetological searches over one day was undertaken at targeted survey sites. In total, 12 person hours of diurnal herpetological surveys were undertaken.

Diurnal herpetological searches were carried out through a search of ground cover items such as rocks, logs and fallen branches. These items were uplifted and sheltering animals beneath were captured, identified and released. The search also looked for burrows, shed skins and droppings. Water bodies were also netted for tadpoles.

Nocturnal Herpetological Searches

Reptiles and amphibians were detected by spotlighting at night. One hour of spotlighting was undertaken over two nights at targeted survey sites where suitable habitat was available. Playback calls for Green and Golden Bell Frogs were also conducted.

Diurnal Birds

Bird surveys were conducted over two mornings at all systematic survey sites (i.e. Sites 1 to 4) and over one or two days at targeted survey sites. The surveys were conducted for 30 minutes along a 200 m transect. All birds seen or heard were recorded according to the DEC (2004) protocol.

Nocturnal Birds

Birds were also detected by spotlighting at night. One hour of spotlighting was undertaken over two nights at each systematic survey site (i.e. Sites 1 to 4) and at targeted survey sites.

Owl surveys were conducted at night using a small portable amplifier. Owl calls were broadcast over two nights at all systematic survey site (i.e. Sites 1 to 4) and at targeted survey sites for Southern Boobook Owls, Powerful Owls, Sooty Owls, Barking Owls, Masked Owls, and Barn Owls. Calls were played after a two minute initial listening period. The calls of each species were approximately two minutes in duration and were followed by a further five minute listening period before the next set of calls was broadcast.

Mammals

Twenty-five Elliott A traps, five Elliott B traps and five arboreal Elliott traps were set out in 200 m long trapping lines at each systematic survey site (i.e. Sites 1 to 4). The traps were checked each morning, closed during the day and reset each afternoon. All Elliott traps were in place at each systematic survey site over four consecutive nights.

Five cage traps were also set out at each systematic survey site (i.e. Sites 1 to 4) over four consecutive nights.

Searches for the tracks and traces of mammals were combined with other survey activities at systematic and targeted survey sites. Searches were conducted for tracks, burrows, fur and bone, scats, drays and trees were examined for scratch marks and bite notches.

Spotlighting for mammals was combined with other nocturnal survey activities. Thirty minutes of spotlighting was undertaken by two people over two nights at each systematic survey site (i.e. Sites 1 to 4) and at targeted survey sites.

Playback calls were played for Squirrel Gliders, Yellow-bellied Gliders, Sugar Gliders and Koalas in areas where potential habitat was present.

Bats

Flying foxes were detected by spotlighting at night. Insectivorous bats were detected using ANABAT™ recorders. These recorders were set to record over bat flyways and were left in location and recorded opportunistically from dusk to dawn. Each site was sampled for two consecutive nights. Recorded bat calls were analysed using ANABAT™ 5.0 software.

Harp traps were also set out over bat flyways.

Opportunistic Searches

Fauna were recorded opportunistically while moving through the study area.

2.4 HABITAT ASSESSMENT

A habitat assessment was conducted at each site based on visual observations. The habitat characteristics and parameters that were assessed included:

- aspect/slope;
- habitat layers and heights (e.g. litter, logs, grass-herb layer, understoreys and canopy);
- percent cover including vegetation components, bare soil and rock;
- rock formation, tree hollows;
- fire history;
- successional stage;
- tree/shrub density;
- habitat connectivity;
- presence of water;
- habitat condition and trends;
- dominant vegetation species; and
- disturbance characteristics (weed invasion, erosion, loss of functional integrity).

This information was recorded in a database and used to categorise and describe the broad fauna habitat types within the study area.

2.5 RELATIVE ABUNDANCE

The relative abundance of each species recorded was estimated as follows:

- 1 One sighting of the species, or at least one trace found.
- U Uncommon, two to five observations of the species, as well as an assessment of how widespread and persistent the species was.
- C Common, six to 30 observations of the species, as well as an assessment of how widespread and persistent the species was.

Hence, relative abundance was based on empirical data as well as being a value judgement made by an experienced surveyor.

3 SURVEY RESULTS

3.1 MAJOR FAUNA HABITAT TYPES

The topographical and geological characteristics of an area have a major impact on the types of habitat present. The two major topographic and geological units identified within the study area are discussed in Section 1.4.5 and include the broad alluvial plain that makes up the bulk of the study area, and the conglomerate-dominated foothills that demarcate the southern portion of the study area.

The habitats identified within the study area and surrounds can be broadly categorised into five habitat types, as listed below.

- Open Pasture Land on Alluvial Plains.
- Farm Dams.
- Low Regenerating Woodland on Alluvium.
- Mixed Woodland and Heath on Low Talus.
- Conglomerate Exposures and Caves.

The habitats Mixed Woodland and Heath on Low Talus and Conglomerate Exposures and Caves occur well outside of the Project area and would not be impacted by the Project.

3.1.1 Open Pasture Land on Alluvial Plains

The majority of the study area lies on unconsolidated alluvial soil derived from the weathering of shales and conglomerates from Narrabeen series rocks. The northern half of the study area is a broad, relatively flat expanse of cleared land that has minimal regeneration (Plate 1). This area is divided into several paddocks and native grasses have been replaced by exotic grasses and pasture. There are no watercourses in this area.



Plate 1: Pasture Land in the Northern Area of Study Area

The clearing of the land for agriculture has not only removed most of the trees and shrubs, but has also resulted in stumps and logs being removed or destroyed. As there are no rock outcrops in this area, there are few solid ground shelter items for terrestrial fauna.

Open Pasture Land on Alluvial Plains is the predominant fauna habitat in the proposed Project area.

3.1.2 Farm Dams

There are eight existing farm dams in the study area. They vary in size and diameter; the largest being the dam near site 4 (Plate 2). Some dams lie out in open pasture without any tree cover (e.g. dams at T11, T13 and T16) while others have a few trees along the side of the dam wall (e.g. dams at T10, T12 and T15). Some of the dams have little or no emergent vegetation (e.g. dams at T11, T13 and T16) while others have patches of emergent vegetation (e.g. dams at T10, T12 and T15).



Plate 2: Farm Dam near Site 4 with Regenerating Woodland in the Background

3.1.3 Low Regenerating Woodland on Alluvium

The majority of the southern half of the study area lies on coarse alluvial soil that contains gravels and pebbles derived from the nearby Widden Brook conglomerate exposures. A large proportion of the area has been cleared but is in various stages of natural regeneration. The regenerating areas are either covered in dense stands of low *Acacia* or copses of saplings, mainly of Slaty Gum (*E. dawsonii*).

Fallen branches and fallen saplings within the regenerating woodland may provide some ground cover shelter for terrestrial fauna. There are no rocky outcrops present, however, there are low, rounded gullies that receive rapid runoff from the escarpment area further to the south, some of which lead directly to farm dams nearby.

Along the eastern fringes of the study area, narrow rounded gullies contain small stands of Paperbarks (*Melaleuca*). These areas receive some directed runoff from the talus areas to the south but no open water is evident in these areas.

Areas of Low Regenerating Woodland on Alluvium habitat exist within the Project area.

3.1.4 Mixed Woodland and Heath on Low Talus

A small area to the south of the study area, well outside of the Project area, lies on low talus composed of decomposing conglomerate. This area is vegetated by tall but spindly Slaty Gum and ironbark trees. Some logs and large fallen branches that provide some ground cover shelter for terrestrial fauna are present among the gravel mounds and scour gullies in this area. Mixed Woodland and Heath on Low Talus habitat would not be impacted by the Project.

3.1.5 Conglomerate Exposures and Caves

The extreme southern margins of the study area, well outside of the Project area, verge onto large exposures of conglomerate. Where erosion is active, horizontal benches of conglomerate have been exposed. The conglomerate exposures support little vegetation other than low herbs and sparse shrubs. In some places, erosion has created caves and overhangs within the conglomerate. Most of the caves are shallow but are used as refuge areas by terrestrial animals, most notably Eastern Wallaroos. The conglomerate exposures and caves would not be impacted by the Project.

3.2 FAUNA SPECIES DIVERSITY AND RELATIVE ABUNDANCE

3.2.1 Species Diversity Across Survey Sites

Species diversity across survey sites for amphibians, reptiles, birds, introduced birds, mammals and introduced mammals is provided in Table 4.

**Table 4
Distribution of Fauna Species Across Survey Sites**

	Survey Sites											
	1	2	3	4	T1	T2	T3	T4	T5	T6	T7	T8
No. Native Amphibians	0	0	0	0	0	0	0	0	0	0	0	0
No. Native Reptiles	2	2	4	3	0	0	0	0	2	1	0	0
No. Native Birds	18	19	23	13	1	0	0	0	8	7	8	11
No. Introduced Birds	0	0	0	0	0	0	0	0	0	0	0	0
No. Native Mammals	3	0	1	2	4	4	2	0	1	3	2	4
No. Introduced Mammals	0	3	4	3	0	1	1	1	0	0	0	1
Total Native Species	23	21	28	18	5	4	2	0	11	11	10	15

	Survey Sites											
	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	
No. Native Amphibians	7	5	5	6	3	0	7	2	0	0	0	
No. Native Reptiles	2	2	2	2	0	4	3	1	2	1	0	
No. Native Birds	1	7	0	6	1	3	0	3	4	0	4	
No. Introduced Birds	0	0	0	0	0	0	0	0	0	0	1	
No. Native Mammals	3	2	1	2	0	2	0	1	1	1	0	
No. Introduced Mammals	2	0	1	1	1	2	1	1	0	0	0	
Total Native Species	13	16	8	16	4	9	10	7	7	2	4	

Native species diversity varied between zero and 28 species per site. Amphibians were not sampled at systematic survey sites as there was no water present. Amphibian surveys were conducted at targeted survey sites near farm dams and channels. Amphibian diversity ranged from zero to seven species, reptile diversity ranged from zero to four species, bird diversity ranged from zero to 23 species and mammal diversity from zero to four species (Table 4).

3.2.2 Species Composition and Abundance

During the survey, a total of 99 species were identified in the study area (including 93 native and 6 introduced species). A total of nine amphibians, 11 reptiles, 61 birds and 18 mammals were located in the study area. A summary of the species located and their abundance is provided in Attachment C.

The number of fauna species in each of the three abundance groupings is illustrated in Table 5 below. Zero species were located based on one observation or trace, 20 species were assessed as uncommon and 79 species were assessed as common (Table 5; Attachment C).

**Table 5
Relative Abundance in Fauna Groupings**

Fauna Group	One Sighting/Trace	Uncommon (2 to 5 observations)	Common (6 to 30 observations)
Amphibians	0	1	8
Reptiles	0	2	9
Birds	0	13	48
Mammals	0	4	14

3.2.2 Amphibians

Nine native amphibian species were located during the survey (Attachment C). All of the frog records were made around the various farm dams and channels. Rain fell on the afternoon and night of 14 September making conditions highly suitable for frog surveys. The number of species located at each of the sampling sites varied between zero and seven species (Table 4). Five Myobatrachidae and four Hylidae were observed (Attachment C). The frog species most widely distributed across the study area was the Common Eastern Froglet (*Crinia signifera*) (Attachment C).

3.2.3 Reptiles

Eleven native reptile species were located during the survey (Attachment C). The number of species located at each of the sampling sites varied between zero and four species (Table 4). One Chelidae, seven Scincidae, two Agamidae, and one Elapidae were located (Attachment C).

This data indicates that reptiles are still diverse but that some taxa are conspicuously absent; namely the goannas and geckoes. This may reflect the previous extent of clearing of the site and the loss of habitat for these animals.

3.2.4 Birds

Sixty-one bird species were identified during the survey, of which only one was a non-native species (Attachment C). The number of species located at all sampling sites varied between zero and 23 species (Table 4).

Overall, native bird species comprised one Phasianidae, three Anatidae, one Podicipedidae, one Ardeidae, one Falconidae, one Accipitridae, two Charadriidae, three Columbidae, three Psittacidae, two Cuculidae, one Alcedinidae, one Maluridae, two Pardalotidae, seven Acanthizidae, five Meliphagidae, two Petroicidae, one Pomatostomidae, one Neosittidae, two Pachycephalidae, four Dicuridae, four Artamidae, one Campephagidae, one Oriolidae, one Corvidae, one Corcoracidae, two Hirundinidae, two Sylviidae, one Dicaeidae, one Motacillidae and two Estrildidae were recorded (Attachment C).

Birds most widely distributed across the study area included the Brown Thornbill (*Acanthiza pusilla*), Yellow-faced Honeyeater (*Lichenostomus chrysops*) and Rufous Whistler (*Pachycephala rufiventris*) (Attachment C).

This data indicates that bird diversity is relatively high, especially in the southern portion of the study area where larger stands of regenerating bushland occur.

3.2.5 Mammals

Eighteen mammal species were located during the survey, 13 of which were native (Attachment C). The number of native mammal species located at each of the sampling sites varied between zero and four species (Table 4).

The native mammals included one Dasyuridae, one Vombatidae, one Petauridae, one Phalangeridae, two Macropodidae, one Molossidae and six Vespertilionidae and (Attachment C).

These data indicate that mammal diversity is much less than expected and probably is a reflection on the impact of previous land clearing and the impact of introduced mammals in the area.

3.2.6 Introduced Fauna

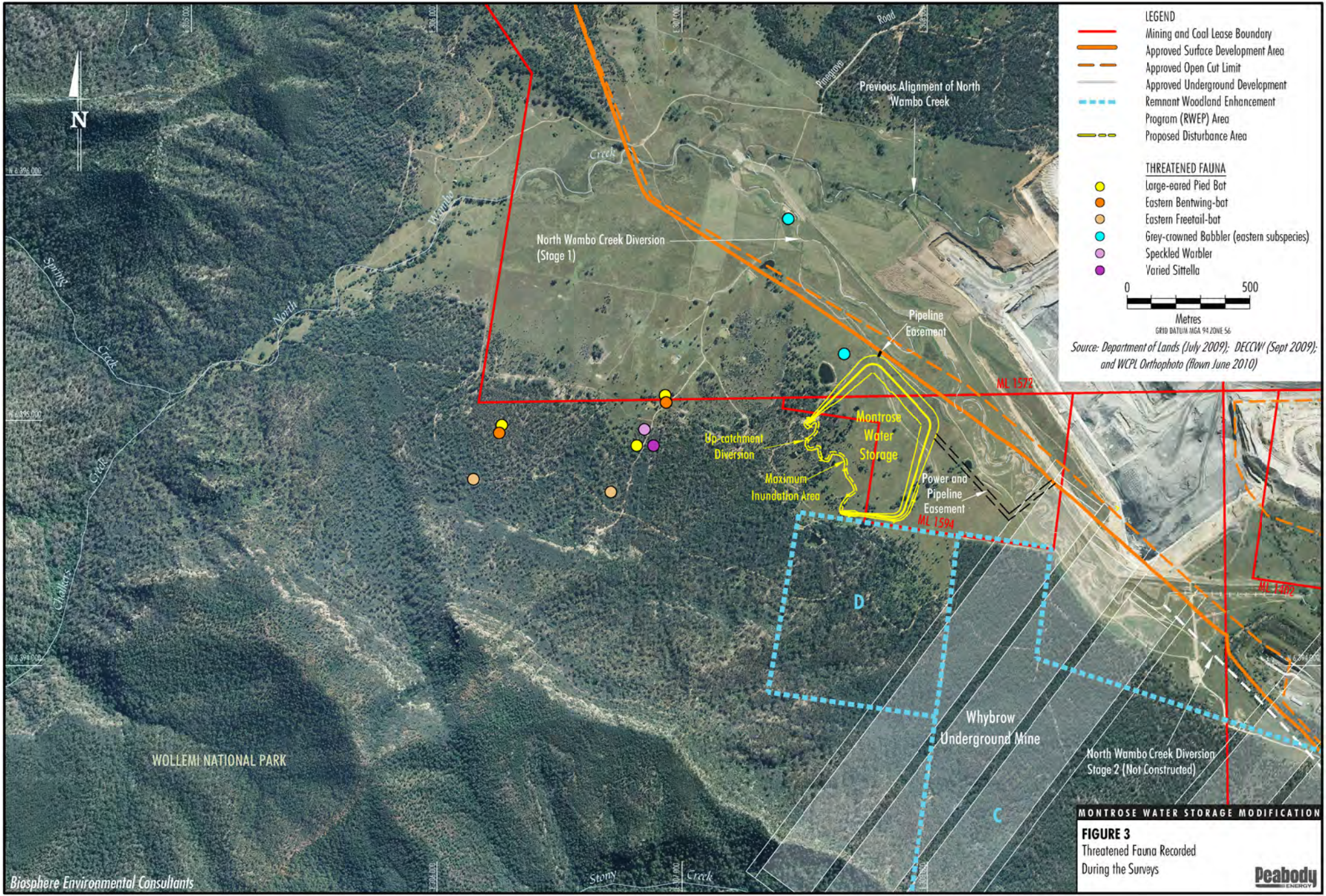
One introduced bird and five introduced mammal species were located during the survey (Attachment C). The number of introduced species located at each of the sample sites varied between zero and four species (Table 4).

