

**Vickery Coal Project**

**Environmental  
Impact  
Statement**

**APPENDIX G**

**AGRICULTURAL  
ASSESSMENT**

VICKERY COAL PROJECT

APPENDIX G - AGRICULTURAL IMPACT STATEMENT



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Project No. WHC-03  
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## TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1 INTRODUCTION	1
1.1 OVERVIEW OF THE PROJECT	1
1.2 SCOPE OF THIS REPORT	3
1.3 STRUCTURE OF THIS REPORT	6
1.4 CONSULTATION	7
2 EXISTING AGRICULTURAL AND GEOPHYSICAL RESOURCES	10
2.1 AGRICULTURAL RESOURCES, ENTERPRISES AND PRODUCTION	10
2.2 GEOPHYSICAL RESOURCES	23
2.2.1 Climate	23
2.2.2 Land Use	23
2.2.3 Landforms	24
2.2.4 Soils	24
2.2.5 Rural Land Capability	27
2.2.6 Agricultural Suitability	29
2.2.7 Biophysical Strategic Agricultural Land	30
2.2.8 Water Resources	34
3 POTENTIAL IMPACTS	38
3.1 ENVIRONMENTAL RISK ASSESSMENT	38
3.2 AGRICULTURAL RESOURCES	38
3.2.1 Impacts on Agricultural and Land Resources during the Project Life	38
3.2.2 Land Resources Post-Mining	39
3.2.3 Availability of Water for Agriculture	44
3.2.4 Potential Air Quality Impacts on Agriculture	46
3.2.5 Potential Road Transport Impacts on Agriculture	46
3.3 AGRICULTURAL PRODUCTION ENTERPRISES AND INFRASTRUCTURE	47
4 MITIGATION AND MANAGEMENT MEASURES	49
4.1 MINIMISATION OF DISTURBANCE TO AGRICULTURAL LANDS	49
4.2 MANAGEMENT OF SOIL RESOURCES	49
4.3 MANAGEMENT OF ADJOINING WHITEHAVEN-OWNED LANDS	50
4.4 RE-ESTABLISHMENT OF AGRICULTURAL LANDS	50
4.5 WATER RESOURCES	51
4.6 OTHER MEASURES	52
5 JUSTIFICATION OF PROPOSED CHANGES TO AGRICULTURAL LANDS	53
6 REFERENCES	54

## TABLE OF CONTENTS (continued)

### LIST OF TABLES

Table 1	Summary of Current Agricultural Practices Based on Local Landholder Consultation
Table 2	Values and Criteria used to Identify BSAL
Table 3	Summary of Agricultural Lands Before and After Mining
Table 4	Potential Impacts of the Project on Regional and State Agricultural Land Area
Table 5	Maximum Annual Regional Production/Economic Impacts of the Forgone Agricultural Production and the Project

### LIST OF FIGURES

Figure 1	Regional Location
Figure 2a	Project Overview – Mining Area
Figure 2b	Project Overview – Private Haul Road and Kamilaroi Highway Overpass
Figure 3	Mapped BSAL in the Boggabri – Gunnedah Area
Figure 4a	Land Ownership Map – Mining Area
Figure 4b	Land Ownership List – Mining Area
Figure 5	Current Agricultural Enterprises in the Project Area and Surrounds
Figure 6a-b	Historic Aerial Photographs of the Project Mining Area
Figure 7a	Land Ownership Map – Private Haul Road and Kamilaroi Highway Overpass
Figure 7b	Land Ownership List – Private Haul Road and Kamilaroi Highway Overpass
Figure 8	Historic Aerial Photographs of the Private Haul Road and Kamilaroi Highway Overpass Area
Figure 9	Project Soil Landscape Units Mapping
Figure 10	Project Rural Land Capability Mapping
Figure 11	Project Agricultural Suitability Mapping
Figure 12	Registered Groundwater Bores and Surface Water Pumping Stations in the Vicinity of the Project
Figure 13	Final Project Landform
Figure 14	Post-mining Agricultural Suitability

### LIST OF ATTACHMENTS

Attachment A	Agricultural Resource Assessment (McKenzie Soil Management, 2012)
Attachment B	Economic Review of Potential Agricultural Impacts (Gillespie Economics, 2012a)

## 1 INTRODUCTION

Whitehaven Coal Limited (Whitehaven) proposes to develop an open cut mining operation known as the Vickery Coal Project (the Project) approximately 25 kilometres (km) north of Gunnedah in New South Wales (NSW) (Figure 1).

The Project is located at the site of the previous Vickery Coal Mine which commenced in 1986 with a small underground operation and continued until 1991. From 1991 to 1998 approximately 4 million tonnes of coal was extracted using open cut mining methods. Mining operations at the Vickery Coal Mine ceased in May 1998. Since mining ceased, rehabilitation activities have been completed and the site is currently under care and maintenance.

The Project would involve the development of an open cut coal mine and associated infrastructure, producing up to approximately 4.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal for a period of approximately 30 years.

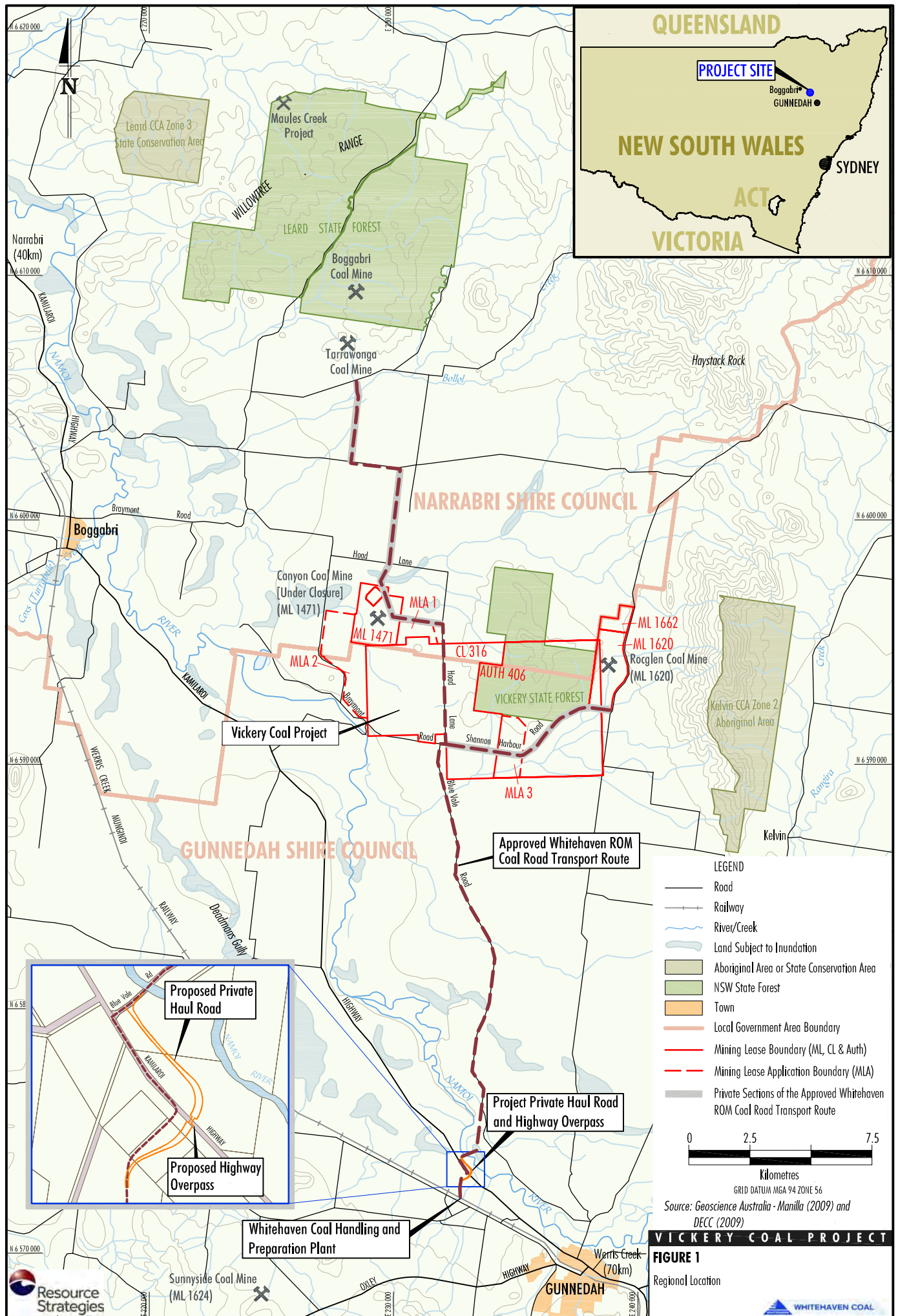
Whitehaven is seeking approval for the Project from the NSW Minister for Planning and Infrastructure in accordance with Division 4.1, Part 4 of the NSW *Environmental Planning and Assessment Act, 1979*.

The purpose of this Agricultural Impact Statement (AIS) is to describe the agricultural resources and enterprises within the Project area and surrounding region, and to identify and assess the potential impacts on them. The report is a key supporting document to the Project Environmental Impact Statement (EIS).

### 1.1 OVERVIEW OF THE PROJECT

The main activities associated with the development of the Project are listed below:

- Development and operation of an open cut mine within Coal Lease 316, Authorisation 406, Mining Lease 1471, Mining Lease Application (MLA) 1, MLA 2 and MLA 3.
- Use of conventional mining equipment, haul trucks and excavators to remove up to 4.5 Mtpa of ROM coal and approximately 48 million bank cubic metres of waste rock per annum from the planned open cut.
- Placement of waste rock (i.e. overburden and interburden/partings) within external emplacements to the west and east of the planned open cut (i.e. Western Emplacement and Eastern Emplacement) and within mined-out voids.
- Construction and use of a Mine Infrastructure Area (MIA), including on-site coal crushing, screening and handling facilities to produce sized ROM coal, workshops, offices and services.
- Transport of ROM coal by haulage trucks to the Whitehaven Coal Handling and Preparation Plant (CHPP) on the outskirts of Gunnedah (approximately 20 km to the south of the Project open cut) for processing.
- Use of an on-site mobile crusher for coal crushing and screening of up to 150,000 tonnes (t) of domestic specification coal per annum for direct collection by customers at the Project site.
- Use an on-site mobile crusher to produce up to approximately 90,000 cubic metres of gravel materials per annum for direct collection by customers at the Project site.
- Construction and use of a water supply bore, and a surface water extraction point on the bank of the Namoi River and associated pump and pipeline systems.
- Construction and use of new dams, sediment basins, channels, dewatering bores and other water management infrastructure required to operate the mine.





- Construction and use of new soil stockpile areas, laydown areas and gravel/borrow areas.
- Construction of a 66 kilovolt (kV)/11 kV electricity substation and 11 kV electricity transmission line.
- Transport of coarse rejects generated within the Whitehaven CHPP via truck to the Project for emplacement within an in-pit emplacement area.
- Transport of tailings (i.e. fine rejects) generated within the Whitehaven CHPP via truck to the Project for emplacement within co-disposal storage areas in the open cut and/or disposal in existing off-site licensed facilities (e.g. the Brickworks Pit).
- Realignment of sections of Blue Vale Road, Shannon Harbour Road and Hoad Lane to the east and south of the open cut.
- Realignment of the southern extent of Braymont Road to the south of the open cut.
- Construction of an approximately 1 km long section of private haul road (including an overpass over the Kamilaroi Highway) between Blue Vale Road and the Whitehaven CHPP (referred to as the private haul road and Kamilaroi Highway overpass).
- Ongoing exploration, monitoring and rehabilitation activities.
- Construction and use of other associated infrastructure, equipment and mine service facilities.

Figures 2a and 2b show the maximum extent of the main Project components overlaid on recent aerial photographs.

## 1.2 SCOPE OF THIS REPORT

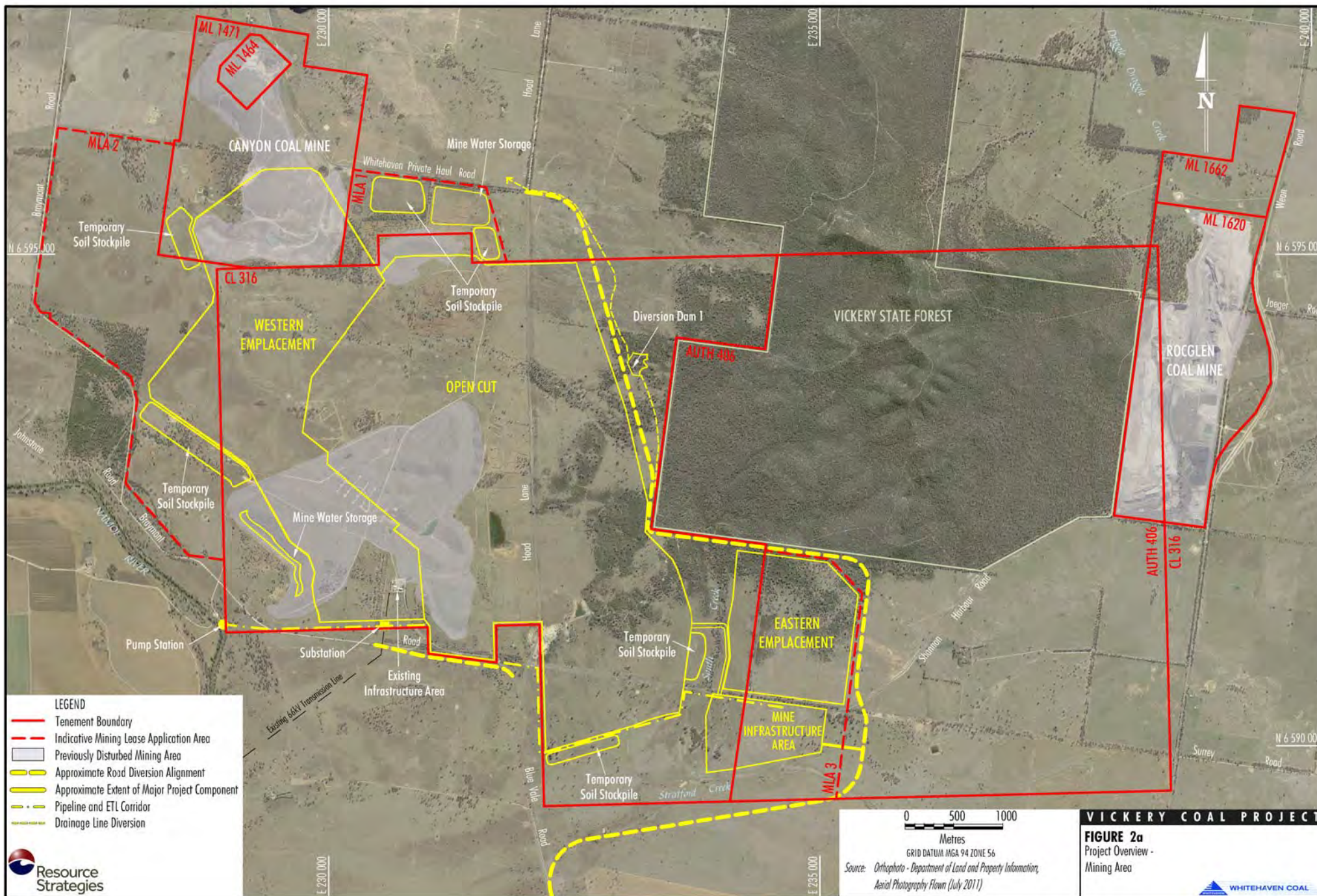
This AIS has been prepared to address the following components of the Director-General's Requirements (DGRs) for the Project:

**Land Resources** - including a detailed description and assessment of impacts on:

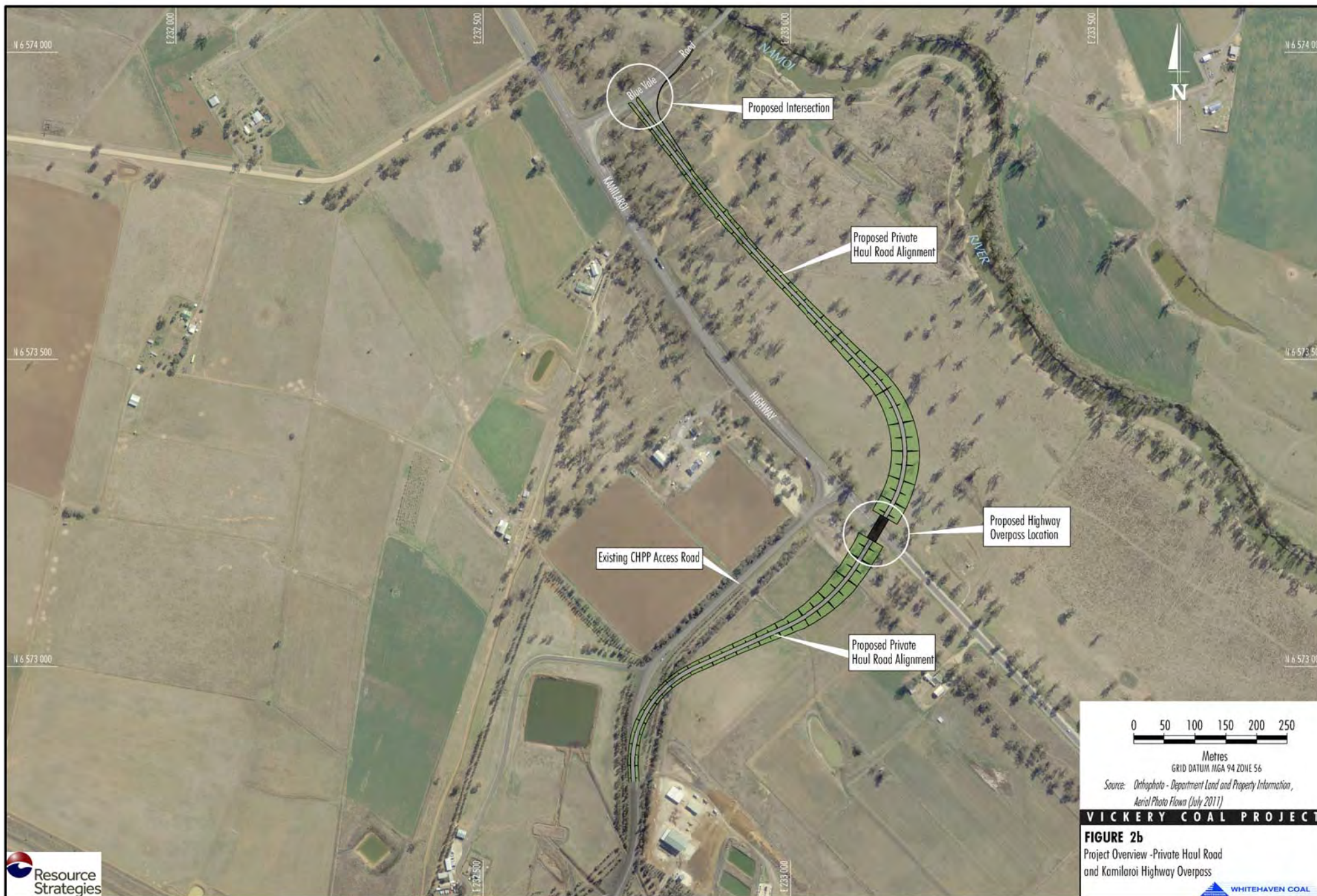
...

- *agricultural resources and/or enterprises of the local area, with particular reference to highly productive alluvial soils that may be impacted directly or indirectly by the project, and including:*
    - *pre-mining and post-mining agricultural assessment and mapping (including land capability and agricultural suitability mapping) of soil characteristics, across all proposed disturbance areas, and an assessment of their value and rehabilitation limitations;*
- ...
- *any change in land-use arising from the creation of biodiversity offsets;*
  - *a detailed description of the measures that would be implemented to avoid, reduce or mitigate impacts of the development on local agricultural resources and/or enterprises; and*
  - *justification for any significant long term changes to agricultural resources, particularly highly productive soils potentially affected by the development.*

This report has also been prepared to address the requirements of the NSW Department of Planning and Infrastructure (DP&I) *Guideline for Agricultural Impact Statements* (DP&I, 2012a) and the *New England North West Strategic Regional Land Use Plan* (New England North West SRLUP) (DP&I, 2012b), which were published in March 2012 and September 2012, respectively.







### 1.3 STRUCTURE OF THIS REPORT

This AIS is structured as follows:

- |           |   |
|-----------|---|
| Section 1 | Provides an introduction and overview of the Project, outlines the scope and structure of this report, and provides a description of relevant consultation.                   |
| Section 2 | Provides a description of the existing geophysical resources, agricultural resources, production and enterprises in the region.   |
| Section 3 | Describes the potential impacts of the Project on agricultural resources and enterprises, including potential impacts on relevant geophysical aspects (e.g. water resources). |
| Section 4 | Describes the mitigation and management measures to be implemented with respect to Project impacts on agricultural resources and enterprises.                                 |
| Section 5 | Provides a conclusion and justification for the changes to agricultural resources that would arise due to the Project.  |
| Section 6 | Provides a list of references.  |

Attachment A provides supporting baseline and impact assessment information in the form of a detailed Agricultural Resource Assessment prepared by McKenzie Soil Management (2012).

Attachment B provides an Economic Review of Potential Agricultural Impacts prepared by Gillespie Economics (2012a).