The species included the Common Starling (*Sturnus vulgaris*), House Mouse (*Mus musculus*), Red Fox (*Vulpes vulpes*), Brown Hare (*Lepus capensis*), Rabbit (*Oryctolagus cuniculus*) and Cattle (*Bos taurus*) (Attachment C).

Of particular note was the extent to which rabbits and hares was recorded across the study area. Hares were sighted at six sites, while rabbits were recorded at 13 sites (Attachment C). Both species were rated as common in abundance.

3.3 THREATENED FAUNA SPECIES

Six threatened species listed under the TSC Act and/or the EPBC Act were recorded during the surveys (Figure 3). These species, together with their sampling sites, respective location co-ordinates and numbers of individuals observed, are listed in Table 6.



**Table 6
Threatened Fauna Species Located During the Surveys**

Common Name	Scientific Name	Conservation Status ¹		Survey Sites	Location of Record (AMG)		Number of Individuals
		TSC Act	EPBC Act		Easting	Northing	
Birds							
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-	4	307556	6395082	11
				T14	307327	6395633	7
Speckled Warbler	<i>Pyrrholaemus saggitatus</i>	V	-	2	306742	6394774	2
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	Opp	306779	6394708	1
Mammals							
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	-	T1	306711	6394708	*
				T6	306150	6394760	*
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	T1	306711	6394708	1
				T2	306830	6394884	3
				T6	306150	6394760	2
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-	T2	306830	6394884	*
				T6	306150	6394760	*

¹ Threatened species status under the TSC Act and EPBC Act (current as at June 2012).

V = Vulnerable

* Species identified using ANABAT™ detectors and number of individuals unknown.

4 FAUNA IMPACT ASSESSMENT

4.1 POTENTIAL IMPACTS OF THE PROJECT ON FAUNA AND THEIR HABITATS

4.1.1 Vegetation Clearance

The construction of the water storage dam would involve the removal of approximately 21 ha of open pasture land on alluvial plains habitat and 2.6 ha of low regenerating woodland on alluvium habitat. The Project would also involve the construction of a powerline and water pipeline. Surface disturbance associated with the powerline would be limited to the installation of the individual powerpoles which would be located in cleared land. The water pipeline would be located above ground and require no additional surface disturbance. Therefore, the focus of the following impact assessment is on the dam wall and inundation area.

Animals can use native vegetation for foraging, roosting, movement, shelter and breeding. *Clearing of native vegetation* is recognised as a key threatening process listed under the TSC Act.

Surface disturbance activities for the Project may include habitat clearance impacts such as loss of hollow-bearing trees, removal of dead wood and dead trees and loss of habitat connectivity.

The removal of dead wood and dead trees is also a key threatening process listed under the TSC Act. Dead trees can provide tree hollows for a range of fauna hollow-nesting birds, bats and arboreal mammals recorded within the Project area. Fallen wood can provide habitat resources for fauna (e.g. lizards and nesting birds). The young regeneration in the Project area provides limited habitat opportunities compared to the mature woodland associated with the escarpment and Wollemi National Park located to the south-west of the proposed Project area.

Vegetation clearance required for the construction of the water storage dam would be conducted in accordance with the Vegetation Clearance Protocol included in the existing Wambo Coal Mine Flora and Fauna Management Plan, including:

- delineation of disturbance areas;
- pre-clearance surveys of habitat trees; and
- salvage of habitat features (e.g. hollow branches) for use in rehabilitation programs.

4.1.3 Other Direct or Indirect Impacts

Additional direct or indirect impacts to fauna and their habitat which may be relevant to the Project (albeit minor) include:

- Introduction of feral animals. The provision of refuge or scavenging areas (e.g. discarded food scraps and other rubbish) has the potential to increase populations of introduced fauna species in or around the Project area. Feral animals may cause increased competition with or predation on native fauna species.
- Increased bushfire risk. High frequency fire resulting in the disruption of lifecycle processes in plants and animals, and loss of vegetation structure is listed as a key threatening process under the TSC Act. The potential for bushfires to occur may be increased due to various activities associated with the Project (e.g. vehicles traversing tracks over grass).
- Increased vehicular traffic movements.

4.2 THREATENED FAUNA

This threatened fauna impact assessment has been prepared in accordance with Section 5A of the EP&A Act and the *Threatened Species Assessment Guidelines: The Assessment of Significance* (NSW Department of Environment and Climate Change, 2007).

The likelihood of the Project significantly affecting threatened species, populations or their habitats listed under the TSC Act has been assessed by considering the following factors:

- (a) *In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.*
- (b) *In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.*
- (c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
 - (i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*
 - (ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*
- (d) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*
- (e) *In relation to the habitat of a threatened species, population or ecological community:*
 - (i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed;*
 - (ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and*
 - (iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*
- (f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*
- (g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

Forty-six species listed as threatened under either the TSC Act and/or the EPBC Act were identified as having the potential to occur within the study area or surrounds (Table 1). These species included four frogs, one reptile, 23 birds (including raptors, parrots, owls, honeyeaters and woodland birds) and 18 mammals (including possums, the koala, macropods, bats and mice).

Six of these species were recorded by the fauna surveys, namely Eastern Free-tailed Bat, Large-eared Pied Bat, Eastern Bentwing Bat, Grey-crowned Babbler (eastern subspecies), Speckled Warbler and Varied Sittella (Section 3.3, Table 6 and Figure 3).

Notwithstanding the above and very conservatively, potential impacts of the Project on all 46 threatened species listed in Table 1 (i.e. all threatened species considered potential occurrences) have been considered as part of this assessment.

Potential impacts of the Project on fauna and their habitats are described in Section 4.1. A number of threatened species have the potential to utilise habitat within the proposed location of the water storage dam. While the removal of habitat has the potential to impact upon individuals (should they be present), the Project is considered unlikely to significantly affect threatened fauna species given:

- The area proposed to be cleared for the construction of the water storage dam is small (i.e. 21 ha of open pasture land and 2.6 ha of low regenerating woodland). As such, the Project would not result in the fragmentation or isolation of an area of habitat for a threatened fauna species.
- Large areas of high quality woodland habitat exists to the south and to the west of the Project area.
- Vegetation clearance for the Project would be undertaken in accordance with Vegetation Clearance Protocol included in the existing Wambo Coal Mine Flora and Fauna Management Plan (Section 4.1.1).
- The existing Wambo Coal Mine Flora and Fauna Management Plan also includes protocols to manage threats to fauna such as feral animals, noxious weeds and fires.

5 REFERENCES

- Australian Muesum (2010) *Database Records within the Following Search Area: -32.49650, 150.86460, -32.63440, 151.02120* Data Received: 15 November 2010.
- Barret, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003) *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Hawthorn East.
- Birds Australia (2010) *Database Records within the Following Search Area: -32.49650, 150.86460, -32.63440, 151.02120* Data Received: 25 November 2010.
- Churchill, S. (2008) *Australian Bats*. 2nd Edition. Reed New Holland, Sydney.
- Cogger, H.G. (2000) *Reptiles and Amphibians of Australia* (Sixth Edition). Reed New Holland, Sydney.
- Date, E.M., Goldney, D.C., Bauer, J. and Paull, D. (2000) *The distribution and abundance of endangered and vertebrate fauna in NSW White Cypress woodlands: implications of state forest management*. In Saunders, D., Mitchell, N. and Craig, J. (Eds.) *Conservation in Production Environments: Managing the Matrix*. Taupo, New Zealand. Surrey Beatty and Sons, Norton Chipping.
- Department of Environment and Conservation (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. Working Draft.
- Department of Environment and Conservation and Department of Primary Industries (2005) *Draft Guidelines for Threatened Species Assessment*.
- Department of Environment and Climate Change (2007) *Threatened Species Assessment Guidelines: The Assessment of Significance*.
- Department of Environment, Climate Change and Water (2010) *Threatened Species - DECCW Atlas Database Records for the Following Search Area: -32.49650, 150.86460, -32.63440, 151.02120*. Data Received: 19 August 2010.
- Department of the Environment, Water, Heritage and the Arts (2007) *Biodiversity Assessment - Sydney Basin*.
Website: <http://www.anra.gov.au/topics/vegetation/assssment/nsw/ibra-sydney-basin.html>
Date Retrieved: April 2010.
- Department of the Environment, Water, Heritage and the Arts (2010) *EPBC Act Protected Matters Search*. Search for co-ordinates: -32.49650, 150.86460, -32.63440, 151.02120.
- Environment Australia (2000) *Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1: Summary Report*.
- Florasearch (2012) *Montrose Water Storage Modification – Flora Assessment*.
- Greg Richards and Associates (2003) *Wambo Development Project Bat Fauna Assessment*.
- HLA Envirosiences Pty Limited (2007) *Terrestrial Fauna Survey*. Report prepared for Wambo Coal Pty Ltd.
- Marchant, S. and Higgins, J. (1993) *Handbook of Australian, New Zealand and Antarctic Birds*. Oxford University Press, Melbourne.

- Menkhorst, P. and Knight, F. (2004) *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne.
- Morcombe, M. (2004) *Field Guide to Australian Birds*. Steve Parish Publishing Pty Ltd, Archerfield, QLD.
- Morgan, G. (2001) *Delineation and description of the Eastern Environmental Subregions (provinces) in New South Wales*. NSW National Parks and Wildlife Service, Hurstville.
- Mount King Ecological Surveys (2003) *Terrestrial Fauna Survey. Wambo Coal Project*. Appendix HB of Wambo Coal Pty Ltd (2003) *Wambo Coal Mine Environmental Impact Statement*.
- Pizzey, G. and Knight, F. (2006) *The Field Guide to the Birds of Australia*. Edited by Menkhorst, P. Harper Collins Publishers, Australia.
- RPS Harpers Somers O'Sullivan (2007) *2007 Annual Ecological Monitoring Report*. Report prepared for Wambo Coal Pty Ltd.
- RPS Harpers Somers O'Sullivan (2008) *2008 Annual Ecological Monitoring Report*. Report prepared for Wambo Coal Pty Ltd.
- RPS Harpers Somers O'Sullivan (2009) *2009 Annual Ecological Monitoring Report*. Report prepared for Wambo Coal Pty Ltd.
- Schodde, R. (1994) *The Bird Fauna of Western New South Wales: Geography and Status*. pp 107-121 in Date, E.M., Goldney, D.C., Bauer, J. and Paull, D. (2000) *The distribution and abundance of endangered and vertebrate fauna in NSW White Cypress woodlands: implications of state forest management* in Saunders, D., Mitchell, N. and Craig, J. (Eds.) *Conservation in Production Environments: Managing the Matrix*. Taupo, New Zealand. Surrey Beatty and Sons, Norton Chipping.
- Smart, J.M. (2002) *The Bioregions of New South Wales, a practical guide to the assessment of their biodiversity*. NSW National Parks and Wildlife Service, Hurstville.
- Stewart, D.A. (1999a) *Bird and Mammal Calls of NE-NSW Western Slopes and Plains*. Nature Sound, Mullumbimby.
- Stewart, D.A. (1999b) *Australian Frog Calls*. Subtropical East, Nature Sound, Mullumbimby.
- Swan, G., Shea, G. and Sadler, R. (2004) *A Field Guide to the Reptiles of NSW*. Second Edition, Reed New Holland.
- Thackway, R. and Cresswell, I.D. (Eds) (1995) *An Interim Biogeographic Regionalisation for Australia: a Framework for Establishing a National System of Reserves, Version 4.0*. Australian Nature Conservation Australia, Canberra.
- Triggs, B. (2004) *Tracks, Scats and Other Traces. A Field Guide to Australian Mammals*. Revised edition, Oxford University Press, Melbourne.
- Van Dyke, S. and Strahan, R. (2008) *The Mammals of Australia, 3rd Edition*. Reed New Holland, Sydney.

ATTACHMENT A
THREATENED SPECIES DATABASE SEARCH

**Table A1
Threatened Fauna Species Database Search Results**

Scientific Name	Common Name	Conservation Status ¹		Source of Record				
		TSC Act	EPBC Act	EPBC Act Protected Matters Search ²	OEH Atlas of NSW Wildlife ³	Birds Australia ⁴	Australian Museum ⁵	WCPL Previous Survey Records ⁶
Amphibians								
<i>Mixophyes iterates</i>	Giant Barred Frog	E	E	●				
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	●				
<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	●				
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	●				
Reptiles								
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	●				
Birds								
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-					●
<i>Circus assimilis</i>	Spotted Harrier	V	-			●		
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-		●	●		
<i>Rostratula australis</i>	Australian Painted Snipe	E	V	●				
<i>Calyptorhynchus lathami</i>	Glossy Black-cockatoo	V	-		●			●
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	-		●	●		●
<i>Lathamus discolor</i>	Swift Parrot	E	E	●				
<i>Neophema pulchella</i>	Turquoise Parrot	V	-		●			●
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-		●	●		●
<i>Ninox strenua</i>	Powerful Owl	V	-					●
<i>Tyto tenebricosa</i>	Sooty Owl	V	-		●			
<i>Tyto novaehollandiae</i>	Masked Owl	V	-					●
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-		●	●		
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-		●	●		●
<i>Pyrrholaemus saggitatus</i>	Speckled Warbler	V	-		●	●		●

Table A1 (Continued)
Threatened Fauna Species Database Search Results

Scientific Name	Common Name	Conservation Status ¹		Source of Record				
		TSC Act	EPBC Act	EPBC Act Protected Matters Search ²	OEH Atlas of NSW Wildlife ³	Birds Australia ⁴	Australian Museum ⁵	WCPL Previous Survey Records ⁶
Birds (continued)								
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E	●	●			
<i>Grantiella picta</i>	Painted Honeyeater	V	-					●
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-		●	●		●
<i>Petroica phoenicea</i>	Flame Robin	V	-		●			
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-		●	●		●
<i>Pachycephala olivacea</i>	Olive Whistler	V	-		●			
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-		●	●		●
Mammals								
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (SE mainland population)	V	E	●	●			
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-		●			
<i>Phascolarctos cinereus</i>	Koala	V	-		●			
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-		●			
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-		●			●
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	●				●
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	●	●			●
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-		●			●
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V	-		●			●
<i>Miniopterus australis</i>	Little Bentwing-bat	V	-		●			●
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V	-		●			●
<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat (south-eastern form)	V	V	●				

Table A1 (Continued)
Threatened Fauna Species Database Search Results

Scientific Name	Common Name	Conservation Status ¹		Source of Record				
		TSC Act	EPBC Act	EPBC Act Protected Matters Search ²	OEH Atlas of NSW Wildlife ³	Birds Australia ⁴	Australian Museum ⁵	WCPL Previous Survey Records ⁶
Mammals (continued)								
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	●	●			●
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-		●			●
<i>Scoteanax rueppelli</i>	Greater Broad-nosed Bat	V	-					●
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-		●			
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	●			●	
<i>Pseudomys oralis</i>	Hasting River Mouse	E	E	●				

Notes:

- Nomenclature consistent with Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2006) *CSIRO List of Australian Vertebrates A Reference with Conservation Status*.

¹ Threatened species status under the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at June 2012).

V = Vulnerable E = Endangered CE= Critically Endangered

² Department of the Environment, Water, Heritage and the Arts (2010) *EPBC Act Protected Matters Search*. Search for co-ordinates: -32.49650, 150.86460, -32.63440, 151.02120.

³ Department of Environment, Climate Change and Water (now the Office of Environment and Heritage) (2010) *Threatened Species - DECCW Atlas Database Records for the Following Search Area: -32.49650, 150.86460, -32.63440, 151.02120*. Data Received: 19 August 2010.

⁴ Birds Australia (2010) *Database Records within the Following Search Area: -32.49650, 150.86460, -32.63440, 151.02120* Data Received: 25 November 2010.

⁵ Australian Museum (2010) *Database Records within the Following Search Area: -32.49650, 150.86460, -32.63440, 151.02120* Data Received: 15 November 2010.

⁶ Previous survey results have been sourced from the following:

Mount King Ecological Surveys (2003) *Wambo Development Project Terrestrial Fauna Assessment*.