The following reports have also been prepared in support of the Project and should be read in conjunction with this AIS:

- Groundwater Assessment (Heritage Computing, 2012) (Appendix A of the EIS);
- Surface Water Assessment (Evans & Peck, 2012) (Appendix B of the EIS);
- Noise and Blasting Assessment (Wilkinson Murray, 2012) (Appendix C of the EIS);
- Air Quality and Greenhouse Gas Assessment (PAE Holmes, 2012) (Appendix D of the EIS);
- Ecological Assessment (Niche Environment and Heritage, 2012) (Appendix E of the EIS);
- Road Transport Assessment (GTA Consultants, 2012) (Appendix F of the EIS);
- Visual Assessment (Urbis, 2012) (Appendix H of the EIS);
- Aboriginal Cultural Heritage Assessment (Landscape, 2012) (Appendix I of the EIS);
- Non-Aboriginal Heritage Assessment (Heritage Management Consultants, 2012) (Appendix J of the EIS);
- Socio-Economic Assessment (Gillespie Economics, 2012b) (Appendix K of the EIS); and
- Environmental Risk Assessment (SP Solutions, 2012) (Appendix M of the EIS).

Key findings of these assessments are summarised in this report where relevant.



## 1.4 CONSULTATION

Since Whitehaven acquired the Vickery Coal Mine site in 2010 it has consulted with relevant stakeholders at a level appropriate to the scale of its on-site activities. Initial consultation activities in 2010 and 2011 were primarily concerned with notification of the NSW Division of Resources and Energy (within NSW Department of Trade and Investment, Regional Infrastructure and Services) of Whitehaven's planned exploration and resource definition drilling activities. Whitehaven also continued and/or established licence agreements with several local landholders so that they could graze their cattle on the Project area, including the rehabilitated Vickery Coal Mine disturbance areas.

Since the second half of 2011, Whitehaven has conducted a comprehensive consultation program with state and local government agencies, the local community, and other interested stakeholders as part of the preparation the Project EIS. The consultation has covered all environmental aspects of relevance to the Project, including potential impacts on agricultural resources, enterprises and supporting industries. Key consultation activities of particular relevance to the AIS are listed below.

- The DP&I has been consulted regularly about the Project. Key meetings have included the initial Project briefing in September 2011, followed by lodgement of the Preliminary Environmental Assessment (PEA) and Planning Focus Meeting in November and December 2011 respectively. Project and environmental study update meetings were held in June, August and September 2012. These meetings covered all environmental aspects of relevance to the Project, including discussion of the baseline soil surveys results and proposed approach to address the *Guideline for Agricultural Impact Statements* (DP&I, 2012a) and the New England North West SRLUP (DP&I, 2012b).
- The NSW Office of Agricultural Sustainability & Food Security was consulted following lodgement of the PEA and provided input to the DGRs for the Project. Meetings were held with the Office of Agricultural Sustainability & Food Security in July and November 2012 to provide Project briefings, and to describe the environmental studies that had been undertaken (in particular the soil surveys, Rural Land Capability, Agricultural Suitability and productivity evaluations). Key issues raised by the Office of Agricultural Sustainability & Food Security included:
  - identification of agricultural resources and/or enterprises in the local area, with particular reference to highly productive alluvial soils that may be impacted directly or indirectly by the Project;
  - descriptive rehabilitation goals relating to land use, soil resources and agricultural productivity, including depth to soil horizons, livestock carrying capacity and total areas of agricultural land classification classes;
  - strategic regional land use planning and identification of strategic agricultural land; and
  - local and regional agricultural productivity and gross margins and pre-mining and post-mining economic considerations.
- The Namoi Catchment Management Authority (Namoi CMA) attended the Planning Focus Meeting and provided input to the DGRs for the Project. The Namoi CMA attended a Project and water studies update meeting with the NSW Office of Water (NOW) in June 2012 and also attended the Project community information day which was held in September 2012. The Namoi CMA has expressed interest in a wide range of environmental aspects, including potential impacts on agricultural lands and land capability within the Project area and surrounds.

- The NSW Department of Primary Industries (DPI) – Catchments and Lands (Lands Department) and the Central North Livestock Health and Pest Authority (CNLH&PA) have been consulted with regard to the private haul road and Kamilaroi Highway overpass. The proposed alignment of the road and overpass crosses two blocks of Crown Land that are nominated travelling stock reserves (TSR) under Part 5 of the NSW *Crown Lands Act, 1989*. The Board of the CNLH&PA, as the nominated managers of the Crown Land, met in November 2011 and resolved to allow the construction of the private haul road and Kamilaroi Highway overpass subject to the following conditions:
  - the section of the private haul road that passes through Lot 7052 DP 1119794 be fenced on both sides to prevent stock from straying into the path of heavy vehicles; and
  - that access for stock using the TSR adjacent to the Kamilaroi Highway, be maintained to the lagoon on Lot 7052 DP 1119794 as this is the only accessible water point during times of drought.
- Project specific newsletters were produced by Whitehaven in January 2012, May 2012 and September 2012 and distributed locally to inform the community of the Development Application and to provide updates on the development of the Project and the progress of the EIS and specialist studies.
- A Project community information day was held at Boggabri in September 2012, to provide an opportunity for the local community to ask Whitehaven and the specialists preparing the EIS studies any specific queries or issues of concern relating to the Project. The Project community information day was attended by representatives of Whitehaven, Heritage Computing, Evans & Peck, McKenzie Soil Management, Niche Environmental and Heritage and Resource Strategies. Issues raised by members of the local community during the Project community information day included:
  - cumulative impacts of the Project plus the other nearby mines on the acoustic, air quality and visual amenity of nearby privately owned properties;
  - potential impacts of the Project on local groundwater and surface water use, and potential impacts on downstream landholders through flooding and/or reduction in flows;
  - the Project noise and air monitoring program;
  - final void depth, location, rehabilitation strategy and potential long-term impacts on local surface and groundwater resources; and
  - agricultural capability of the land within the Project area and the proposed biodiversity offset area.
- Whitehaven conducted a bore census of 53 privately-owned bores/wells on 21 properties in the vicinity of the Project in March 2012. The results of the census (e.g. confirmed bore/well locations and spot water levels/water quality measurements) were used to confirm the number and type of groundwater users in the vicinity of the Project, as well as assisting in the development of the regional numerical groundwater model and the Project groundwater impact assessment (Appendix A of the EIS).
- Whitehaven consulted with local landholders in September and October 2012 to gather information about the existing and historical agricultural practices within the Project area and adjoining properties. The consultation included landholders that have farmed the Project area for several generations and have firsthand experience of the productivity and capability of the land. Key findings from these discussions are described in this AIS where relevant.

Further details of the consultation program conducted for the Project are provided in Section 3 in the Main Report of the EIS.



During the life of the Project Whitehaven would continue to report on its activities and consult with state and local government agencies, the local community, and other interested stakeholders. It is expected that operational reporting and consultation would be via the mechanisms specified in the Project Development Consent. It is also expected that a Community Consultative Committee would be established, and would be comprised of an independent chair and appropriate representation from Whitehaven, the Gunnedah and Narrabri Shire Councils, and the local community.

## 2 EXISTING AGRICULTURAL AND GEOPHYSICAL RESOURCES

### 2.1 AGRICULTURAL RESOURCES, ENTERPRISES AND PRODUCTION

#### *Regional*

The Narrabri and Gunnedah Local Government areas (LGAs) are located in the Namoi Valley and host a wide range of agricultural activities. They have a combined land area of approximately 1,800,000 hectares (ha), of which approximately 68% is agricultural land. Irrigated agricultural land makes up approximately 5.6% of the total agricultural land (Gillespie Economics, 2012a).

Agricultural enterprises in the Narrabri and Gunnedah LGAs are primarily associated with livestock and crop production, and include the following commodities:

- beef;
- lamb/mutton;
- poultry;
- pork;
- wool;
- cotton;
- wheat;
- sorghum;
- barley;
- oats;
- soybeans;
- chickpeas;
- canola;
- mungbeans;
- maize; and
- sunflowers.

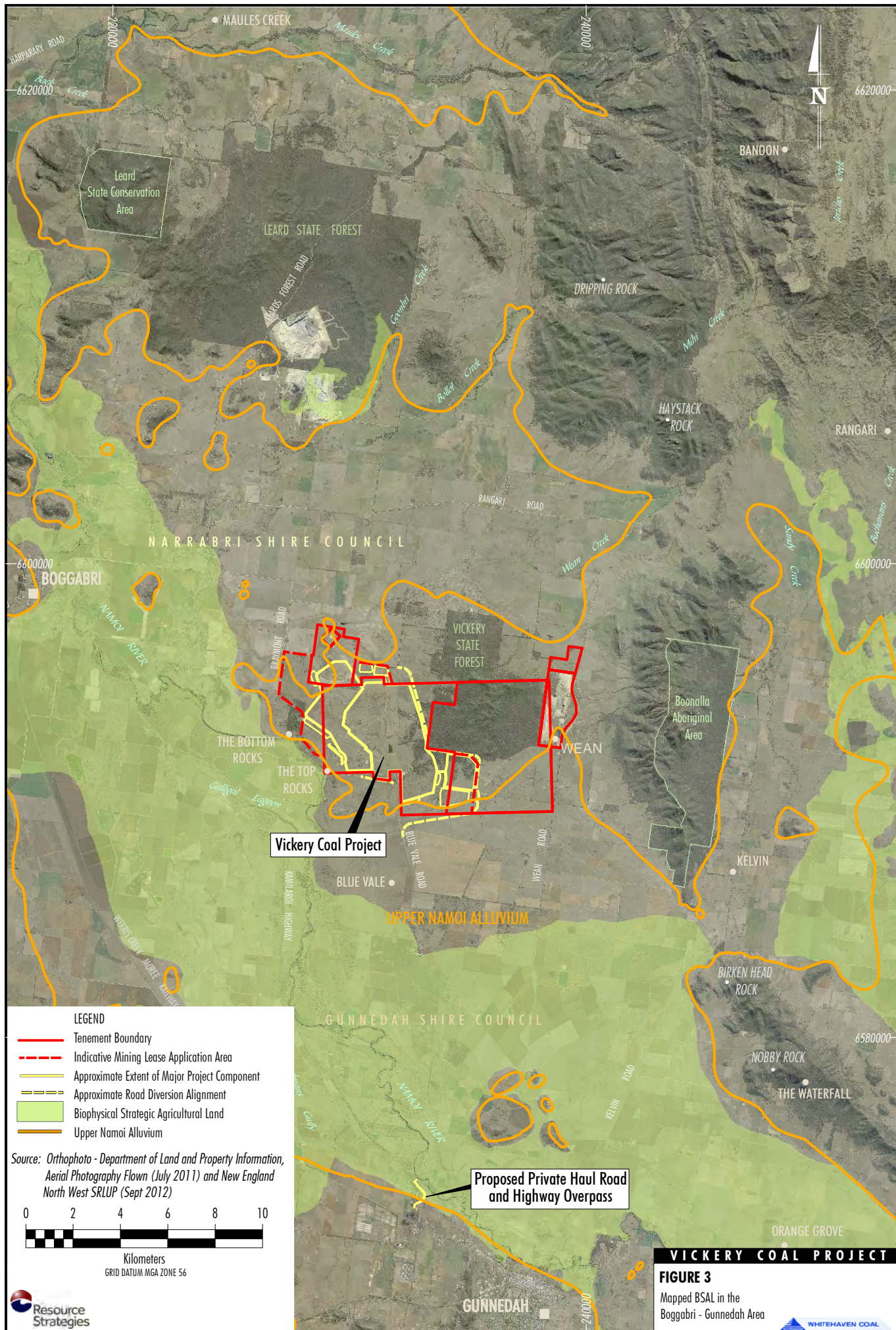
The Project is located in the centre of the Namoi River Catchment near the boundary between the Narrabri and Gunnedah LGAs (Figure 1). Agricultural enterprises in the Narrabri and Gunnedah LGAs vary depending on location and seasonal conditions. Farms located on the floodplains generally concentrate on cropping, whereas farms located on the slopes tend to focus on livestock production. Cotton production is concentrated in areas of the floodplains that are suitable for irrigation (e.g. close to the Namoi River and/or productive groundwater resources).

The Namoi River Catchment occupies an area of approximately 42,000 square kilometres (km<sup>2</sup>). The Namoi Catchment Action Plan (Namoi CMA, 2007) describes agricultural production within the Catchment as being valued at more than \$748 million (M) in 2005-2006. This included livestock production (\$260 M per annum [Mpa]), grain (\$201 Mpa) and other agriculture including cotton and lucerne production totalling over \$282 Mpa. Forty-eight percent of the gross value of agricultural production in 2005-2006 came from the Catchment's irrigation activities (Namoi CMA, 2007).

The Namoi Catchment Action Plan (Namoi CMA, 2007) describes the first agricultural developments in the Catchment as taking place in the early 1800s based on grazing on native pastures and subsequently on improving pastures for grazing. The development of tillage technologies suitable for self-mulching soils in the early 1900s enabled cereal production to be expanded and to include both summer and winter crops. After the construction of the Keepit Dam in the 1950s, the available tillage and irrigation technologies combined to allow areas of land suitable for irrigation to be developed and used for intensive cropping, especially cotton production (Namoi CMA, 2007).

The areas of intensive agriculture in the Catchment are primarily located adjacent to the Namoi River and its main tributaries, and are strongly associated with the Upper Namoi Alluvium which contains productive groundwater and highly fertile soil resources. The recently released New England North West SRLUP (DP&I, 2012b), has identified and mapped large areas of Biophysical Strategic Agricultural Land (BSAL) within the Catchment, including land along the Namoi River adjacent to the Project mining area. Figure 3 shows the regionally mapped BSAL, as well as the approximate boundary of the Upper Namoi Alluvium, in the vicinity of the Project.







The development of intensive cropping and irrigation over the past 50 years has supported the growth of a range of industries associated with more intensive land use, of farm input services and the transporting, processing and marketing of farm products (Namoi CMA, 2007).

A variety of specialist agricultural suppliers and services (e.g. agricultural supplies, irrigation supplies, harvest contractors and machinery service centres) are located in Gunnedah, Narrabri, Boggabri and other towns in the Narrabri and Gunnedah LGAs.

Infrastructure to allow for the transport, temporary storage and dispatch of crops (e.g. cotton and wheat) is located throughout the Narrabri and Gunnedah LGAs. This infrastructure includes silos, storage warehouses and rail and truck loading facilities. Cotton gins are operated in Boggabri and Narrabri. In addition, livestock saleyards are located in Narrabri and Gunnedah.

The Narrabri and Gunnedah LGAs are well located to use existing road and rail transport networks to access domestic and export markets. The key road transport routes servicing the area are the Kamilaroi and Newell Highways. The Newell Highway provides access to markets/ports in Brisbane and Melbourne, and the Kamilaroi Highway provides access to markets/ports in Newcastle and Sydney. The Werris Creek Mungindi Railway provides access to markets/ports in Newcastle, Sydney and Brisbane.

The Australian Cotton Research Institute Facility (operated by the Commonwealth Scientific and Industrial Research Organisation) and the Wheat Research and Plant Breeding Centre (operated by the University of Sydney) are located in the Narrabri LGA.

Gunnedah and Boggabri are the closest towns to the Project (Figure 1), and provide a wide range of service and infrastructure facilities to support local agricultural industries (e.g. regional rail and road links, livestock saleyards, grain storage and loading facilities, agricultural equipment sales and servicing businesses, and various agriculture-related consultancy and service firms). Access to these towns from the Project mining area is via the sealed Blue Vale Road (to Gunnedah in the south) or via the unsealed Braymont Road/Hoad Lane/Rangari Road (to Boggabri in the north-west) (Figure 1).

### ***Project Mining Area and Immediate Surrounds***

The Project mining area (Figure 2a) is located within an 'island' of Permian-aged sedimentary rocks of the Maules Creek Formation, which is surrounded by the Upper Namoi Alluvium associated with the floodplains of the Namoi River (Figure 3). The geological setting has influenced the topography, soils and vegetation, which in turn has influenced the current and historical agricultural land use of the area.

The topography is more elevated and undulating within the Project mining area, when compared with the adjoining floodplains to the south, west and north. The soils in the Project mining area are generally thinner and less fertile than the adjoining floodplains, as they are derived from older sedimentary rocks (e.g. conglomerates and sandstones) rather than alluvial sediments. Groundwater resources are also significantly less productive within the Project mining area. The majority of the Project mining area (i.e. 1,284 ha) is cleared and is dominated by native pasture species and occasional regrowth trees. Approximately 464 ha within the Project mining area consists of scattered remnants of woodland, semi-cleared woodland, and White Cypress Pine (*Callitris glaucophylla*) regrowth. In addition, the Project area includes approximately 405 ha of land that has been previously disturbed by mining activities and is now rehabilitated (Figure 2a).



Historical research conducted as part of the Project Non-Aboriginal Heritage Assessment (Heritage Management Consultants, 2012), combined with interviews with local landholders, indicates that the initial agricultural land use in the Project area was sheep grazing on native pasture in the 1830s and 1840s, which was gradually combined with small scale dryland cropping of barley and some wheat using horse-drawn ploughs and harvesters. Anecdotal information from local landholders indicates that the dryland cropping was low yielding and was largely abandoned in the early to mid 1900s when tractors were introduced to the region and the cropping potential of the black soils on the Gunnedah Region's floodplains was 'discovered'.

Over the past 50 years the Project mining area has been mostly used for grazing purposes (currently cattle only), with intermittent small scale dryland cropping on areas with higher soil fertility. Anecdotal information from local landholders indicates that many families tried to farm the area as small enterprises in the 1960s and 1970s, however they generally only lasted a year or two.

The entire Project mining area is currently owned by Whitehaven (Figures 4a and 4b), with the land being used for cattle grazing by several local landholders under licence. The carrying capacity of the Project mining area is generally considered to be relatively low. Privately-owned land on the floodplains to the immediate north, north-west and west of the Project mining area is predominately used for cropping (Figure 5).

Figures 6a and 6b show a series of aerial photographs of the Project mining area obtained from the NSW Department of Lands, the oldest of which was taken in the 1950s. The photographs show the Project mining area as having been predominately cleared for at least 55 years, with numerous small paddocks some of which appear to have been sown to crops.

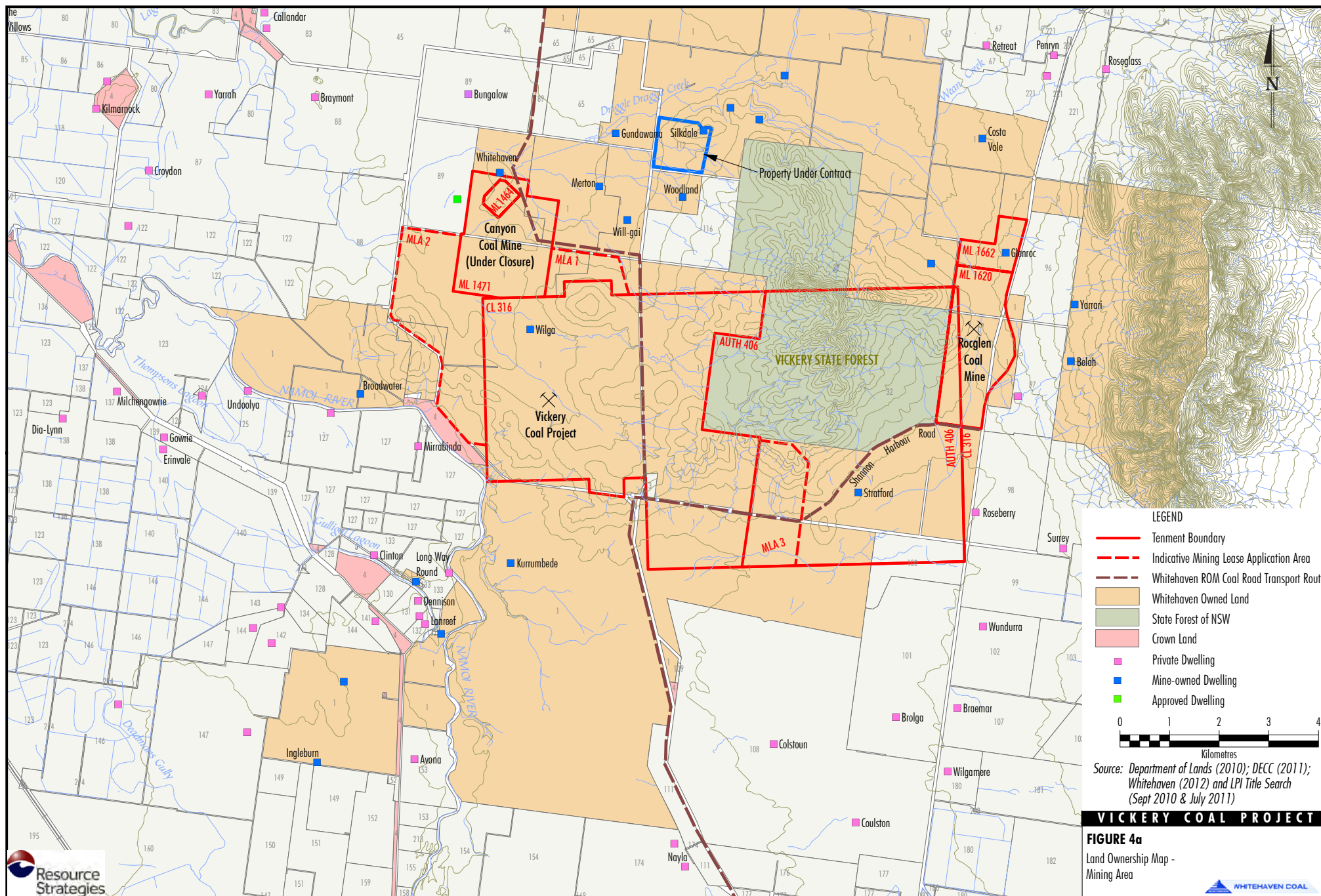
As described in Section 1.4, Whitehaven consulted with local landholders in September and October 2012 to gather information about the existing and historical agricultural practices within the Project mining area and at some of the adjoining properties. Table 1 provides a summary of the information obtained through this consultation.