Greg Richards and Associates (2003) *Wambo Development Project Bat Fauna Assessment*.

HLA-Envirosciences Pty. Ltd. (2007) *Terrestrial Fauna Survey Wambo Coal*.

RPS Harper Somers O'Sullivan Pty Ltd (2007) *Annual Ecological Monitoring Report - Wambo Coal*.

RPS Harper Somers O'Sullivan Pty Ltd (2008) *Annual Ecological Monitoring Report - Wambo Coal*.

RPS Harper Somers O'Sullivan Pty Ltd (2009) *Annual Ecological Monitoring Report - Wambo Coal*.

ATTACHMENT B
SURVEY EFFORT

**Table B1
Survey Effort**

Method	Site Effort	Total Effort
ANABAT™ detectors	1 ANABAT™ detector for 2 nights at Sites T9, T10, T11, T12, T13, T14, T15, T16.	16 ANABAT™ detector nights
Harp traps	One harp trap at T1, T2, T3, T4, T5, T6, T7, T8 for two nights.	16 trap nights
Spotlighting	Two person hours per site (i.e. Sites 1 to 4 and T5, T9, T12, T14, T15, T17, T18).	22 person hours
Diurnal herpetological searches	Up to 1 person hour per site on two days at Sites 1 to 4 and 1 person hour at T5, T14, T17, T18.	12 person hours
Nocturnal amphibian searches	One person hour per site on two nights at Sites T9, T10, T11, T12, T13, T15, T16.	7 person hours
Bird surveys	Thirty minutes on two days at each systematic survey site (i.e. Sites 1 to 4) and 30 minutes over one or two days at T5, T6, T7, T8, T9, T10, T11, T12, T13, T15, T19.	11 person hours
Call playback	Up to 20 mins at each systematic survey site on two nights (i.e. Sites 1 to 4) and up to 20 minutes on one or two nights at sites T5, T6, T7, T9, T12.	4.4 hours
Elliott A traps	Twenty-five Elliott A traps at Sites 1 to 4 for four nights.	400 trap nights
Elliott B traps	Five Elliott B traps at Sites 1 to 4 for four nights.	80 trap nights
Arboreal Elliott traps	Five arboreal Elliott traps at Sites 1 to 4 for four nights.	80 trap nights
Standard cage traps	Five traps at Sites 1 to 4 for four nights.	80 trap nights
Opportunistic observations	<i>Ad lib</i> across the study area.	<i>Ad lib</i>
Tracks and traces	<i>Ad lib</i> or when engaged in other activities above.	<i>Ad lib</i>

ATTACHMENT C

FAUNA SPECIES RECORDED DURING THE SURVEYS

**Table C1
Fauna Species Recorded During the Surveys**

Common Name	Scientific Name	Conservation Status ¹		Survey Sites ²	Relative Abundance ³	Method of Detection ⁴
		TSC Act	EPBC Act			
Amphibians						
MYOBATRACHIDE						
Common Eastern Froglet	<i>Crinia signifera</i>	-	-	T9, T10, T11, T12, T13, T15, T16	C	X, H
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>	-	-	T9, T15	C	X
Brown-striped Frog	<i>Limnodynastes peronii</i>	-	-	T11, T16	C	X, H
Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	-	-	T9, T12, T15	C	X, H
Dusky Toadlet	<i>Uperoleia fusca</i>	-	-	T9, T10, T11, T12, T13, T15	C	X, H
HYLIDAE						
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>	-	-	T9, T10, T12, T15	C	X, H
Broad-palmed Frog	<i>Litoria latopalmata</i>	-	-	T13	U	X, H
Peron's Tree Frog	<i>Litoria peronii</i>	-	-	T9, T10, T11, T12, T15	C	X, H
Verreaux's Tree Frog	<i>Litoria verreauxii</i>	-	-	T9, T10, T11, T12, T15	C	X, H
Reptiles						
CHELIDAE						
Snake-necked Turtle	<i>Chelodina longicollis</i>	-	-	T9, T10, T11, T12, T16	C	X
SCINCIDAE						
Cream-striped Shining-skink	<i>Cryptoblepharus virgatus</i>	-	-	1, 2, 3, 4, T5, T10, T14, T15	C	X
Copper-tailed Skink	<i>Ctenotus taeniolatus</i>	-	-	1, T5, T6, T17	C	X
Tree Skink	<i>Egernia striolata</i>	-	-	3, T2, T17, T18	C	X
Eastern Water-skink	<i>Eulamprus quoyii</i>	-	-	T12, T15	C	X
Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	-	-	2, 3, 4, T9, T14, T15, T17	C	X
Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>	-	-	4, T11, T14	C	X
Eastern Blue-tongue	<i>Tiliqua scincoides</i>	-	-	3, opp	U	X
AGAMIDAE						
Nobbi Dragon	<i>Amphibolurus nobbi</i>	-	-	Opp	C	X
Bearded Dragon	<i>Pogona barbata</i>	-	-	Opp	U	X
ELAPIDAE						
Eastern Brown Snake	<i>Pseudonaja textilis</i>	-	-	T14	C	X
Birds						
PHASIANIDAE						
Brown Quail	<i>Coturnix ypsilophera</i>	-	-	Opp	U	X
ANATIDAE						
Australian Wood Duck	<i>Chenonetta jubata</i>	-	-	T12, T16	C	X
Pacific Black Duck	<i>Anas superciliosa</i>	-	-	T12	C	X
Grey Teal	<i>Anas gracilis</i>	-	-	T1	C	X

Table C1 (Continued)
Fauna Species Recorded During the Surveys

Common Name	Scientific Name	Conservation Status ¹		Survey Sites ²	Relative Abundance ³	Method of Detection ⁴
		TSC Act	EPBC Act			
Birds (Continued)						
PODICIPEDIDAE						
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	-	-	T12, T13	C	X
ARDEIDAE						
White-faced Heron	<i>Egretta novaehollandiae</i>	-	-	T12	C	X
FALCONIDAE						
Australian Kestrel	<i>Falco cenchroides</i>	-	-	4, T19	C	X
ACCIPITRIDAE						
Wedge-tailed Eagle	<i>Aquila audax</i>	-	-	T6, Opp	C	X
CHARADRIIDAE						
Masked Lapwing	<i>Vanellus miles</i>	-	-	T12, T16	C	X
Black-fronted Dotterel	<i>Charadrius melanops</i>	-	-	T12	C	X
COLUMBIDAE						
Common Bronzewing	<i>Phaps chalcoptera</i>	-	-	4, Opp	C	X
Crested Pigeon	<i>Geophaps lophotes</i>	-	-	T14	U	X
Peaceful Dove	<i>Geopelia placida</i>	-	-	2	C	X
PSITTACIDAE						
Galah	<i>Cacatua roseicapilla</i>	-	-	3, T5, T16, T19	C	X
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	-	-	1, 2, 3, 4	C	X, H
Eastern Rosella	<i>Platycercus eximius</i>	-	-	3, 4, T8, T14	C	X
CUCULIDAE						
Fan-tailed Cuckoo	<i>Cuculus flabelliformis</i>	-	-	1, 2	C	X
Shining Bronze-Cuckoo	<i>Chalcites lucidus</i>	-	-	2, 3, T7, Opp	C	X
ALCEDINIDAE						
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	-	-	2	C	X, H
MALURIDAE						
Splendid Fairy-wren	<i>Malurus splendens</i>	-	-	1, 3, T10, Opp	C	X
PARDALOTIDAE						
Spotted Pardalote	<i>Pardalotus punctatus</i>	-	-	1, 4, T8.	C	X, H
Striated Pardalote	<i>Pardalotus striatus</i>	-	-	1	C	X
ACANTHIZIDAE						
Speckled Warbler	<i>Pyrrholaemus sagittatus</i>	V	-	2	U	X, H
Weebill	<i>Smicromis brevirostris</i>	-	-	3, Opp	C	X

Table C1 (Continued)
Fauna Species Recorded During the Surveys

Common Name	Scientific Name	Conservation Status ¹		Survey Sites ²	Relative Abundance ³	Method of Detection ⁴
		TSC Act	EPBC Act			
Birds (Continued)						
White-throated Gerygone	<i>Gerygone olivacea</i>	-	-	2, 3	C	X, H
Brown Thornbill	<i>Acanthiza pusilla</i>	-	-	1, 2, 3, T5, T6, T7, T8, T17	C	X
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	-	-	Opp	C	X
Yellow Thornbill	<i>Acanthiza nana</i>	-	-	2, T6, T10, T17	C	X
Striated Thornbill	<i>Acanthiza lineata</i>	-	-	2	C	X
MELIPHAGIDAE						
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	-	-	1, 2, 3, T5, T6, T7, T17	C	X
Noisy Minor	<i>Manorina melanocephala</i>	-	-	4	U	X
White-naped Honeyeater	<i>Meliphreptus lunatus</i>	-	-	4	U	X
Noisy Friarbird	<i>Philemon corniculatus</i>	-	-	1, 2, T8, Opp	C	X, H
Striped Honeyeater	<i>Plectorhynchus lanceolata</i>	-	-	1	U	X
PETROICIDAE						
Eastern Yellow Robin	<i>Eopsaltria australis</i>	-	-	1, 2, 3, T6, T7, T8	C	X
Red-capped Robin	<i>Petroica goodenovii</i>	-	-	3	U	X
POMATOSTOMIDAE						
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-	4, T14	C	X, H
NEOSITTIDAE						
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	Opp	U	X
PACHYCEPHALIDAE						
Rufous Whistler	<i>Pachycephala rufiventris</i>	-	-	1, 2, 3, T5, T6, T7, T8, T10, Opp	C	X, H
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	-	-	1, 2, T5, T7, T8	C	X
DICRURIDAE						
Rufous Fantail	<i>Rhipidura rufifrons</i>	-	-	2, 3, T8, T10	C	X
New Zealand Fantail	<i>Rhipidura fuliginosa</i>	-	-	3	U	X
Willie Wagtail	<i>Rhipidura leucophrys</i>	-	-	2	U	X, H
Magpie-lark	<i>Grallina cyanoleuca</i>	-	-	3, 4	C	X, H
ARTAMIDAE						
Grey Butcherbird	<i>Cracticus torquatus</i>	-	-	3, 4, T6, T7	C	X
Pied Butcherbird	<i>Cracticus nigrogularis</i>	-	-	1,3, 4, T5, Opp	C	X
Australian Magpie	<i>Gymnorhina tibicen</i>	-	-	T8, T19	C	X, H
Pied Currawong	<i>Strepera graculina</i>	-	-	1, T5, T7	C	X, H

Table C1 (Continued)
Fauna Species Recorded During the Surveys

Common Name	Scientific Name	Conservation Status ¹		Survey Sites ²	Relative Abundance ³	Method of Detection ⁴
		TSC Act	EPBC Act			
Birds (Continued)						
CAMPEPHAGIDAE						
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	-	-	1, T5, T17	C	X, H
ORIOLIDAE						
Olive-backed Oriole	<i>Oriolus sagittatus</i>	-	-	1, 2, 3	C	X
CORVIDAE						
Australian Raven	<i>Corvus coronoides</i>	-	-	1, 2, 3, 4, T6	C	X, H
CORCORACIDAE						
White-winged Chough	<i>Corcorax melanoramphos</i>	-	-	1, 3, 4, T8, Opp	C	X, H
STURNIDAE						
Common Starling*	<i>Sturnus vulgaris</i>	-	-	T19	C	X
HIRUNDINIDAE						
Welcome Swallow	<i>Hirundo neoxena</i>	-	-	3, T9, T10	C	X
Fairy Martin	<i>Petrochelidon ariel</i>	-	-	T10, Opp	C	X
SYLVIIDAE						
Little Grassbird	<i>Megalurus gramineus</i>	-	-	Opp	U	X
Golden-headed Cisticola	<i>Cisticola exilis</i>	-	-	3, Opp	C	X
DICAEIDAE						
Mistletoebird	<i>Dicaeum hirundinaceum</i>	-	-	3, Opp	C	X
MOTACILLIDAE						
Australian Pipit	<i>Anthus australis</i>	-	-	T19, Opp	C	X
ESTRILDIDAE						
Red-browed Finch	<i>Neochmia temporalis</i>	-	-	T10	U	X
Double-barred Finch	<i>Taeniopygia bichenovii</i>	-	-	T8	U	X
Mammals						
DASYURIDAE						
Brown Antechinus	<i>Antechinus stuartii</i>	-	-	1	U	X
VOMBATIDAE						
Common Wombat	<i>Vombatus ursinus</i>	-	-	T2, T8, T9, T14	C	X
PETAURIDAE						
Sugar Glider	<i>Petaurus breviceps</i>	-	-	T17, T18	C	X
PHALANGERIDAE						
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	-	-	1	C	X

Table C1 (Continued)
Fauna Species Recorded During the Surveys

Common Name	Scientific Name	Conservation Status ¹		Survey Sites ²	Relative Abundance ³	Method of Detection ⁴
		TSC Act	EPBC Act			
Mammals (Continued)						
MACROPODIDAE						
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	-	-	3, 4, T8, T9, T14, T16	C	X
Euro	<i>Macropus robustus robustus</i>	-	-	1, 4, T5, T7, T10	C	X
MOLOSSIDAE						
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	-	T1, T6	C	H
VESPERTILIONIDAE						
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	V	-	T2, T6	U	H
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	T1, T2, T6	C	H
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	-	-	T1,T6, T9,T12	C	H
Little Forest Bat	<i>Vespedelus vulturnus</i>	-	-	T1, T2, T3, T8, T10, T11, T12	C	H
Goulds Long-eared Bat	<i>Nyctophilus gouldii</i>	-	-	T3	U	H
Lesser long-eared Bat	<i>Nyctophilus geoffroyi</i>	-	-	T1, T7, T8	C	H
MURIDAE						
House Mouse*	<i>Mus musculus</i>	-	-	2, 3, 4	C	X
CANIDAE						
Red Fox*	<i>Vulpes vulpes</i>	-	-	3	U	X
LEPORIDAE						
Brown Hare*	<i>Lepus capensis</i>	-	-	2, 3, 4, T9, T11, T14	C	X
Rabbit*	<i>Oryctolagus cuniculus</i>	-	-	2, 3, 4, T2, T3, T4, T8, T9, T12, T13, T14, T15, T16	C	X
BOVIDAE						
Cattle*	<i>Bos taurus</i>	-	-	Opp	C	X

¹ Threatened species status under the NSW *Threatened Species Conservation Act, 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (current as at June 2012).

V = Vulnerable

² A prefix of 'T' denotes a targeted survey site. 'Opp' denotes an opportunistic sighting.

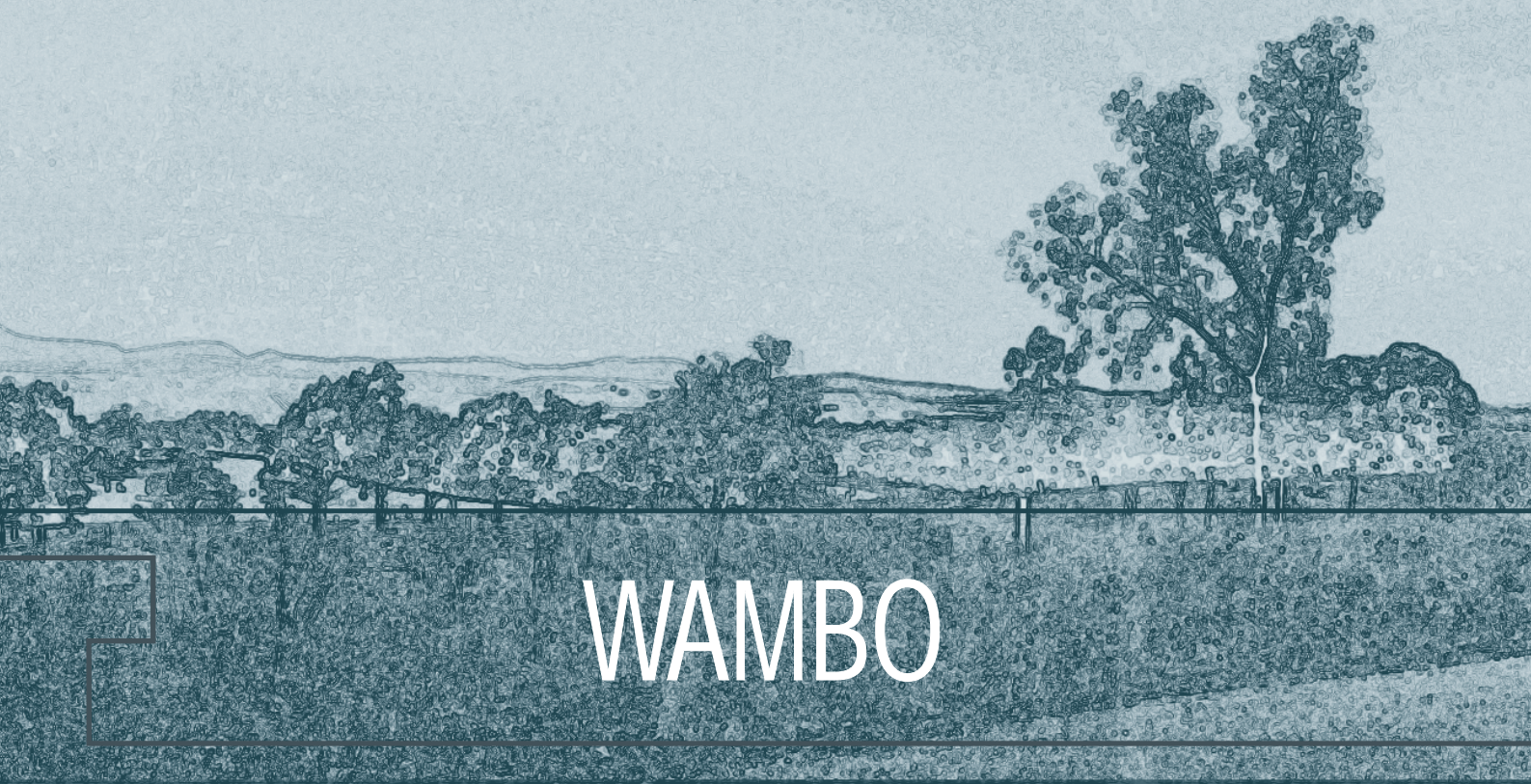
³ U Uncommon, 2-5 observations of the species, as well as an assessment of how widespread and persistent the species was.

C Common, 6-30 observations of the species, as well as an assessment of how widespread and persistent the species was.

⁴ X Visual Id.

H Heard, identified by call.

* Introduced species.



WAMBO

MONTROSE WATER STORAGE MODIFICATION
ENVIRONMENTAL ASSESSMENT

APPENDIX D

AGRICULTURAL RESOURCES ASSESSMENT

June
2012

Agricultural Resource Assessment: “Montrose Water Storage”, Wambo NSW

Prepared for Wambo Coal Pty. Ltd.



Contents

1.0	INTRODUCTION.....	1
1.1	<i>Background</i>	1
1.2	<i>Scope and Objectives</i>	1
2.0	MODIFICATION OVERVIEW	5
3.0	MONTROSE WATER STORAGE AREA DESCRIPTION	6
4.0	SOIL RESOURCES	7
4.1	<i>Review of Existing Information</i>	7
4.2	<i>Methodology</i>	13
4.3	<i>Soil Types</i>	18
4.4	<i>Soil Conditions for Plant Growth</i>	18
5.0	BIOPHYSICAL STRATEGIC AGRICULTURAL LAND ASSESSMENT.....	22
6.0	AGRICULTURAL PRODUCTIVITY	24
7.0	SOIL RESOURCE MANAGEMENT MEASURES.....	25
8.0	REFERENCES.....	27

List of Figures

Figure 1	Regional Location
Figure 2	Aerial Photograph of Wambo and Surrounds
Figure 3	Aerial Photograph of the Montrose Water Storage Area and Soil Pit Locations
Figure 4	Soil Landscapes Mapping
Figure 5	Geology Mapping
Figure 6	Strategic Agricultural Land in the Vicinity of Wambo
Figure 7	Rural Land Capability Mapping
Figure 8	Agricultural Suitability Mapping
Figure 9	The Link between ASWAT Results and Soil Management Options
Figure 10	Soil Types Identified during the Survey

List of Tables

Table 1	Soil landscape units (Kovac & Lawrie 1991) in the vicinity of the Montrose Water Storage
Table 2	The relationship between the Emerson aggregate stability test and the ASWAT test that assess the severity of dispersion when soil aggregates are added to water
Table 3	Soil types according to the Australian Soil Classification and Great Soil Groups
Table 4	Summary of Biophysical Strategic Agricultural Land Assessment
Table 5	Approximate productivity of the agricultural enterprises on the Montrose Water Storage area

List of Appendices

Appendix 1	Field Observations and Laboratory Data
------------	--

1.0 INTRODUCTION

1.1 Background

The Wambo Coal Mine (Wambo) is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW) (Figure 1). Wambo is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited (75%) and Sumiseki Materials Co. Ltd (25%).

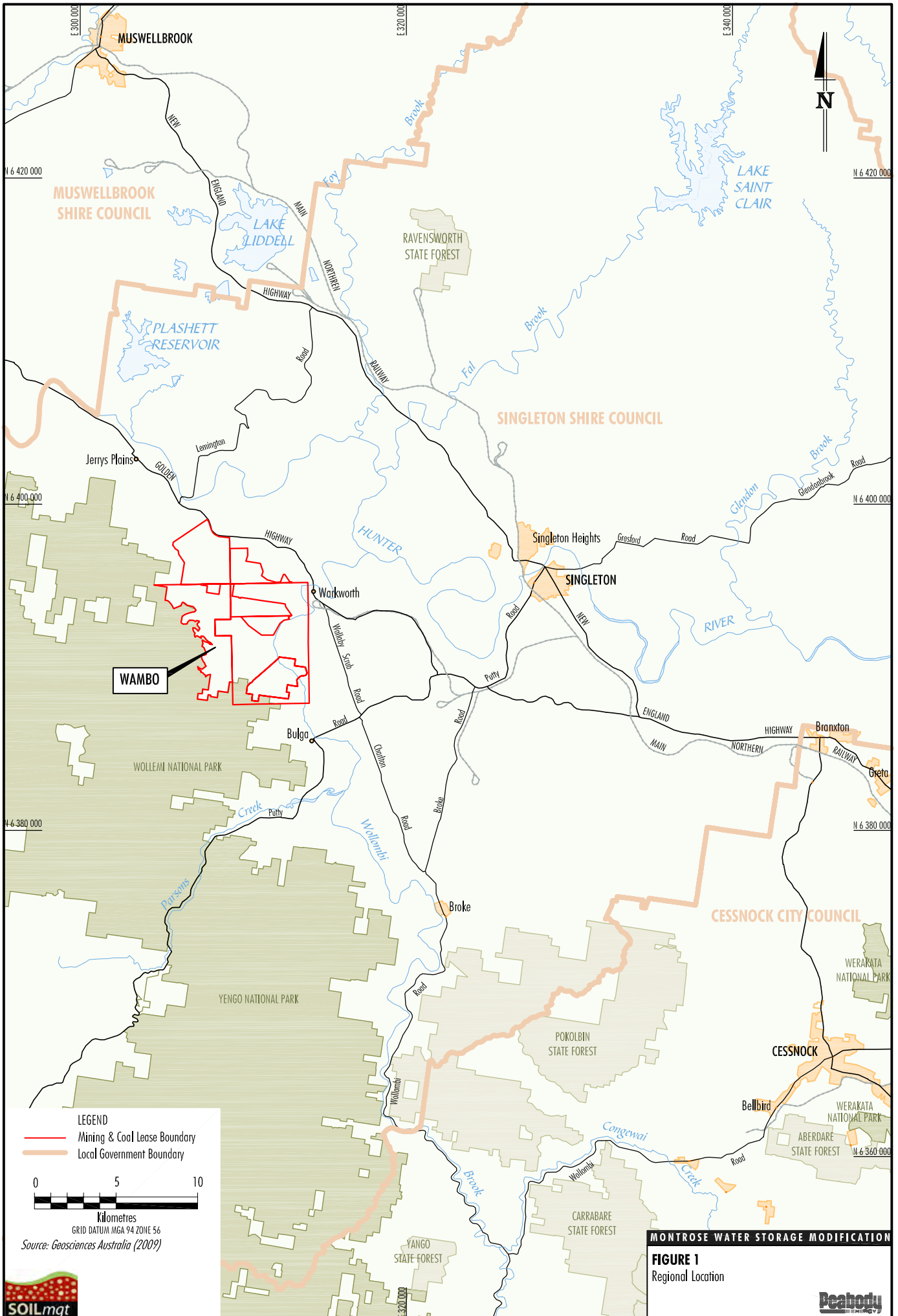
A range of open cut and underground mine operations have been conducted at Wambo since mining operations commenced in 1969. Mining under Development Consent DA 305-7-2003 commenced in 2004 and currently both open cut and underground operations are conducted. An aerial photograph of Wambo, illustrating the approved extent of the open cut and underground mine operations and locations of key infrastructure is provided on Figure 2.

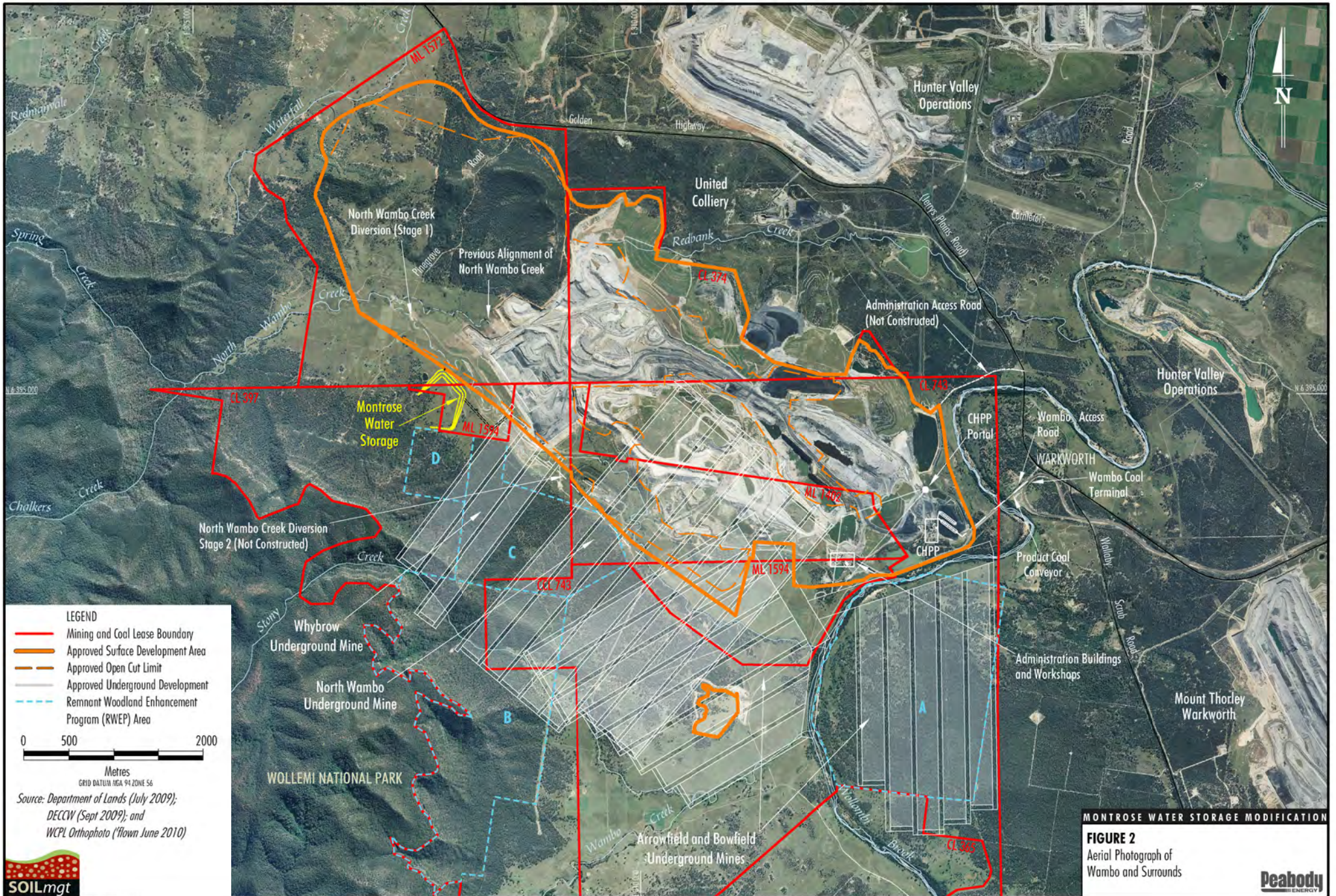
1.2 Scope and Objectives

This agricultural resource assessment has been prepared to support an application to modify Development Consent DA 305-7-2003 to allow for the construction and operation of the Montrose Water Storage and associated supporting infrastructure (i.e. pumps, pipelines and power) (Figures 2 and 3).

The objectives of this assessment were to provide the following:

- Describe the agricultural resources and enterprises of the lands associated with the Montrose Water Storage area.
- Recommend management measures for agricultural resources, with emphasis on soil assessment and management.





2.0 MODIFICATION OVERVIEW

The Modification would comprise the construction and operation of the Montrose Water Storage and associated supporting infrastructure (i.e. pumps, pipelines and power) (Figure 3).

The Montrose Water Storage would be a "turkey's nest" style dam located to the south-west of the approved open cut limit (Figure 3) and have a capacity of approximately 1,500 million litres (ML). The footprint of the Montrose Water Storage would be approximately 24 hectares (ha).

The design of the Montrose Water Storage would include aspects to minimise seepage, including constructing the embankments with a low permeability core and cut-off key that would be extended into competent basement material.

Up-catchment diversions would be constructed on the southern side of the Montrose Water Storage (Figure 3) to divert runoff around the Montrose Water Storage (i.e. no surface water runoff would be collected). The up-catchment diversions would divert runoff into existing drainage lines which report to the North Wambo Creek Diversion.

3.0 MONTROSE WATER STORAGE AREA DESCRIPTION

Wambo is located in the Upper Hunter Valley region where landforms are characterised by gently sloping flood plains associated with the Hunter River and the undulating foothills, ridges and escarpments of the Mount Royal Range and Great Dividing Range. Wambo adjoins grazing land to the south, other coal mining operations to the east and north, grazing land to the north-west and Wollemi National Park to the west and south-west.

Elevations in the vicinity of Wambo range from approximately 60 metres (m) Australian Height Datum (AHD) at Wollombi Brook to approximately 650 m AHD at Mount Wambo within the Wollemi National Park to the west of Wambo. Elevations in the Montrose Water Storage area range from approximately 100 m AHD at the North Wambo Creek Diversion to approximately 130 m AHD near the southern boundary (Figure 3).

Land use in the Montrose Water Storage area includes areas remnant vegetation and cleared grazing land (Figure 3). The cleared grazing land is under unimproved pasture. There is no evidence of recent cropping activities or vineyards in the Montrose Water Storage area.

Mean annual rainfall figures over a period of approx 120 years at the nearby towns of Jerrys Plains and Broke, respectively, are 645 millimeters (mm) (range = 234 to 1,191 mm) and 655 mm (range = 306 to 1,156 mm) (Bureau of Meteorology, 2012).

4.0 SOIL RESOURCES

4.1 Review of Existing Information

The following existing information relevant to the Montrose Water Storage area was reviewed for this agricultural resources assessment:

- Soil Profile Attribute Data Environment (SPADE) soil profiles (part of the NSW Natural Resource Atlas);
- Soil type and landscape mapping (Kovac and Lawrie, 1991);
- Geology Hunter Coalfield Regional Geology 1:100,000 Sheet (Department of Mineral Resources, 1993);
- Biophysical Strategic Agricultural Land (BSAL) mapping (NSW Government, 2012);
- Critical Industry Cluster mapping (NSW Government, 2012);
- Rural Land Capability mapping (Soil Conservation Services of NSW, 1985); and
- Agricultural Suitability mapping (NSW Agriculture, 1983).

A brief summary of relevant information from these reports is provided in the following subsections.

SPADE Soil Profile Database

A search of the NSW Government's SPADE website (part of the NSW Natural Resource Atlas) was conducted to identify any existing soil profile information in the Montrose Water Storage area. No SPADE soil profiles were located in the Montrose Water Storage area.