### ***Private Haul Road and Kamilaroi Highway Overpass Area***

The proposed private haul road and Kamilaroi Highway overpass would be located approximately 5 km north-west of Gunnedah on the floodplain of the Namoi River (Figures 1 and 2b). The portion of the proposed disturbance area on the north-east side of the Kamilaroi Highway is cleared grassland with scattered trees and is currently used for grazing purposes. This area includes a block of Crown Land which is a dedicated TSR (i.e. Lot 7052 DP1119794), plus a block of privately-owned land (Figures 7a and 7b). Whitehaven has entered into an agreement with the owner of the privately-owned block to subdivide and purchase the land on which the private haul road and Kamilaroi Highway overpass would be constructed.

The portion of the proposed disturbance area on the south-west side of the Kamilaroi Highway also includes a section of dedicated TSR (i.e. Lot 7010 DP1074926) as well as a block of land that is currently owned by Whitehaven (Figures 7a and 7b). The Whitehaven-owned block is cleared and has been used for cropping purposes (most recently oats and lucerne for hay making).

Figure 8 provides historical aerial photographs of the private haul road and Kamilaroi Highway overpass area taken in 1956, 1975, 1991 and 2001.



REFERENCE No.	LANDHOLDER	REFERENCE No.	LANDHOLDER
1	Whitehaven Coal Mining Pty Ltd	130	HM Cassidy
3	Gunnedah Shire Council	131	BJ & DP Keeler
4	The State of New South Wales	132	EJ & CA Hannan
6	Narrabri Shire Council	133	GA Mcilveen
7	The Council of the Shire of Namoi	134	TB Roberts
9	The Commissioner for Railways	136	EF Darley
32	State Forests of NSW	137	AC & GT Carrigan
39	DV Gillham	138	AC Carrigan
44	RR & PL Crosby	139	KL & SR Crawford
45	RP & RD McGregor	140	DA & JE Watt
65	TR Hall & AI Myers Johnson	141	DM & AM Heinemann
67	RL & KA Penrose	142	TB & A Roberts
68	PG & IL Capel	143	SL Johns
78	JM & NM McKechnie	144	EF & JT Darley
79	KD Gillham	146	GC Carrigan
80	A D Watson Holdings Pty Ltd	147	TJ & C Loveridge
82	EC & JE Clarke	148	DJ & RG Ewing
83	RP McGregor	149	PJ Loveridge
85	Kilmarnock (Boggabri) Pty Ltd	150	TJ Loveridge
86	PJ Watson Holdings Pty Ltd	151	LG Sims
87	DS Riley	152	CJ Sims
88	MJ & JH Maunder	153	RG & HK Mansfield
89	KA & C Blanch	154	MM & SM Dawson
94	RJ & A Barnes	155	M & GO Jensen
95	CW & MJ Harmse	157	IK, KD, PRB & JE Mcarthur
96	GJ Rennick	158	BC Martin & LD Curran
97	RS & GJ Rennick	159	IE Sims
98	RS Rennick	160	RS Blackmore
99	WN & KE Sales	161	PRB & JE Mcarthur
100	C McKillop Laurie	168	GW & GN Thibault
101	WF & SE Nicholls	169	WJ & SL Evans
102	JC & JE Meyers	174	Selkirk Pastoral Co Pty Limited
103	KG Perrett	176	WM & KL Campbell
104	DA & RK Torrens	177	South Weroona Pty Limited
105	JC & MA King	178	BA & D Edwards
106	MJ Pickett	180	RJ & PF Fitzpatrick
107	JC Wise & LD Miller	181	M & TC Clifton
108	AC Wannan & PM Winter	182	DJ & DA Shaw
109	Namoi Valley Coal Pty Limited	183	GL Knapman
111	RB Kelly	184	JR & JE Floyd
112	NP & SA Jackson (Under Contract)	187	BJ, LA, AJ & MA Thibault
116	C R & C P Stewart Investments Pty Limited	195	DW & KA Rolinson
118	AD Watson	197	CAL & CG Boileau
120	Nambarloo Pty Limited	199	RP & SM Urquhart
122	Nandewar Pty Limited	200	DK & BM Swain
123	Primeag Australia Limited	208	O Gremmer
124	JP Carrigan	211	LJ Carrigan
125	S & AJ Maunder	213	Damilabe Pty Ltd
127	JK Barlow	214	GC Carrigan GM Carrigan
128	GA & TJ Mcilveen	221	ME Geddes

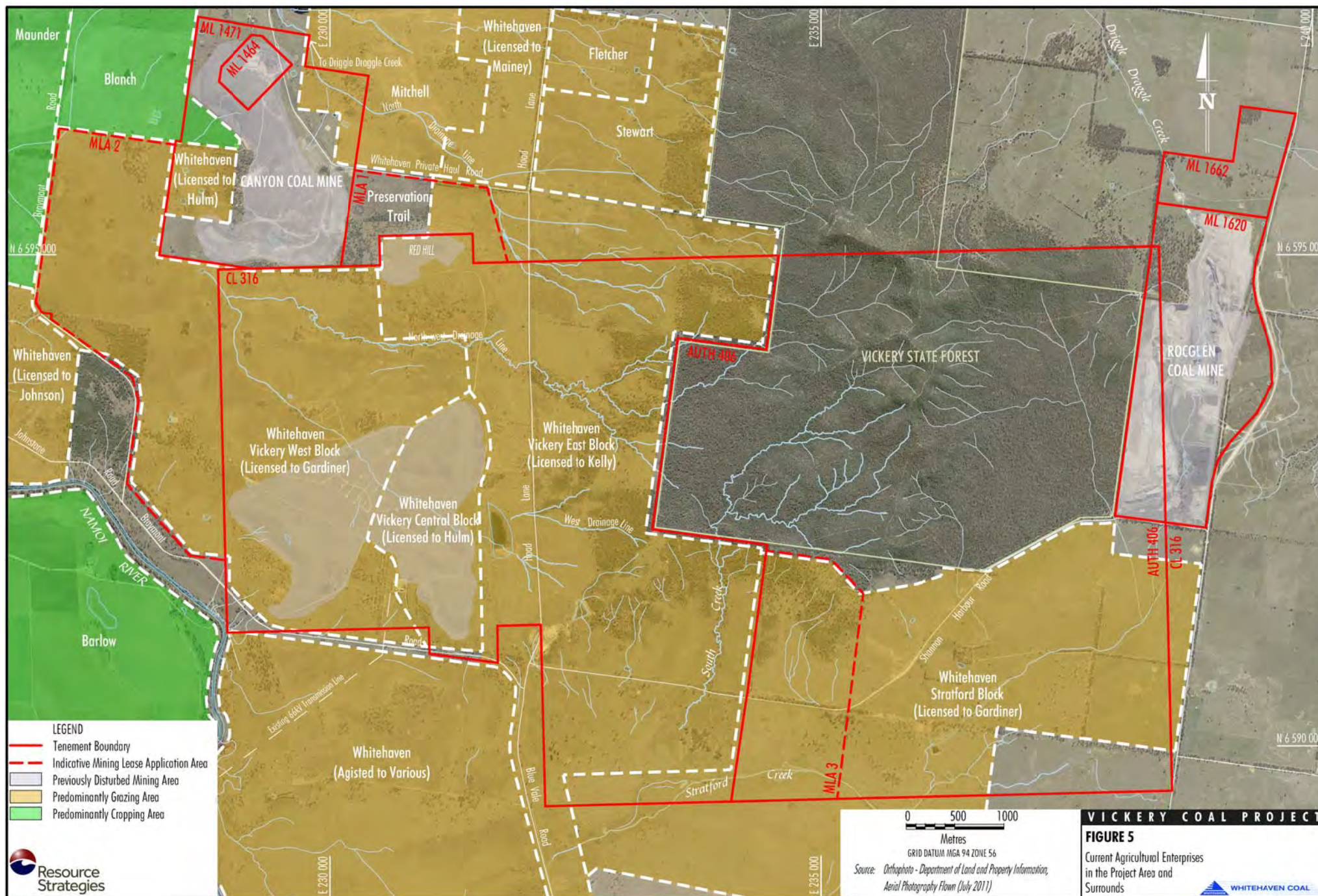
# VICKERY COAL PROJECT

## FIGURE 4b

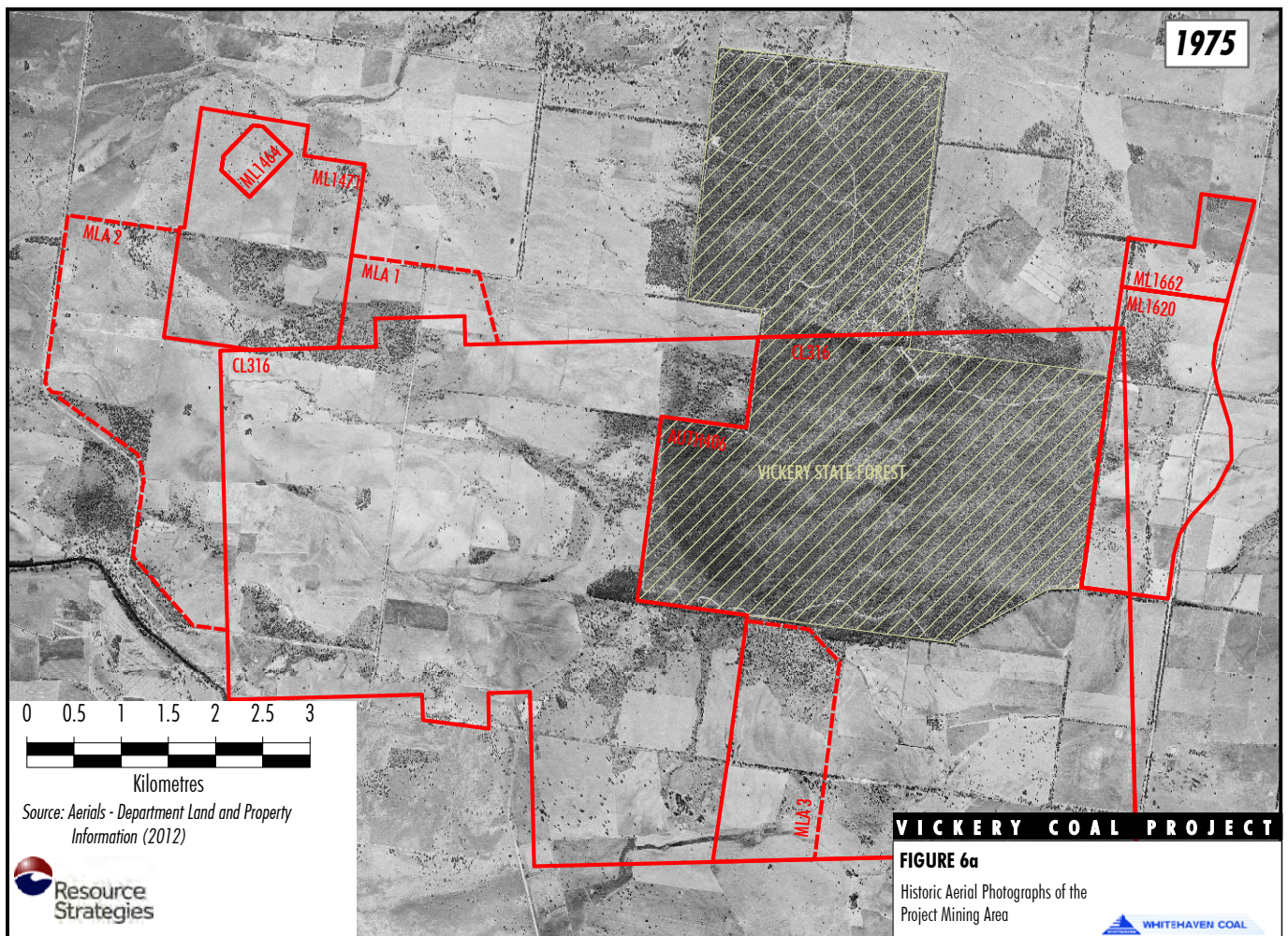
Relevant Land Ownership List -  
Mining Area