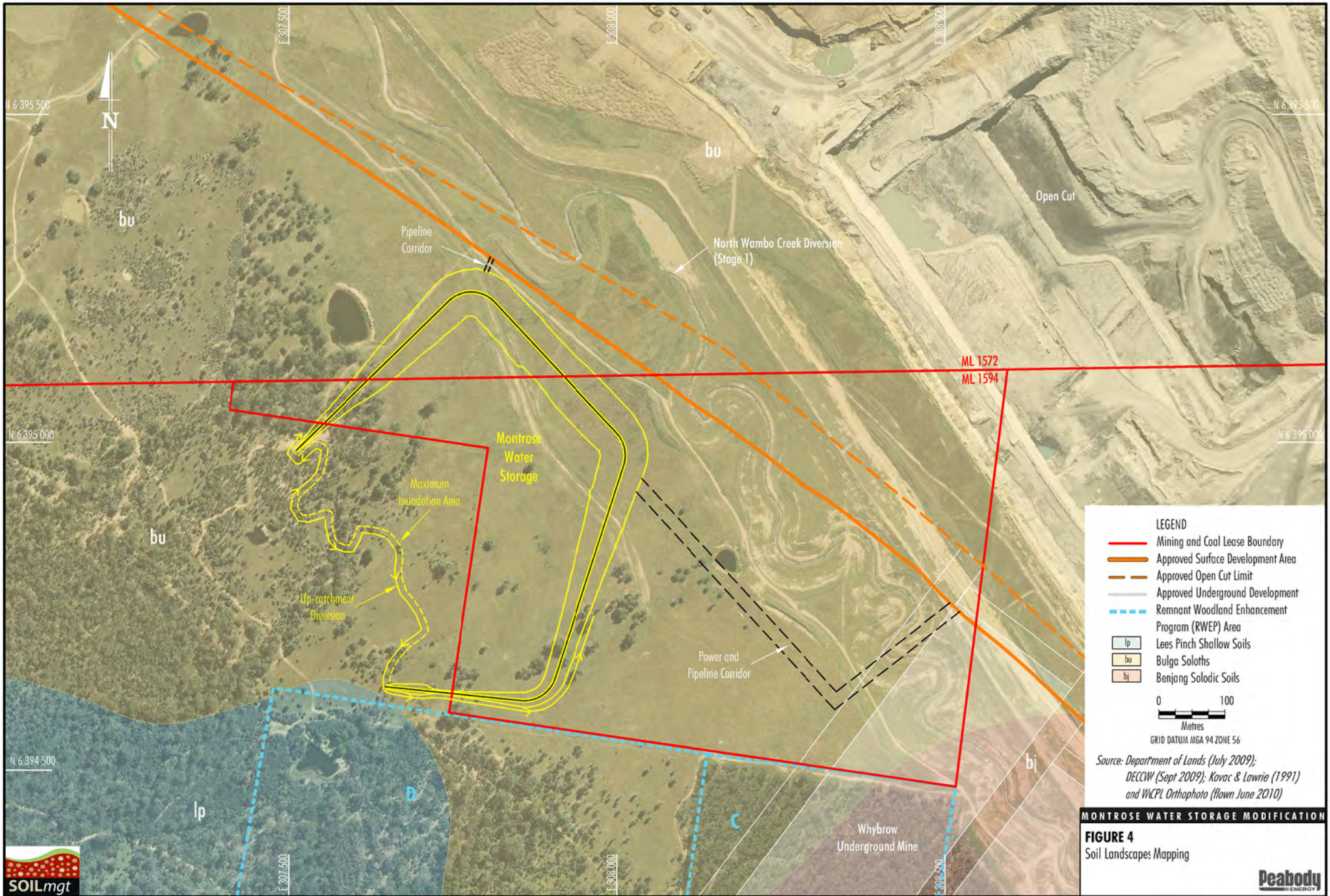
Soil Types and Landscapes

Figure 4 shows the location of soil landscape units as mapped and described by Kovac and Lawrie (1991) in the vicinity of the Montrose Water Storage. The descriptions of these units indicate the presence of soil conditions that generally are poor for plant growth (Table 1).

The Montrose Water Storage area is part of the 'Bulga Soloths' Soil Landscape unit.

Table 1. Soil landscape units (Kovac & Lawrie 1991) in the vicinity of the Montrose Water Storage

Soil landscape unit	Soil types present	Likely constraints for agricultural production based on these descriptions
Bulga Soloths (bu)	Yellow soloths on upper to midslopes; sometimes Yellow and Brown Solodic Soils and Brown Earths on lower slopes.	Poor aeration in subsoils when wet, very hard when dry. Prone to water erosion when bare. Acidic
Benjang Solodic Soils (bj)	Yellow, red and brown Solodic Soils on imperfectly drained benched slopes, with Brown Podzolic Soils on upper slopes and Non-calcic Brown Soils on lower parts of flatter slopes.	Poor aeration in subsoils when wet, very hard when dry. Prone to water erosion when bare.
Lees Pinch Shallow Soils (lp)	Shallow Silicious Sands, some Yellow and Brown Earths on footslopes. Yellow and grey Soloths in breaks of slope. Yellow Podzolic Soils and Earthy Sands on some upper slopes.	Very poor waterholding capacity, acidity and a lack of nutrients. Prone to water erosion when bare.



Geology / Parent Materials for Soil Formation

The Hunter Coal Fields Geology 1:100 000 map sheet shows the rock types that are the parent material for soil formation in the vicinity of the Montrose Water Storage are shown in Figure 5. The presence of siltstone and tuffaceous claystone in the 'Wollombi Coal Measures' and 'Wittingham Coal Measures' units indicates that there may be pockets of soil in the vicinity of the Montrose Water Storage with soil conditions significantly better than those shown in Table 1.

Biophysical Strategic Agricultural Land

The *Draft Upper Hunter Strategic Regional Land Use Plan* (DSRLUP) (NSW Government, 2012) includes mapping of lands identified as Biophysical Strategic Agricultural Land (BSAL). Figure 6 shows BSAL mapped in the vicinity of Wambo.

BSAL is classified as land with a soil fertility of 'high' or 'moderately high' (Draft Inherent General Fertility of NSW), Class II or III Land and Soil Capability, with reliable water of suitable quality and a minimum area of 20 ha (NSW Government, 2012).

The closest mapped BSAL is associated with the Hunter River and is located approximately 3 km to the north of the Montrose Water Storage (Figure 6).

The DSRLUP includes mapping of lands identified as Viticulture and Equine Critical Industry Clusters (Figure 6).

The closest Viticulture Critical Industry Cluster is located approximately 1 km to the south of the Montrose Water Storage (Figure 6). The closest Equine Critical Industry Clusters is located approximately 8 km to the north-west of the Montrose Water Storage (Figure 6).

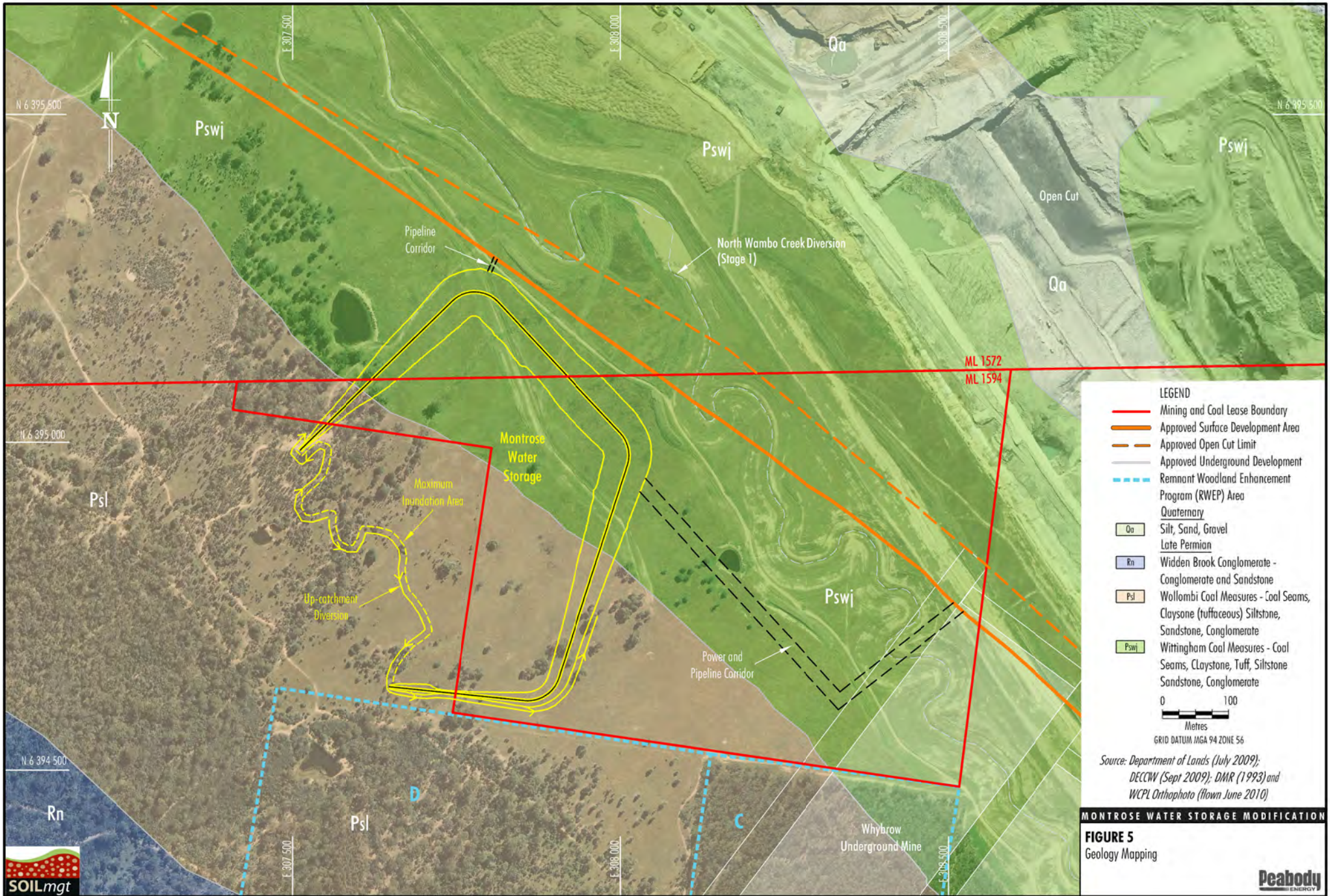
Rural Land Capability

The Rural Land Capability classification in NSW was developed by the NSW Soil Conservation Service (Emery 1986). It was derived from the scheme of Klingebiel and Montgomery (1961).

Land is allocated to one of eight classes, with emphasis on the erosion hazards in the use of the land. The Rural Land Capability classes are as follows (Emery 1986; Sonter and Lawrie 2007):

- Class I-III:** Land Suitable for Regular Cultivation / Cropping.
- Class IV-VI:** Land Suitable Mainly for Grazing.
- Class VII:** Land Suitable for Tree Cover.
- Class VII:** Land best protected by Trees.
- Class VIII:** Land Unsuitable for Agriculture.

The regional Rural Land Capability mapping (Soil Conservation Services of NSW 1985) indicates that the Montrose Water Storage is Class IV (Figure 7).



LEGEND

- Mining and Coal Lease Boundary
- Approved Surface Development Area
- - - Approved Open Cut Limit
- - - Approved Underground Development
- - - - - Remnant Woodland Enhancement Program (RWE) Area

Quaternary

- Qa Silt, Sand, Gravel

Late Permian

- Rn Widden Brook Conglomerate - Conglomerate and Sandstone
- Psl Wollombi Coal Measures - Coal Seams, Claystone (tuffaceous) Siltstone, Sandstone, Conglomerate
- Pswj Wittingham Coal Measures - Coal Seams, Claystone, Tuff, Siltstone Sandstone, Conglomerate

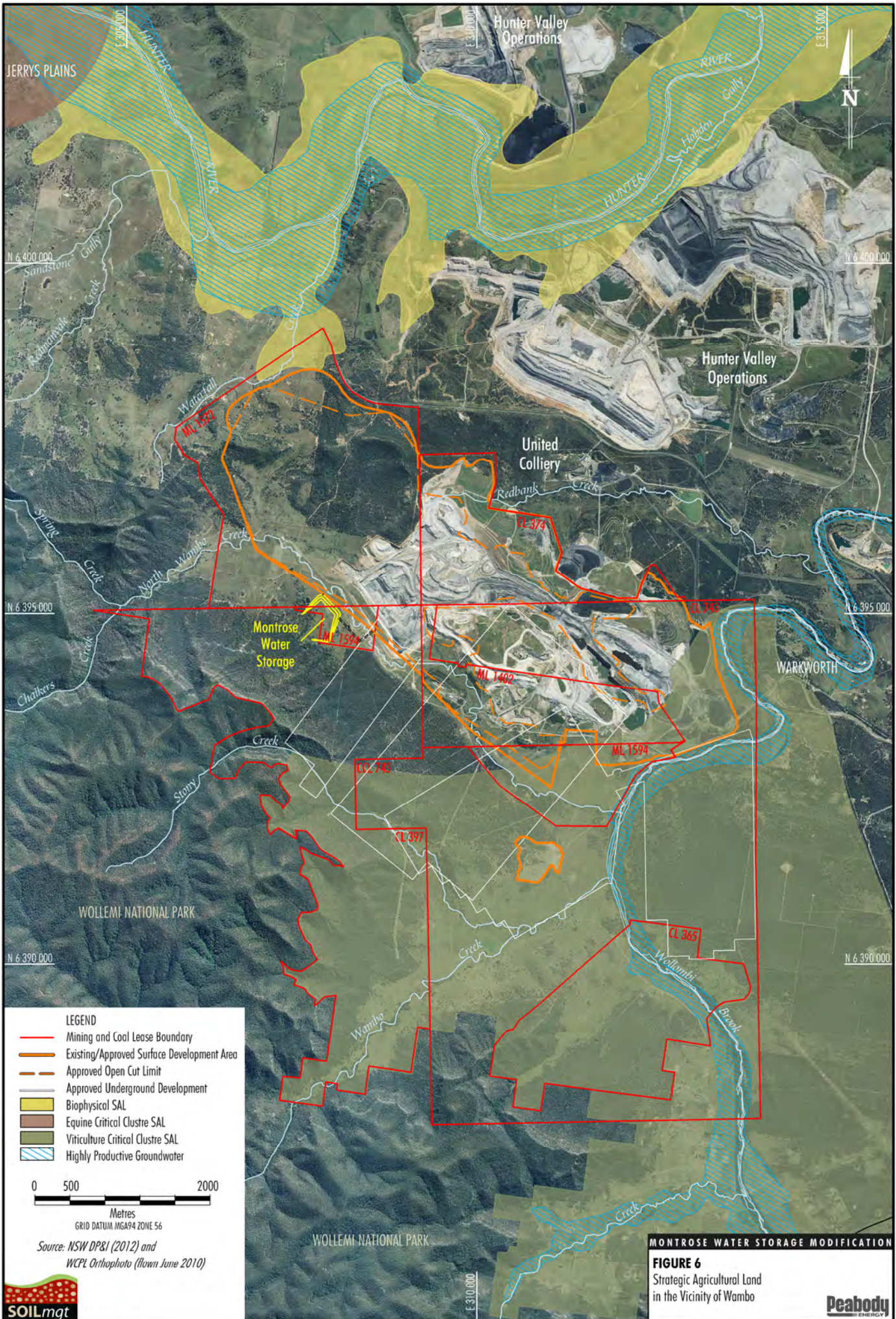
0 100
Metres
GRID DATUM MGA 94 201E 56

Source: Department of Lands (July 2009); DECCW (Sept 2009); DMR (1993) and WCPL Orthophoto (flown June 2010)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 5
Geology Mapping





LEGEND

- Mining and Coal Lease Boundary
- Existing/Approved Surface Development Area
- - - Approved Open Cut Limit
- Approved Underground Development
- Biophysical SAL
- Equine Critical Clustre SAL
- Viticulture Critical Clustre SAL
- Highly Productive Groundwater