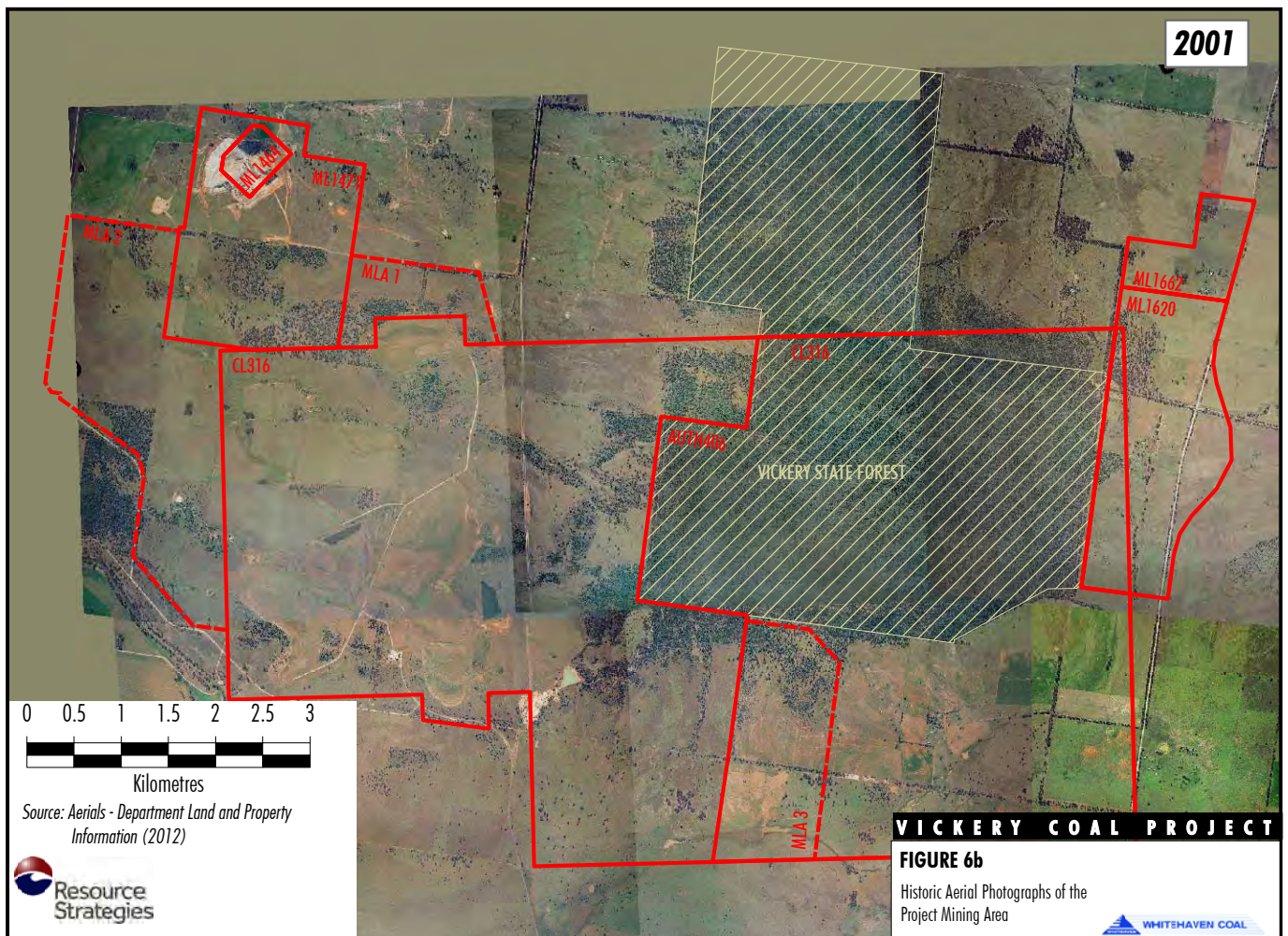
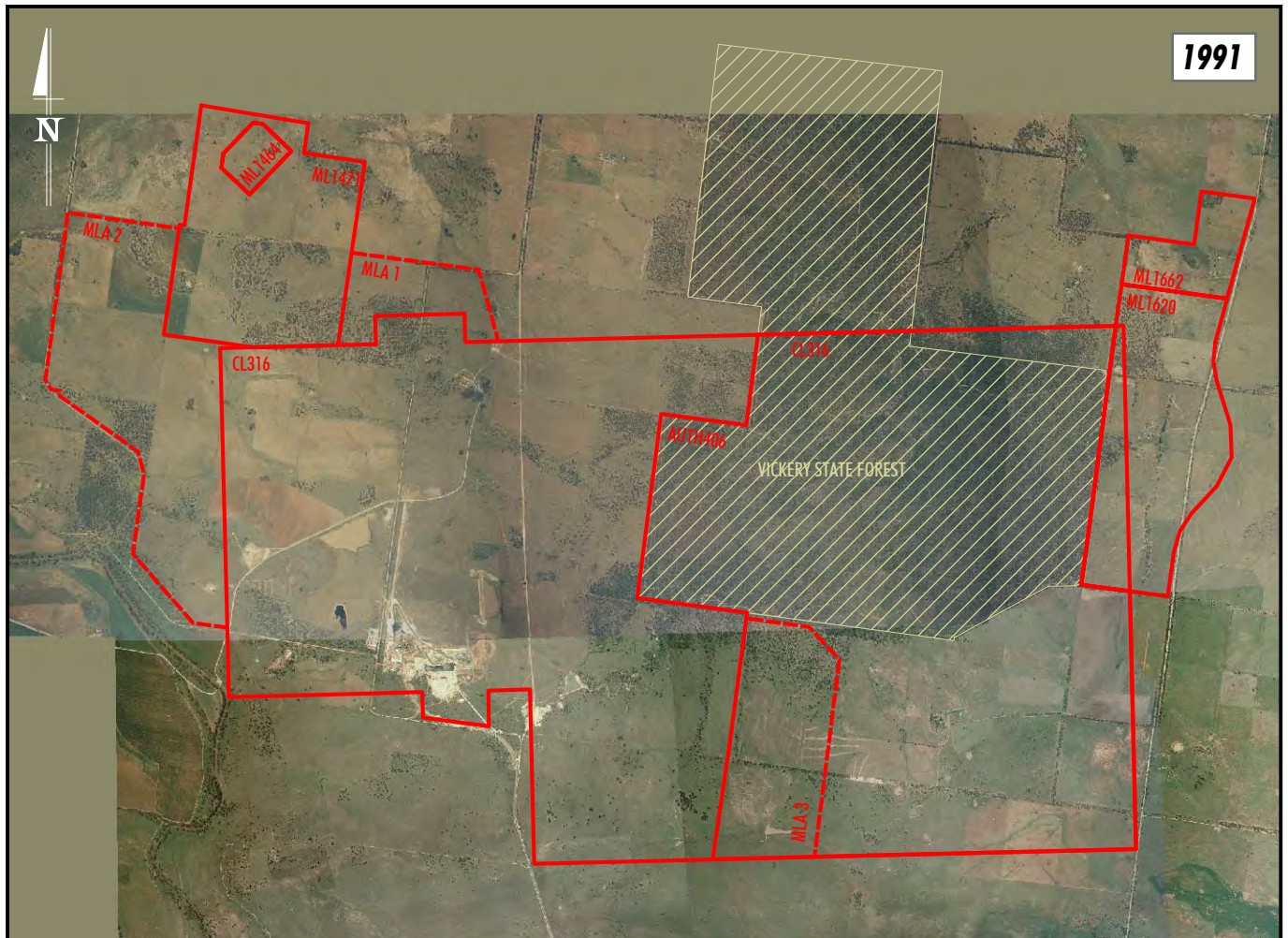








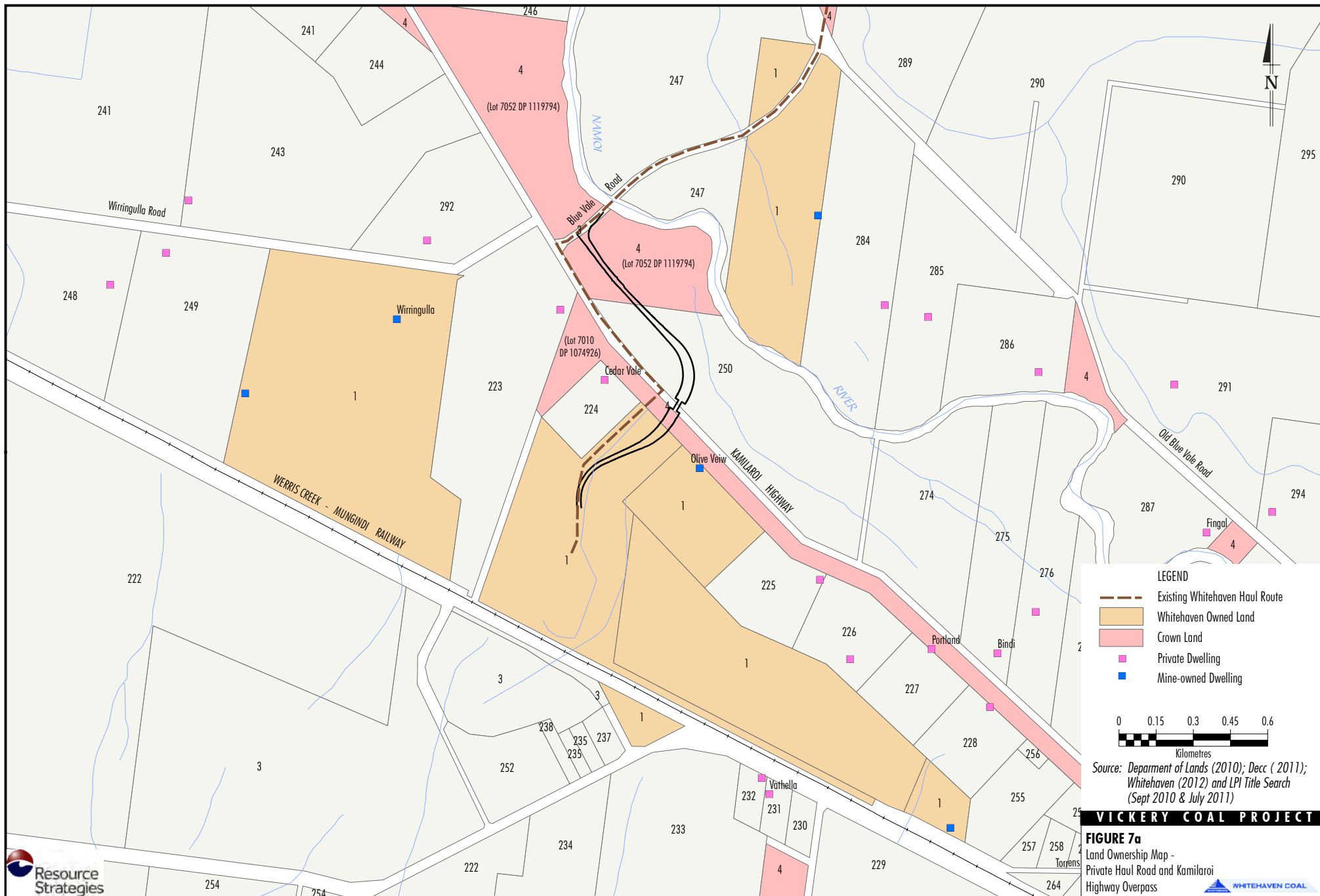






**Table 1**  
**Summary of Current Agricultural Practices Based on Local Landholder Consultation**

Area (Figure 5)	Comments
Vickery East Block	<ul style="list-style-type: none"> <li>• Used intermittently for cattle grazing (approximately 115 head; cows and weaners), but only for short periods (i.e. currently only 2-3 weeks per year) due to the areas low stocking capacity (i.e. approximately 1 cow per 60 acres).</li> <li>• Soil is thin and land is poor adjacent to the Vickery State Forest, generally not used for grazing (i.e. 'cattle will survive but not fatten').</li> <li>• Paddock near the former Red Hill mining area has slightly better soil, and better stock carrying capacity.</li> <li>• Stock watering is via farm dams only. Previously had a windmill to the south of the Project mining area (approximately 240 feet deep) near Blue Vale Road, but performance and water quality was poor.</li> <li>• No knowledge of cropping of this area in the past 10 years.</li> <li>• No pasture improvements conducted. Plains Grass (<i>Austrostipa aristiglumis</i>) and White Cypress Pine regrowth are ongoing management issues.</li> </ul>
Vickery Central Block	<ul style="list-style-type: none"> <li>• Former Vickery Coal Mine rehabilitation area is used year round for cattle grazing (approximately 45 head; cows with calves). Stock watering via farm dams only. No pasture improvements conducted.</li> <li>• Small block in north-west corner is primarily used for cattle grazing (approximately 16 head; cows with calves), but it has also been intermittently used for cattle fodder production (e.g. lucerne, oats, sorghum) in the past 2-3 years. However yields have been low (e.g. 18 bales of sorghum hay off 25 acres) and it is not considered to be good for cropping on its own. Stock watering is via farm dams.</li> </ul>
Vickery West and Stratford Blocks	<ul style="list-style-type: none"> <li>• Vickery West block is used for cattle grazing only (average 100 -150 head; currently heifers and steers). The stock perform well on the rehabilitated areas, especially in summer as the area is sown with sub-tropical grass species that provide good feed. Stock watering is via farm dams only. No pasture improvements conducted.</li> <li>• Stratford block also used for cattle grazing. Soils on the north-west side of the block are quite poor.</li> </ul>
Cropping Area – North-west	<ul style="list-style-type: none"> <li>• Block is privately-owned and is referred to as 'Bungalow South'. It covers approximately 70 acres, and is located to the north-west of the Project mining area.</li> <li>• Block has been used for cropping over the past few years (e.g. barley, sorghum), but requires a lot of phosphorous and has been relatively low yielding.</li> <li>• Attempting to improve the land by returning the stubble and land management, but will likely revert back to grazing as the crop yields are low and costs relatively high.</li> </ul>
Cropping Area – West	<ul style="list-style-type: none"> <li>• Property is privately-owned and is on the western bank of the Namoi River to the west of the Project mining area. The current owners have held the property since 1968. Originally ran as a combined grazing (sheep and cattle) and cropping farm, but now cropping only.</li> <li>• Approximately 2,000 acres of which 15% is dryland cropping (wheat and barley) and 85% is irrigated cropping (wheat, barley, canola, chickpeas, cotton, sorghum, sunflowers, corn, mungbeans, soybeans). Crops are rotated as required.</li> <li>• Dryland cropping average yields: approximately 1 t per acre (wheat, barley).</li> <li>• Irrigated cropping average yields: approximately 2 - 2.5 t per acre (wheat, barely); approximately 1 t per acre (canola, mungbeans, soybeans); approximately 4.5 bales per acre (cotton); approximately 20 t per acre (corn); approximately 15 t per acre (sorghum).</li> <li>• Predominately flood irrigation, with some pivot irrigation (i.e. 120 acres).</li> <li>• Soil includes black, red and grey soil areas. Black soil areas are the most productive. Soil improvements include annual nitrogen fertilizer application.</li> <li>• Property has two surface water pump stations and three groundwater bores (plus one collapsed).</li> </ul>





REFERENCE No.	LANDHOLDER
1	Whitehaven Coal Mining Pty Ltd
3	Gunnedah Shire Council
3	The Council of The Shire Of Gunnedah
4	The State of New South Wales
222	Walleroy Crescent Pty Limited Chamberlain Avenue Pty Limited
223	RW Tibbs
224	TD & PA Burns, GR & KL Harris
225	JC & DL Wilkinson
226	CJ & WD Jaeger
227	PA & DL Rankin
228	RS & CA Brown
229	North West Projects (NSW) Pty Limited
230	WP Small
231	JB & DA Tibbett
232	CBC Finlay & KM Hunt
233	GS & HA Finlay
234	Pryde and Scott Investments Pty Limited
235	Pryde's Tucker Bag Pty Ltd
237	Manildra Flour Mills Retirement Fund Pty Limited
238	CJ & S Beattie Pty Limited
241	CJ & PA Waters
243	RT Dugan
244	PJ & D Fuller
246	RO & AF Cochrane
247	BD Kelly
248	SV Wicks
249	KB Hill
250	PJ Hedges
252	Blackjack Carbon Pty Limited
253	TM Bruce
254	AG, KJ, MA & SL Kennedy
255	Mackellar Equipment Hire Pty Ltd
256	GH & TG Foster
257	KJR Barnard & JE Niquet
258	North West Scrap Metal Pty Limited
259	OD & BJ Dennis
274	TB & AK Donoghue
275	JI Knebel
276	BA & K Edmonston
277	EC Riordan
278	VV Snape
279	PD Jones
284	RI & JE Horne
285	WH & SGBA Heath
286	RF & CC Wall
287	SM & RL Middleton
288	MJ Furner & A Ogi
289	RN Thomson
290	Gunnible Pastoral Company Pty Limited
291	PA Ryman
292	RI & JR Paterson