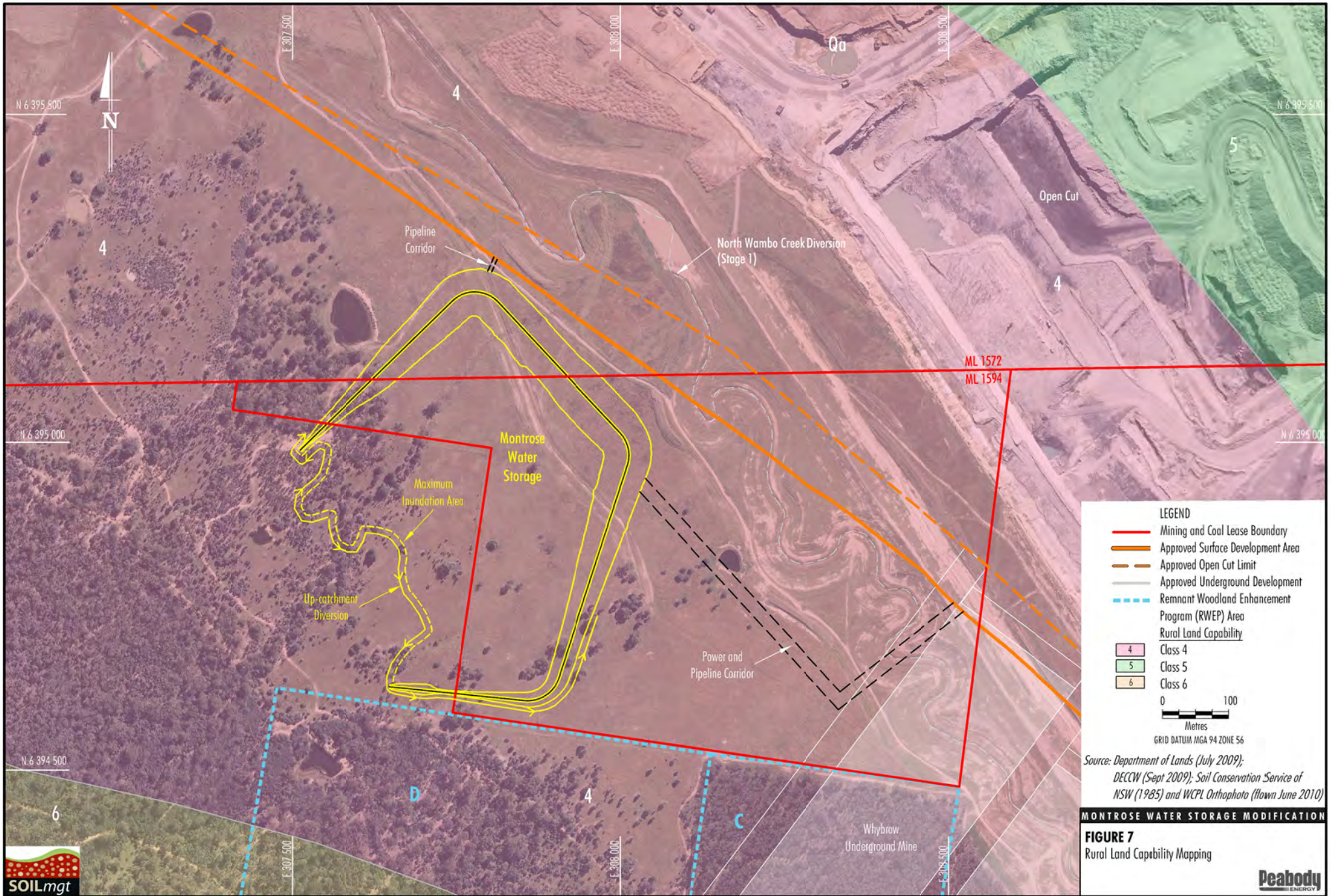
0 500 2000
Metres
GRID DATUM MGA94 ZONE 56
Source: NSW DP&I (2012) and
WCPL Orthophoto (flown June 2010)

SOILmgt

MONTROSE WATER STORAGE MODIFICATION

FIGURE 6
Strategic Agricultural Land
in the Vicinity of Wambo

Peabody
ENERGY



Agricultural Suitability

This five class system used by NSW Agriculture classifies land in terms of its suitability for general agricultural use (Hulme *et al.* 2002). It was developed specifically to meet the objectives of the NSW *Environmental Planning and Assessment Act, 1979*.

Agricultural land is classified by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture. In general terms, the fewer the constraints on the land, the greater its value for agriculture (Hulme *et al.* 2002). Higher quality lands (Classes 1 and 2) have fewer constraints and a greater versatility for agriculture than poorer quality lands. The essential characteristics of the five classes are as follows (Hulme *et al.* 2002):

- Class 1:** Arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent.
- Class 2:** Arable land suitable for regular cultivation for crops, but not suited to continuous cultivation.
- Class 3:** Grazing land or land well suited to pasture improvement.
- Class 4:** Land suitable for grazing but not for cultivation.
- Class 5:** Land unsuitable for agriculture.

The regional Agricultural Suitability mapping (NSW Agriculture 1983) indicates that most of the Montrose Water Storage is Class 3 with some minor sections Class 2 and 4 (Figure 8).

4.2 Methodology

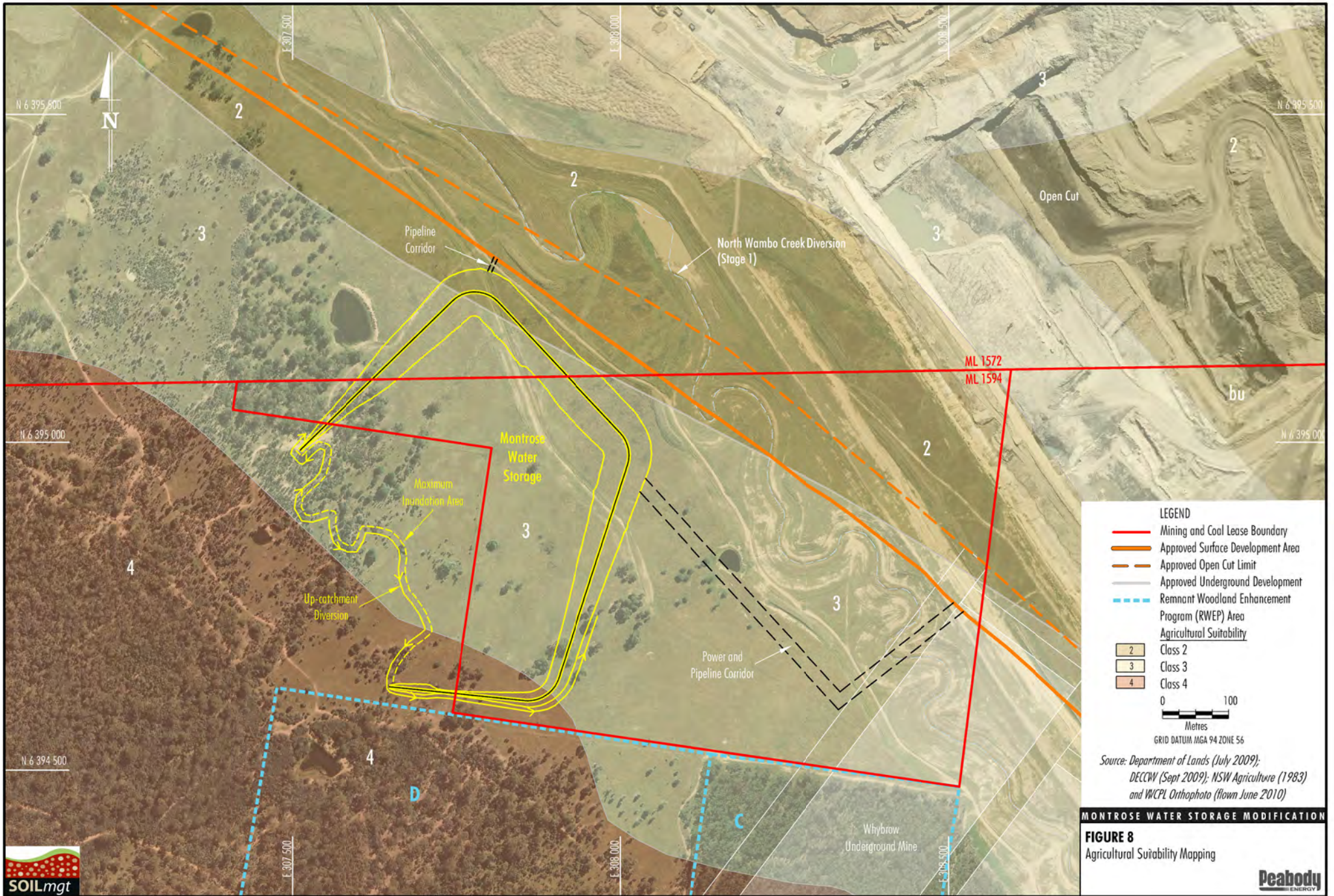
A soil survey was conducted to characterise and assess the soils in the Montrose Water Storage area. This section provides a description of the soil survey methodology and outcomes.

The following soil information is regarded by Ward (1998) as being important for soil and overburden assessment associated with mine site reclamation:

- Classification (structure, texture, etc.); allows existing data and experience on managing similar soils elsewhere to be applied.
- Dispersion index and particle size analysis; indicates soil structural stability and erodibility.
- pH; need to identify extreme ranges for treatment of lime or selection of suitable plant species.
- Electrical conductivity (EC); indicates soluble salt status.
- Macro- and micro-nutrients.

More specifically, Elliott and Reynolds (2007) suggest that the following soil factors need to be considered when assessing suitability of topdressing materials for mine site reclamation:

- Structure grade, which affects the ability of water and oxygen to enter soil.
- The ability of a soil to maintain structure grade following mechanical work associated with the extraction, transportation and spreading of topdressing material.
- The ability of soil peds to resist deflocculation when moist.
- Macrostructure; where soil peds are larger than 100 mm in the subsoil, they are likely to slake or be hardsetting and prone to surface sealing.
- Mottling; its presence may indicate reducing conditions and poor soil aeration.



- Texture; soil with textures equal to or coarser than sandy loam are considered unsuitable as topdressing materials because they are extremely erodible and have low waterholding capacities.
- Material with a gravel and sand content greater than 60% is unsuitable.
- Saline material is unsuitable.

These soil factors have been taken into account when planning the soil assessment methodology.

The assessment has also been prepared with regard to 'Soil and Landscape Issues in Environmental Impact Assessment' (Department of Land and Water Conservation 2000), and with a sampling intensity recommended by Gallant *et al.* (2008).

Field Survey

A site inspection and soil survey was conducted as part of the agricultural resource assessment. The field work was carried out on 29 to 30 May 2012. Six backhoe pits (approx. 1.4 m deep; shallower where hard rock was encountered) were assessed across the Montrose Water Storage area. The locations are shown on Figure 3. The pits were located in a way that covered as many of the major variations in elevation and landforms as possible.

A Garmin 'GPSmap 62S' instrument with an accuracy of about ± 4 m was used to record the pit coordinates (Appendix 1).

The soil was examined using pits approximately 1.4 m deep that were dug with a backhoe. They were trimmed with a geological pick to allow photography and description of the undisturbed structure and root growth.

The field description methods were as described in the 'Australian Soil and Land Survey Field Handbook' (National Committee on Soil and Terrain 2009) and the 'Guidelines for Surveying Soil and Land Resources, Chapter 29' (McKenzie *et al.* 2008). The soil profiles have been classified (Appendix 1) according to the Australian Soil Classification (Isbell 2002).

Field Soil Observations/Testing

The following characteristics were assessed for the layers identified in each of the soil profiles:

- thickness of each layer (horizon);
- soil moisture status at the time of sampling;
- pH (using Raupach test kit);
- colour of moistened soil (using Munsell reference colours);
- pedality of the soil aggregates;
- amount and type of coarse fragments (gravel, rock, manganese oxide nodules);
- texture (proportions of sand, silt and clay), estimated by hand;
- presence/absence of free lime and gypsum;
- root frequency; and
- dispersibility and the degree of slaking in deionised water (after 10 minutes).

Field observations for each pit are presented in Appendix 1.

The soil structure information (Appendix 1) has been summarised to give SOILpak 'compaction severity' scores (McKenzie 2001). This allows deep tillage recommendations to be made from the structure observations. The score is on a scale of 0.0 to 2.0, with a score of 0.0 indicating very poor structure for crop root growth and water entry/storage. Ideally, the SOILpak score of the root zone should be in the range 1.5–2.0.

Hand texturing (National Committee on Soil and Terrain (2009) provides an approximation of the clay content of a soil. In conjunction with the estimation of coarse fragment (gravel) content, it provides a low-cost alternative to particle size analysis.

Total available water (TAW) for the upper 1 m of soil has been estimated using texture, structural form and coarse fragment content data (McKenzie *et al.* 2008).

Laboratory Soil Testing

All of the pits were sampled for laboratory analysis. The sampling intervals for laboratory analysis were 0-15 centimetres (cm); 15-30 cm; 30-60 cm; 60-90 cm and (where appropriate) 90-120 cm.

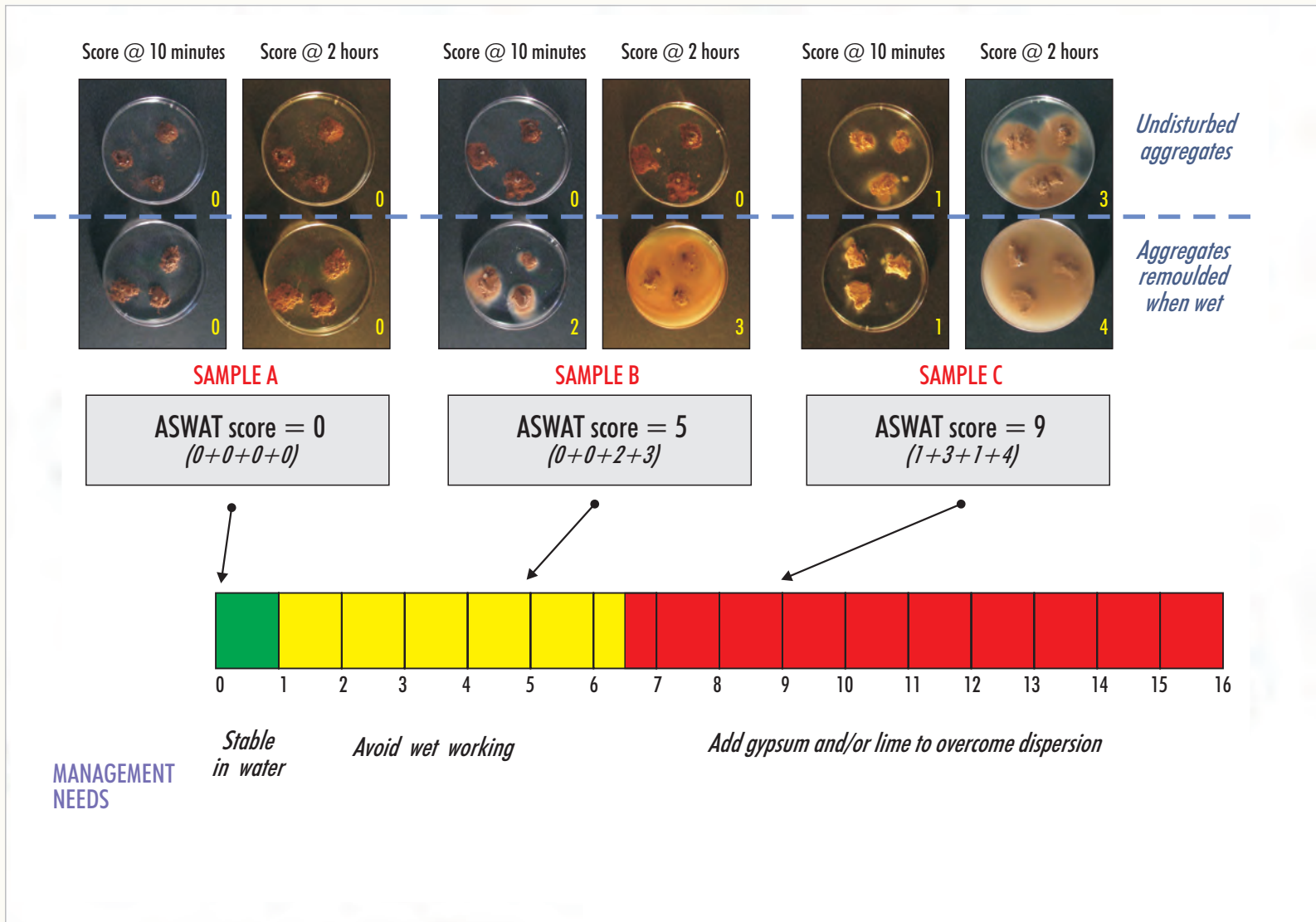
The soil from these pits was analysed by Incitec-Pivot Laboratory, Werribee Victoria for exchangeable cations, pH, electrical conductivity, chlorides, nutrient status (nitrate-nitrogen, phosphorus, sulfur, zinc, copper, boron) and organic matter content. An ammonium acetate method was used for the extraction of exchangeable cations. The cation exchange capacity (CEC) values are the sum of exchangeable sodium, potassium, calcium, magnesium and aluminium. Phosphorus was determined using the Colwell method, sulphur by the CPC method, boron by a calcium chloride (CaCl₂ extraction) and zinc/copper by a DTPA extraction (see Rayment and Lyons [2011] for further details).

Soil dispersibility, as measured by the Aggregate Stability in Water (ASWAT) test (Field *et al.* 1997), was assessed by McKenzie Soil Management in Orange. The results are presented in Appendix 1. The ASWAT test has been related to the well known Emerson aggregate stability test by Hazelton and Murphy (2007) – see Table 2. An advantage of the ASWAT test is that the results can be linked with management issues such as the need for gypsum application and avoidance of wet working (Figure 9).

Table 2. The relationship between the Emerson aggregate stability test and the ASWAT test that assess the severity of dispersion when soil aggregates are added to water

Dispersibility	Emerson Aggregate Classes	Probable Score for the ASWAT Test (Field <i>et al.</i> 1997)
Very high	1 and 2(3)	12-16
High	2(2)	10-12
High to moderate	2(1)	9-10
Moderate	3(4) and 3(3)	5-8
Slight	3(2), 3(1) and 5	0-4
Negligible/aggregated	4, 6, 7, 8	0

The conversion factors of Slavich and Petterson (1993) allowed the electrical conductivity of saturated paste extracts (EC_e) to be calculated from the EC of 1:5 soil:water suspensions (EC_{1:5}) and texture.



Source: Central West Catchment Management Authority (2011)

MONTROSE WATER STORAGE MODIFICATION

FIGURE 9

The Link between ASWAT Results and Soil Management Options



4.3 Soil Types

The Australian Soil Classification (Isbell 2002) has been used to determine soil types at each of the 6 pits (Table 3).

Table 3. Soil types according to the Australian Soil Classification and Great Soil Groups

Pit Site	Australian Soil Classification	Great Soil Group
1	Grey Sodosol	Soloth
2	Spolic Anthrosol	-
3	Brown Sodosol	Soloth
4	Red Kandosol	Red Earth (less fertile)
5	Grey Sodosol	Solodic
6	Brown Kandosol	Red Earth (less fertile)

The soil types at the Montrose Water Storage area have the following characteristics:

- Sodosols have a strong texture contrast between topsoil and sodic (exchangeable sodium percentage [ESP] of 6 or greater) subsoil which is not strongly acidic.
- Kandosols lack strong texture contrast and have poorly structured massive subsoils.
- Anthrosols are soil types that are formed from human activities that have caused profound modification, mixing, truncation or burial of the original soil horizons (McKenzie *et al.* 2004).

Photos of the soils found in the Montrose Water Storage area are presented in Figure 10.

4.4 Soil Conditions for Plant Growth

Soil Depth, Texture and Waterholding Capacity

As soil becomes shallower, stonier and/or sandier, its ability to store water declines (White 2006).

The shallowest soil was in the more elevated sections of the Montrose Water Storage area (i.e. Pits 1 and 5). The impact of profile shallowness and stoniness on the ability of the soil to store Plant Available Water (TAW) is shown in Appendix 1.

Plants are more likely to suffer drought stress where soil has a poor water storage capacity, particularly in hot weather with extended dry periods between rainfall events. At the Montrose Water Storage area, the lack of waterholding capacity in shallow soils is a major constraint to agricultural productivity.



Pit 1: Grey Sodosol



Pit 2: Spolic Anthrosol



Pit 3: Brown Sodosol



Pit 4: Red Kandosol



Pit 5: Grey Sodosol



Pit 6: Brown Kandosol

Figure 10. Soil Types Identified during the Survey

Waterlogging Hazard

When soil is waterlogged, several adverse processes take place (Batey 1988):

- The lack of oxygen reduces the ability of plant roots to function properly.
- Anaerobic conditions can cause large losses of soil nitrogen to the atmosphere.
- Near-surface waterlogging is associated with inefficient storage of water due to excessive evaporation losses.

Pits 1, 3 and 4 had evidence of waterlogging, i.e. subsoil mottling (Appendix 1).

pH Imbalance

Topsoil acidity was widespread across the Montrose Water Storage area (Appendix 1) and was associated with the presence of exchangeable aluminium (Appendix 1). The low CEC values (see below) in the topsoil indicate a low buffering capacity. Subsoil acidity also was a problem at Pits 1, 3, 4, 5 and 6. The topsoil acidity problems can be overcome readily through the use of agricultural lime, but subsoil amelioration is more difficult and costly because of the need for mechanical incorporation of the lime.

Soil Stability in Water – Dispersion and Slaking

Dispersion is the separation of soil micro-aggregates into sand, silt and clay particles, which tend to block soil pores and create problems with poor aeration (Levy 2000). It is a process with the potential to reduce root growth and adversely affect profitability of most crop and pasture enterprises.

Dispersion may be associated with slaking, which is the collapse of soil aggregates to form micro-aggregates under moist conditions (So and Aylmore 1995). Slaking is associated with a lack of organic matter, which is important for the binding of soil micro-aggregates.

Soil prone to slaking, and particularly dispersion, is much more likely to be lost by water erosion than stable soil. This is because the soil tends to seal over under moist conditions and lose water as runoff, rather than taking in the water for storage in the subsoil (So and Aylmore 1995).

Pits 1 and 5 have strongly dispersive subsoil. The other pits are less sodic, but are prone to dispersion because of low electrolyte concentrations. However, these dispersion problems can be overcome in a cost-effective manner through the use of gypsum application.

The main chemical factors influencing the behaviour of clay particles in sodic soils are exchangeable sodium and low electrolyte concentrations, but elevated exchangeable magnesium concentrations (calcium/magnesium ratios <1; see Appendix 1) also can make clay particles in soil less stable in water (Levy 2000). Exchangeable aluminium, however, is a trivalent cation that tends to minimise dispersion.

Compaction Status

Compaction can strongly restrict plant growth because of poor water entry, poor efficiency of water storage, waterlogging when moist, and poor access to nutrients by plant roots (McKenzie 1998).

Compaction was assessed in this study using the SOILpak scoring system (Appendix 1). Most of the topsoil was not compacted and tended to be associated with relatively high organic carbon contents (Appendix 1). However, deeper layers were mostly in a compacted state because of subsoil dispersion.

Structure Self-repair Ability

The ability of a soil to overcome compaction through shrinking and swelling induced by wet-dry cycles (soil structural resilience) can be estimated via CEC values (McKenzie 1998). The topsoil had a poor shrink-swell capacity, so the rate of recovery from compaction damage would be slow. The subsoil at Pits 1 and 5 had a sufficiently high content of swelling clay minerals to have favourable structural resilience.

Salt Concentrations

Topsoil in the Montrose Water Storage area was non-saline. However, the subsoil at Pits 1 and 5 was sufficiently saline to reduce the water uptake of most crop and pasture species.

Nutrients

Much of the soil was deficient (from an agricultural perspective) in phosphorus in the Montrose Water Storage area. Sulfur and nitrogen deficiencies were present in the lighter-textured soil (eg. Pits 3 and 6) (Appendix 1).

As the sum of exchangeable cations (an approximation of CEC) increases, the ability of soil to hold cation nutrients such as calcium, magnesium and potassium becomes greater (White 2006). CEC values (Appendix 1) show a poor ability for the subsoil to store cation nutrients at Pits 3 and 6.

Soil Carbon and Soil Biological Health

The favourable organic carbon concentrations in the topsoil (0-15 cm) (Appendix 1) mean that beneficial soil organisms have a ready supply of food.

Summary of Soil Constraints

A broad range of soil physical and chemical constraints for agricultural land use have been identified on the Project site including:

- **Topsoil and subsoil acidity and associated aluminium toxicity** is a major constraint to agricultural productivity. Acidic soil lacks versatility in terms of agricultural management as many plant species do not thrive with this chemical constraint to crop/pasture production. Agricultural lime can be used to overcome acidity, but the required mechanical incorporation of the lime would be difficult to achieve and would leave the soil prone to erosion losses.
- **A lack of waterholding capacity** where there is a large stone content in the soil and/or bedrock close to the soil surface; poor subsoil structure limits root growth and creates a similar effect. This is not a major concern when irrigation water and/or frequent showers of rain are applied to soil, but prolonged dry spells will induce drought stress in plants when they are grown in shallow and/or stony soil (eg. Pits 1, 5 and 6).
- **Dispersive subsoil** due to sodicity, a lack of electrolyte and excessive exchangeable magnesium percentage. As discussed above, dispersion induces waterlogging stress under moist conditions and excessive hardness when the soil is dry.
- **Subsoil salinity** in the elevated areas represented by Pits 1 and 5. Some pasture species, particularly legumes, have a poor ability to extract water from the soil when soil salinity is elevated.
- **Nutrient deficiencies**, particularly phosphorus, limit the growth of plants even when other essential requirements such as water and adequate aeration are present in the soil.

5.0 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND ASSESSMENT

Biophysical Strategic Agricultural Land

The DSRLUP outlines the following definition for BSAL:

- *land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), and*
- *land capability classes II or III under the Land and Soil Capability Mapping of NSW (OEH), and*
- *reliable water of suitable quality, characterised by land having rainfall of greater than 350mm per annum (9 out of 10 years) or land within 150m of the following surface or groundwater resource:*
 - *a regulated river, or*
 - *unregulated rivers where there are flows for at least 95% of the time (ie the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers, or*
 - *groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5L/s and total dissolved solids of less than 1,500mg/L.*
- *Minimum 20 hectares in areas (based on minimum area required for commercial food production).*

It is noted that the DSRLUP requires all components of the BSAL definition to be met for land to be considered BSAL. An assessment of the Montrose Water Storage area has been conducted against these criteria listed in the DSRLUP (Table 4).

None of the soils types identified in the Montrose Water Storage area are classified as having "high" or "moderately high" soil fertility as defined in 'Draft Inherent General Fertility of NSW' (OEH 2012) (Table 4). The Montrose Water Storage area can therefore not be classified as BSAL in accordance with the DSRLUP.

Notwithstanding the above, an assessment of the Land and Soil Capability of the Montrose Water Storage area has been conducted in accordance with Land and Soil Capability (Murphy and Taylor 2008). The Montrose Water Storage area is considered to have a Land and Soil Capability classification of Class 4 as all of the soil pits (particularly Pits 1, 5 and 6) had serious soil limitations for plant growth (Table 4).

Given the above, it is considered that the Montrose Water Storage area does not meet the BSAL criteria outlined in the DSRLUP.

Critical Industry Clusters

The closest Viticulture Critical Industry Cluster is located approximately 1 km to the south of the Montrose Water Storage (Figure 6). There is no evidence of vineyards in the Montrose Water Storage area.

The closest Equine Critical Industry Clusters is located approximately 8 km to the north-west of the Montrose Water Storage (Figure 6).

It is considered that the Montrose Water Storage would not have any significant adverse impacts on the Critical Industry Clusters.

Table 4. Summary of Biophysical Strategic Agricultural Land Assessment

Pit	Soil constraints	Is it ' <u>High</u> ' Fertility class ¹ ?	Is it ' <u>Moderately High</u> ' Fertility class ¹ ?	Land & Soil Capability classification ²	Is the land under consideration BSAL ³ ?
1	Acidic to 75cm (requires lime), dispersive / saline subsoil; poor topsoil cation exchange capacity; nutrient deficiencies (N, P, Cu)	No (Soloth; Grey Sodosol)	No	Class 4; because of the following most limiting factor, 'Naturally neutral soils (pH water >6.0), low buffering capacity'	No
2	Acidic to 15cm (requires lime), dispersive deep subsoil; poor subsoil cation exchange capacity nutrient deficiencies (N, P, S)	No (Spolic Anthroposol)	No	Class 4; because of the following most limiting factor, 'Naturally neutral soils (pH water >6.0), low buffering capacity'	No
3	Acidic topsoil and deep subsoil. Dispersive deep subsoil; poor cation exchange capacity; nutrient deficiencies (N, P, S)	No (Soloth; Grey Sodosol)	No	Class 4; because of the following most limiting factor, 'Naturally neutral soils (pH water >6.0), low buffering capacity'	No
4	Acidic topsoil (requires lime), dispersive deep subsoil; poor topsoil cation exchange capacity; nutrient deficiencies (N, P, S)	No (Red Earth – less fertile; Red Kandosol)	No	Class 4; because of the following most limiting factor, 'Naturally neutral soils (pH water >6.0), low buffering capacity'	No
5	Acidic to 60cm (requires lime), dispersive / saline subsoil; poor topsoil cation exchange capacity; nutrient deficiency (N)	No (Solodic; Grey Sodosol)	No	Class 4; because of the following most limiting factor, 'Naturally neutral soils (pH water >6.0), low buffering capacity'	No
6	Acidic to 60cm (requires lime), dispersive subsoil; very low cation exchange capacity; nutrient deficiencies (N, P, S, Zn, Cu)	No (Red Earth – less fertile; Brown Kandosol)	No	Class 4; because of the following most limiting factor, 'Naturally neutral soils (pH water >6.0), low buffering capacity'	No

¹ In accordance with Draft Inherent General Fertility of NSW (OEH 2012).

² In accordance with Land and Soil Capability (Murphy 2008).

³ In accordance with DSRLUP (NSW Government 2012) - ie. 'High' or "Moderately High' fertility class, Class 2 or 3 according to the 'Land & Soil Capability' classification, area greater than 20 ha.

6.0 AGRICULTURAL PRODUCTIVITY

Agricultural enterprises known to have been conducted on the Montrose Water Storage area include cattle grazing for beef production on rain-fed unimproved pastures.

The NSW Department of Primary Industries Gross Margin Budget for 'North Coast Weaners – Unimproved Land'⁴ would provide the best estimate of productivity in the Montrose Water Storage area. The productivity of this agricultural enterprises is summarised in Table 5.

Table 5. Approximate productivity of the agricultural enterprises on the Montrose Water Storage area

Enterprise	Stocking Rate (DSE/ha)	Gross Margin (\$/ha/year)
Beef cattle grazing (weaners) on unimproved pastures or low productivity improved pastures; conducted on the majority agricultural areas on the Project site	3	53.06

Given the serious soil limitations for plant growth (Table 4) and the previous agricultural activities conducted (beef cattle production on rain-fed unimproved pasture), the Montrose Water Storage area is not considered to be highly productive agriculture land.

⁴ http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/175523/16-North-Coast-store-weaners-unimproved-country.pdf

7.0 SOIL RESOURCE MANAGEMENT MEASURES

General soil resource management practices, where surface development is proposed within the Montrose Water Storage area, should involve the stripping and stockpiling of soil resources prior to any mine-related disturbance, other than clearing vegetation.

The objectives of soil resource management for the Montrose Water Storage area should be to:

- Identify and quantify potential soil resources for rehabilitation.
- Optimise the recovery of useable soil resources during stripping operations.
- Manage soil reserves so as not to degrade the resource when stockpiled.
- Establish effective soil amelioration procedures to maximise the availability of soil reserves for future rehabilitation works.
- Where soil profiles are to be reconstructed for native woodland/open forest, take into account both the natural soil requirements of the local native vegetation, and the need to provide soil conditions that minimise the risk of soil loss via wind and water erosion during and after rehabilitation.

Stripping

It is recommended that approximately 15 cm of soil should be stripped in Modification disturbance areas for use in rehabilitation. The following management measures should be implemented during the stripping of soils:

- Areas of disturbance requiring soil stripping are to be clearly defined following vegetation clearing.
- Soil stripping during periods of high soil moisture content (i.e. following heavy rain) is to be avoided to reduce the likelihood of damage to soil structure.

The degree of success of a stripping and stockpiling program is strongly influenced by soil water content. Stripping during periods of high soil moisture content can result in excessive compaction and/or remoulding of the soil.

Where soil dispersion problems are aggravated by stripping during periods of high moisture content, gypsum should be applied to encourage re-stabilisation of the stripped soil.

Stockpile Management

The following management measures should be implemented during the stockpiling/storage of soils:

- Soil stockpiles should be retained at a height of 3 m, with slopes no greater than 1:2 (vertical to horizontal) and a slightly roughened surface to minimise erosion.
- Construct soil stockpiles in a way that minimises erosion, encourages drainage, and promotes revegetation.
- Where amendments such as lime, gypsum and fertiliser are needed to improve the condition of cut soil, they should be applied to the stockpiles in-between the application of separate layers.
- Wherever practicable, soil should not be trafficked, deep ripped or removed in wet conditions to avoid breakdown in soil structure.

- All soil stockpiles should be seeded with a non-persistent cover crop to reduce erosion potential as soon as practicable after completion of stockpiling. Where seasonal conditions preclude adequate development of a cover crop, stockpiles should be treated with a straw/vegetative mulch to improve stability.
- Grow deep-rooting vegetation to encourage organic matter accumulation and maintain microbial activity. Stockpile height can be excessive because of limited space at mine sites, but try to keep it as low as possible. This maximises the chances of plenty of plant roots reaching the base of the stockpile as it awaits redistribution.
- There should be as little vehicle access as possible on soil stockpiles.
- Soil stockpiles should be located in positions to avoid surface water flows. Silt stop fencing would be placed immediately down-slope of stockpiles until stable vegetation cover is established.
- In the event that unacceptable weed generation is observed on soil stockpiles, a weed eradication program should be implemented.
- In preference to stockpiling, wherever practicable, stripped soil should be directly replaced on completed sections of the final landform.

8.0 REFERENCES

- Batey T (1988) *Soil Husbandry* (Soil and Land Use Consultants: Aberdeen).
- Bureau of Meteorology (2012) *Bureau of Meteorology Website*.
- Department of Land and Water Conservation (2000) *Soil and Landscape Issues in Environmental Impact Assessment*, Technical Report No. 34, 2nd edition. (NSW Department of Land and Water Conservation, Sydney).
- Department of Mineral Resources (1993) *Geology Hunter Coalfield Regional Geology 1:100,000 Sheet*, NSW.
- Elliott GL, Reynolds KC (2007) Soil rehabilitation for extractive industries. In Charman PEV, Murphy BW (eds.) *Soils: Their Properties and Management, 3rd Edition*, pp. 406-412 (Oxford University Press).
- Emery KA (1986) *Rural Land Capability Mapping* (Soil Conservation Service of New South Wales: Sydney).
- Field DJ, McKenzie DC, Koppi AJ (1997) Development of an improved Vertisol stability test for SOILpak. *Australian Journal of Soil Research* **35**, 843–852.
- Gallant JC, McKenzie NJ, McBratney AB (2008) Scale. In: *Guidelines for surveying soil and land resources: Second edition* (eds. NJ McKenzie, MJ Grundy, R Webster, AJ Ringrose-Voase); Chapter 3, pp. 27-43. (CSIRO Publishing: Collingwood).
- Hazelton P, Murphy B (2007) *Interpreting Soil Test Results: What do all the numbers mean?* (CSIRO Publishing: Collingwood).
- Hulme T, Grosskopf T, Hindle J (2002) *Agricultural Land Classification*; Agfact AC. 25 (NSW Agriculture: Orange).
- Isbell, R (2002) *The Australian Soil Classification, Revised Edition* (CSIRO: Melbourne).
- Klingbiel AA, Montgomery PH (1961) *Land Capability Classification*; US Department of Agriculture Handbook 210 (Government Printer: Washington DC).
- Kovac M, Lawrie JW (1991) Soil Landscapes of the Singleton 1:250 000 Sheet. (Soil Conservation Service of NSW: Sydney).
- Levy GJ (2000) Sodicity. In: Sumner ME (ed.) *Handbook of Soil Science*; pp. G27-G63. (CRC Press: Boca Raton).
- McKenzie DC (ed.) (1998) *SOILpak for Cotton Growers, 3rd Edition* (NSW Agriculture: Orange).
- McKenzie N, Jacquier D, Isbell R, Brown K (2004) *Australian Soils and Landscapes: An Illustrated Compendium* (CSIRO Publishing: Collingwood).
- McKenzie DC (2001). Rapid assessment of soil compaction damage. I. The SOILpak score, a semi-quantitative measure of soil structural form. *Australian Journal of Soil Research* **39**, 117–125.
- McKenzie DC, Rasic J, Hulme PJ (2008) Intensive survey for agricultural management. In: *Guidelines for surveying soil and land resources: Second edition* (eds. NJ McKenzie, MJ Grundy, R Webster, AJ Ringrose-Voase); Chapter 29, pp. 469-490. (CSIRO Publishing: Collingwood).
- Murphy B, Taylor S (2008) *Land and Soil Capability – How We Safely Manage the Land*. (Central West Catchment Authority: Wellington NSW).
- National Committee on Soil and Terrain (2009) *Australian Soil and Land Survey Field Handbook: Third Edition*. (CSIRO Publishing: Collingwood).

NSW Agriculture (1983) *Agricultural Land Classification for Part of the Singleton Shire between Bulga and Jerrys Plains, NSW*.

NSW Government (2012) *Draft Upper Hunter Strategic Regional Land Use Plan*.

Office of Environment and Heritage (2012) *Draft Inherent Fertility of NSW*.

Rayment GE, Lyons DJ (2011) *Soil Chemical Methods – Australasia* (CSIRO Publishing: Collingwood).

Slavich PG, Petterson GH (1993) Estimating the electrical conductivity of saturated paste extracts from 1:5 soil:water suspensions and texture. *Australian Journal of Soil Research* **31**, 73-81.

So HB, Aylmore LAG (1995) The effects of sodicity on soil physical behaviour. In Naidu R, Sumner ME, Rengasamy P (eds.) *Australian Sodic Soils; Distribution, Properties and Management*, pp. 71-79. (CSIRO Publications: East Melbourne).

Soil Conservation Service of NSW (1985) *1:100,000 Land Capability Mapping, New South Wales*. Department of Sustainable Natural Resources.

Sonter RO, Lawrie JW (2007) Soils and Rural Land Capability. In Charman PEV, Murphy BW (eds.) *Soils: Their Properties and Management, 3rd Edition*, pp. 287-296 (Oxford University Press).

Ward S (1998) *Mine Rehabilitation Handbook, Second Edition*. (Mineral Council of Australia).

White RE (2006) *Principles and Practice of Soil Science, Fourth Edition* (Blackwell Publishing: Oxford).

APPENDIX 1

FIELD OBSERVATIONS AND LABORATORY DATA

Montrose soil pit #	Landuse / vegetation type	Landscape features	Easting, m WGS84	Northing, m WGS84	Google Earth elevation, m	Plant Available Water (TAW, mm/m)	Australian Soil Classification	Other comments
1	Mediocre pasture	Upper mid-slope	307655	6395036	116	70	Grey Sodosol	Sandstone parent material
2	Moderate-good pasture	Colluvial outwash?	307748	6395231	108	129	Spolic Anthroposol	Site may have been disturbed/reconstructed - near re-aligned creek
3	Moderate-good pasture	Mid-slope	307814	6394935	113	134	Brown Sodosol	A3 slightly water repellent & powdery
4	Vigorous pasture	Toe of colluvial outwash	308017	6395023	105	123	Red Kandosol	
5	Sparse pasture	Upper slope	307724	6394590	125	73	Grey Sodosol	
6	Mediocre pasture	Colluvial outwash	307863	6394701	117	87	Brown Kandosol	

South Wambo soil pit #	Horizon	Lower depth cm	Texture	pH water	Moist soil colour (Munsell)	Colour	Mottles	SOILpak compaction score	Gravel fragments, %	Dispersion 10 minutes	Moisture	Lime % Type	Root score	
1	A1	15	Sandy loam	5.5	7.5YR4/2	Brown	-	1.4	3	0	S/M	-	-	1
	A2	30	Sandy loam	5.0	10YR5/2	Greyish brown	-	0.7	10	1	S	-	-	1
	B2	75	Sandy light clay	6.0	10YR4/2	Dark greyish brown	yellow	0.4	5	3	S	-	-	1
	C	125+							98					
2	A1	20	Sandy clay loam	5.0	7.5YR2.5/2	Very dark brown	-	1.7	2	0	S/M	-	-	3
	2A	50	Sandy clay loam	5.5	7.5YR3/2	Dark brown	-	1.4	4	0	S	-	-	3
	3A	75	Sandy loam	6.0	7.5YR4/4	Brown	-	1.4	4	0	S	-	-	3
	4A	140+	Loamy sand	6.0	7.5YR3/3	Dark brown	-	1.3	3	1	S	-	-	1
3	A1	15	Sandy clay loam	6.0	7.5YR3/3	Dark brown	-	1.6	1	0	S/M	-	-	3
	A3	65	Fine sandy loam	5.5	7.5YR4/4	Brown	-	1.4	3	0	S	-	-	3
	B2	140+	Light clay	5.5	10YR4/3	Brown	grey & orange	0.8	0	0	S/M	-	-	1
4	A11	12	Silty clay loam	5.5	7.5YR4/3	Brown	-	1.3	0	1	S/M	-	-	2
	A12	25	Silty clay loam	5.5	7.5YR5/4	Brown	-	1.1	0	2	S	-	-	2
	B21	50	Light clay	5.5	5YR4/3	Reddish brown	-	1.1	0	0	S	-	-	2
	B22	140+	Light clay	6.0	5YR4/6	Yellowish red	grey	0.7	3	1	S	-	-	1
5	A1	3	Sandy clay loam	5.0	7.5YR4/2	Brown	-	1.5	2	0	S/M	-	-	2
	A2	12	Sandy clay loam	4.5	7.5YR3/2	Dark brown	-	1.2	5	0	S	-	-	1
	B2	50	Light clay	5.5	7.5YR4/2	Brown	-	0.7	15	3	S	-	-	0.5
	B2	80	Light clay	5.5	7.5YR4/2	Brown	-	0.7	70	3	S	-	-	0.5
	2B	140+	Light clay	7.0	7.5YR4/1	Dark grey	-	1.0	0	0	S	-	-	1
6	A1	15	Sandy loam	5.5	7.5YR3/3	Dark brown	-	1.6	2	0	S/M	-	-	2
	2A	35	Sandy loam	5.5	7.5YR4/4	Brown	-	1.1	5	2	S	-	-	2
	3A	75	Clayey sand	6.0	7.5YR4/4	Brown	-	0.8	60	2	S	-	-	2
	4A	140+	Sandy loam	6.0	5YR5/3	Reddish brown	-	1.1	20	3	S	-	-	1

South Wambo soil pit #	Horizon	Lower depth cm	PEDALITY Grade	Type	Size, mm	FABRIC	CONSISTENCE	SOILpak compaction score
1	A1	15	M	PO	8	E	2	1.4
	A2	30	W	LE	12	E	3	0.7
	B2	75	W	LE	12	RP	6	0.4
	C	125+						
2	A1	20	M	SB	7	E	2	1.7
	2A	50	M	SB	10	E	3	1.4
	3A	75	W	PO	8	E	2	1.4
	4A	140+	W	LE	8	E	2	1.3
3	A1	15	W	PO	7	E	1	1.6
	A3	65	W	PO	9	E	2	1.4
	B2	140+	M	LE	15	RP	3	0.8
4	A11	12	M	PO	8	E	2	1.3
	A12	25	M	LE	10	E	3	1.1
	B21	50	M	LE	10	RP	3	1.1
	B22	140+	M	LE	15	RP	5	0.7
5	A1	3	M	PO	7	E	2	1.5
	A2	12	W	LE	10	E	3	1.2
	B2	80	S	LE	15	RP	6	0.7
	2B	140+	S	B	10	RP	6	1.0
6	A1	15	W	PO	7	E	1	1.6
	2A	35	W	LE	10	E	2	1.1
	3A	75	W	LE	8	E	3	0.8
	4A	140+	W	po	8	E	2	1.1

Montrose soil pit #	Depth, cm	pH (water)	pH (CaCl2)	EC 1:5 dS/m	ECe dS/m	Chloride mg/kg	Exchangeable cations, meq/100g				Al	CEC	ESP	ESI	Ca/Mg	ASWAT score	NO3-N mg/kg	Colwell P mg/kg	SO4-S mg/kg	DTPA-Cu mg/kg	DTPA-Zn mg/kg	Boron mg/kg	Org C %
							Ca	Mg	K	Na													
1	15	5.6	4.5	0.04	0.55	16	1.6	1.2	0.7	0.1	0.4	3.9	1.8	0.02	1.33	5	2	9	6	0.12	2.40	0.23	1.70
1	30	5.9	4.4	0.03	0.41	11	0.7	1.0	0.5	0.1	0.6	2.9	3.8	0.01	0.71	10	1	7	3	0.06	0.22	0.15	0.83
1	60	6.3	5.4	0.30	2.58	250	0.4	8.2	0.6	2.7	0.1	12.0	22.5	0.01	0.05	15	1	5	40	0.13	0.19	0.53	0.45
1	90	6.2	5.4	0.48	4.13	410	0.2	9.9	0.7	3.4	0.1	14.3	23.9	0.02	0.02	13	1	5	85	0.21	0.27	0.61	0.34
2	15	6.1	5.1	0.08	0.76	24	7.5	1.8	1.5	0.1	0.1	11.0	0.5	0.18	4.17	4	6	10	9	0.34	4.70	0.61	2.40
2	30	6.6	5.5	0.04	0.38	10	9.5	1.6	0.8	0.0	0.0	12.0	0.3	0.12	5.94	7	2	6	4	0.34	0.98	0.83	2.70
2	60	7.6	6.5	0.03	0.29	12	6.0	1.2	0.3	0.0	0.0	7.6	0.5	0.06	5.00	11	1	5	3	0.29	0.39	0.50	0.65
2	90	7.7	6.6	0.02	0.28	10	4.0	2.1	0.2	0.1	0.0	6.4	0.9	0.02	1.90	11	1	5	2	0.31	0.15	0.38	0.38
2	120	7.3	6.1	0.04	0.91	22	4.0	3.0	0.2	0.3	0.0	7.5	3.6	0.01	1.33	11	1	7	7	0.37	0.33	0.38	0.48
3	15	6.4	5.4	0.03	0.29	10	2.9	0.9	0.6	0.0	0.1	4.6	0.4	0.07	3.19	10	3	7	4	0.16	1.60	0.31	0.97
3	30	6.7	5.6	0.02	0.28	10	2.1	0.8	0.5	0.0	0.0	3.4	0.6	0.03	2.59	12	2	5	2	0.11	0.17	0.22	0.42
3	60	7.0	5.8	0.02	0.28	10	2.1	1.2	0.4	0.0	0.0	3.7	0.5	0.04	1.75	13	1	6	2	0.40	0.03	0.24	0.29
3	90	6.5	5.0	0.04	0.34	22	2.6	5.1	0.3	0.6	0.1	8.7	6.6	0.01	0.51	15	1	5	5	1.00	0.35	0.64	0.39
4	15	5.9	4.8	0.05	0.43	24	4.1	1.1	1.1	0.0	0.1	6.4	0.5	0.11	3.73	4	4	6	4	0.54	2.20	0.60	1.60
4	30	6.5	5.3	0.02	0.19	10	3.6	1.5	0.5	0.1	0.1	5.7	0.9	0.02	2.40	12	1	5	3	0.45	0.20	0.48	0.68
4	60	6.6	5.4	0.03	0.26	10	3.5	3.5	0.3	0.3	0.1	7.7	3.6	0.01	1.00	11	1	5	8	0.40	0.06	0.76	0.32
4	90	7.2	5.9	0.06	0.52	18	4.6	4.4	0.4	0.7	0.0	10.0	6.5	0.01	1.05	13	1	5	12	0.30	0.04	1.50	0.32
5	15	5.6	4.4	0.03	0.29	11	1.3	0.9	0.6	0.1	0.4	3.3	2.1	0.01	1.43	7	2	29	3	0.11	2.10	0.23	1.30
5	30	5.8	4.8	0.19	1.63	100	2.6	9.1	1.2	1.6	0.3	14.8	10.8	0.02	0.29	14	1	5	13	0.11	0.17	0.95	0.58
5	60	5.7	4.9	0.41	3.53	330	2.0	9.9	1.2	3.0	0.2	16.3	18.4	0.02	0.20	12	1	7	58	0.11	0.08	1.50	0.55
5	90	7.7	7.0	0.77	6.62	910	1.1	9.1	0.6	5.7	0.0	16.5	34.6	0.02	0.12	0	1	5	90	0.19	0.22	1.20	0.22
5	120	8.0	7.4	0.96	8.26	1100	1.7	12.0	0.8	7.8	0.0	22.3	35.0	0.03	0.14	0	1	5	98	0.32	0.93	1.30	0.25
6	15	5.9	4.8	0.03	0.41	10	2.1	0.9	0.6	0.0	0.1	3.7	0.8	0.04	2.31	4	1	7	5	0.11	0.48	0.29	1.20
6	30	5.8	4.6	0.02	0.28	10	1.0	0.5	0.4	0.0	0.4	2.2	0.9	0.02	1.94	12	1	7	2	0.03	0.03	0.18	0.37
6	60	6.0	4.7	0.01	0.23	10	0.4	1.2	0.3	0.0	0.2	2.1	0.9	0.01	0.36	12	1	5	2	0.03	0.02	0.13	0.15
6	90	6.6	5.4	0.01	0.14	10	0.7	1.4	0.1	0.1	0.1	2.4	2.5	0.00	0.50	12	1	6	2	0.03	0.02	0.12	0.15