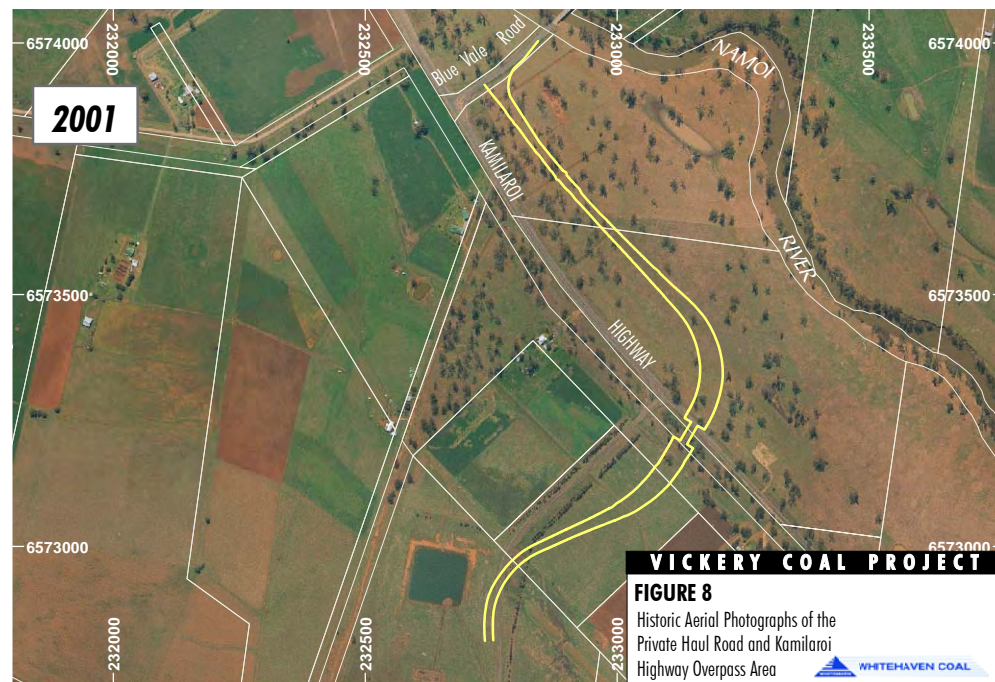
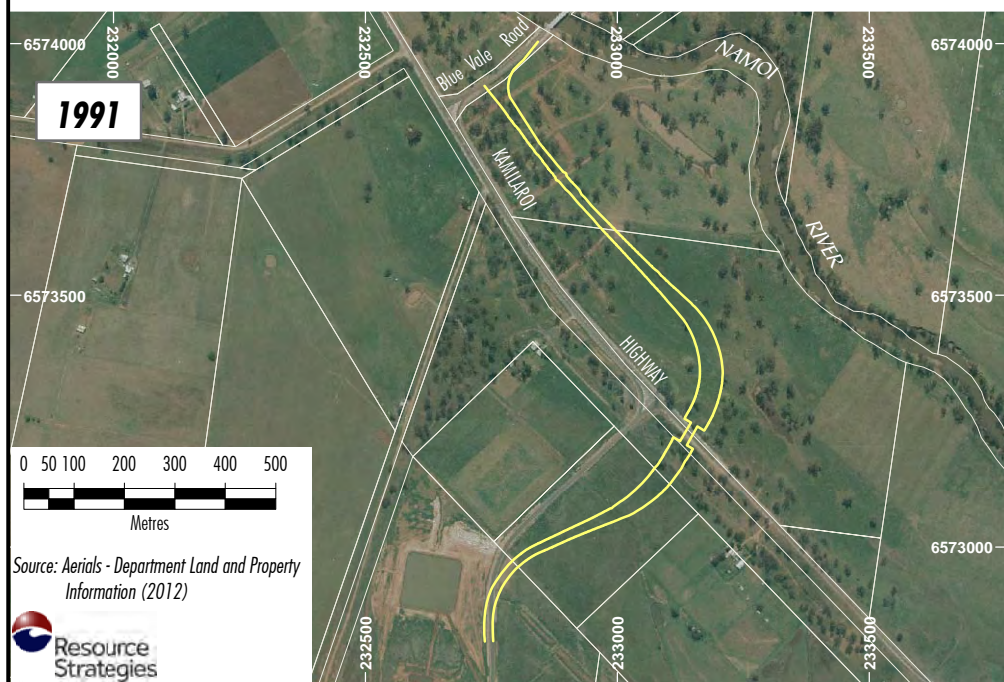
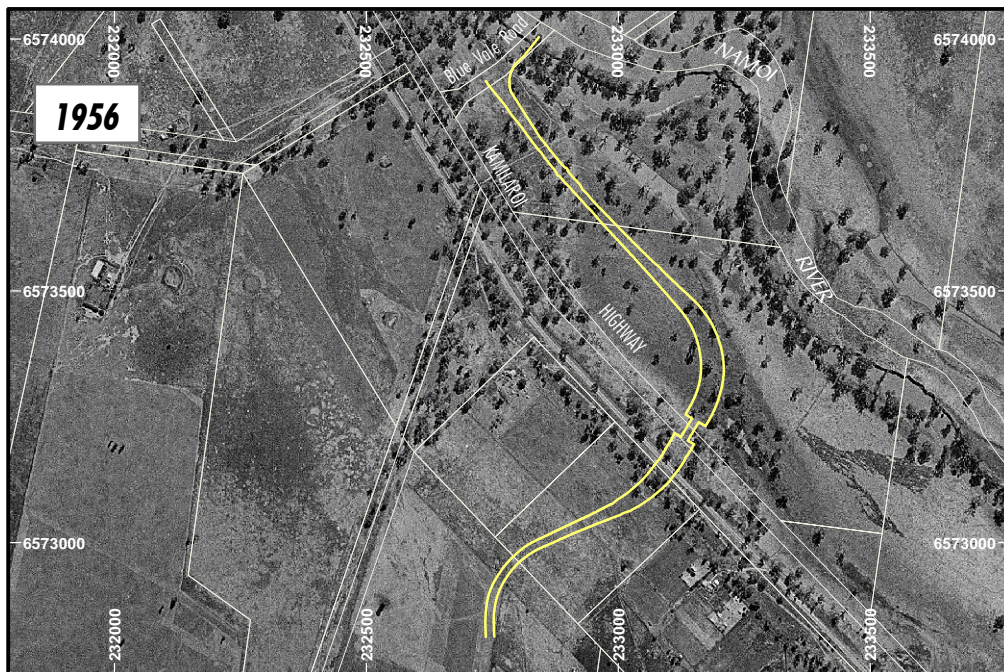
# VICKERY COAL PROJECT

## FIGURE 7b

Land Ownership List –  
Private Haul Road and Kamilaroi  
Highway Overpass









## **2.2 GEOPHYSICAL RESOURCES**

### **2.2.1 Climate**

Long-term meteorological data for the region is available from the Commonwealth Bureau of Meteorology (BoM) meteorological stations, while shorter term local records are available from weather stations located in the vicinity of the Project.

#### ***Temperature***

The Gunnedah meteorological station records show that temperatures are warmest from November to March and coolest from June to August (BoM, 2012). Monthly-average daily maximum temperatures are highest in January (34 degrees Celsius [°C]) and monthly-average daily minimum temperatures are lowest in July (3°C).

#### ***Rainfall***

The long-term average annual rainfall recorded at the Boggabri (Retreat) and Gunnedah Pool BoM meteorological stations was 579.3 millimetres (mm) and 622.4 mm respectively. Rainfall is reasonably well distributed throughout the year, however there is a slight peak in the summer months and marginally lower rainfall in autumn. On average, January is the wettest month of the year and April is the driest. The wetter months of December, January and February also have a reasonably low number of mean rain days, suggesting the higher volumes of rainfall are associated with higher intensity storms falling over shorter periods of time. The region is also susceptible to extended periods of drought (Evans & Peck, 2012).

#### ***Evaporation***

Evaporation records are available from the Keepit Dam and Gunnedah Resource Centre meteorological stations, which have recorded average annual evaporation levels of approximately 1,825 mm and 1,853 mm respectively.

The highest monthly-average evaporation is in December (259.4 mm and 250.5 mm for Keepit Dam and the Gunnedah Resource Centre, respectively), and the lowest monthly-average evaporation is in June (56.1 mm and 61.7 mm for Keepit Dam and the Gunnedah Resource Centre, respectively).

Measured monthly-average evaporation exceeds the measured monthly-average rainfall in all months.

Further descriptions of the climate of the Project area, including tabulated climatic data and a description of winds are presented in Section 4.2 in the Main Report of the EIS. Appendix D of the EIS (PAEHolmes, 2012) also provides windroses developed from a synthesis of data from nearby automatic weather stations.

### **2.2.2 Land Use**

As described in Section 1.4 and shown on Figure 4a, the entire Project mining area is owned by Whitehaven and is currently used intermittently for cattle grazing on predominantly cleared unimproved pasture. Cattle grazing takes place on almost all of the Project mining area, including some of the areas of woodland and semi-cleared woodland, as well as the majority of the 405 ha of rehabilitated mining landforms associated with the historical Vickery Coal Mine. Livestock are excluded from the existing infrastructure area (Figure 2a), which is currently used as a Project office and as the workshop and truck parking area for Whitehaven's coal haulage contractor.



There are no occupied dwellings within the Project mining area, although there is one small farm cottage plus the former Wilga homestead (Figure 4a). There are also various small sheds, yards, spray dips, windmills, and miscellaneous agricultural equipment items scattered across the Project mining area. These items are all in varying states of decay and have no, or very limited ongoing agricultural value or function. A comprehensive assessment of the potential heritage significance of these items has been conducted by Heritage Management Consultants (2012), and concluded that none of the identified items within the Project mining area have heritage significance (Appendix J of the EIS).

The land ownership in the vicinity of the private haul road and Kamilaroi Highway overpass is shown on Figures 7a and 7b. As illustrated in Figure 7a, the block of land located adjacent to Blue Vale Road (i.e. Lot 7052 DP 1119794) and the block of land that runs parallel to the Kamilaroi Highway (i.e. Lot 7010 DP 1074926) are both owned by the State of NSW (i.e. Crown Land) and are classified as TSRs within the meaning of Part 5 of the NSW *Crown Lands Act, 1989*. The CNLH&PA is the nominated manager of the reserves. As described in Section 1.4, Whitehaven has consulted with the DPI – Lands Department and the CNLH&PA with regard to the construction of the private haul road and Kamilaroi Highway overpass.

The remaining freehold land on the north-east side of the Kamilaroi Highway that would be affected by the private haul road and Kamilaroi Highway overpass is privately-owned and is used for grazing purposes. Whitehaven has entered into an agreement to subdivide and purchase the relevant portion of the block. The freehold block located on the south-west side of the Kamilaroi Highway is owned by Whitehaven and has been used for cropping oats and lucerne hay.

### **2.2.3 Landforms**

The natural topography in the Project mining area consists of undulating hills and slopes, with the elevation ranging from approximately 255 metres (m) Australian Height Datum (AHD) to approximately 325 m AHD. The topography is more dissected and steeper within the Vickery State Forest to the east of the Project where it rises to approximately 479 m AHD. To the north, south and west of the Project mining area the topography is gently sloping to almost flat, and generally drains towards the Namoi River. These floodplains typically have elevations of between 250 to 260 m AHD.

The land that would be affected by the private haul road and Kamilaroi Highway overpass is on the floodplain adjacent to the Namoi River. Its elevation ranges from approximately 262 to 265 m AHD.

Figures showing the slope and evaluation of the Project mining area are contained in Attachment A.

### **2.2.4 Soils**

A comprehensive soil survey of the Project mining area has been conducted by McKenzie Soil Management (2012) and is contained in the Project Agricultural Resource Assessment (Attachment A). The fieldwork was carried out over 11 days in November and December 2011, and included 75 soil pits covering all the main vegetation, topography, geology and land use types.

The main soil types mapped in the Project mining area were Dermosols (25%) and Sodosols (21%), with lesser areas of Anthrosols, Vertosols, Rudosols, Chromosols, Ferrosols, Tenosols and Kandosols also observed. Soil Landscape units containing groupings of these soil types were identified during the soil survey and are listed below.

- **Rehabilitated Land:** disturbed mining lands with a broad range of slopes; Anthroposols.
- **Drainage Line Variant (a):** ancient clay-rich plains and recent colluvium; strongly saline in low-lying areas; mainly in the area near Stratford Creek (Fluvial Systems, 2012); dominated by Brown and Grey Vertosols and Brown Dermosols; Sodosols and Stratic Rudosols sub-dominant.
- **Drainage Line Variant (b):** sand-dominated recent drainage-line-deposits in the northern drainage line; mainly Stratic Rudosols with saline subsoils.
- **Drainage Line Variant (c):** recent drainage-line-deposits and colluvium derived from a mix of basic volcanic and sedimentary parent materials (north-western and western drainage lines); dominated by Dermosols; Vertosols and Sodosols sub-dominant in upper reaches of north-west drainage line; Chromosols and Kandosols sub-dominant west of Hoad Lane.
- **Gentle Slopes Variant (a):** 3-10% slope on sedimentary parent material (sandstone, siltstone, conglomerate); mosaic of Sodosols, Vertosols (possibly aeolian origins), Chromosols and Dermosols.
- **Gentle Slopes Variant (b):** 3-10% slope on basaltic parent material; Red Ferrosols, Red Dermosols and Red Vertosols.
- **Steep Upper Slopes:** >10% slope on sedimentary parent material; dominated by Tenosols.

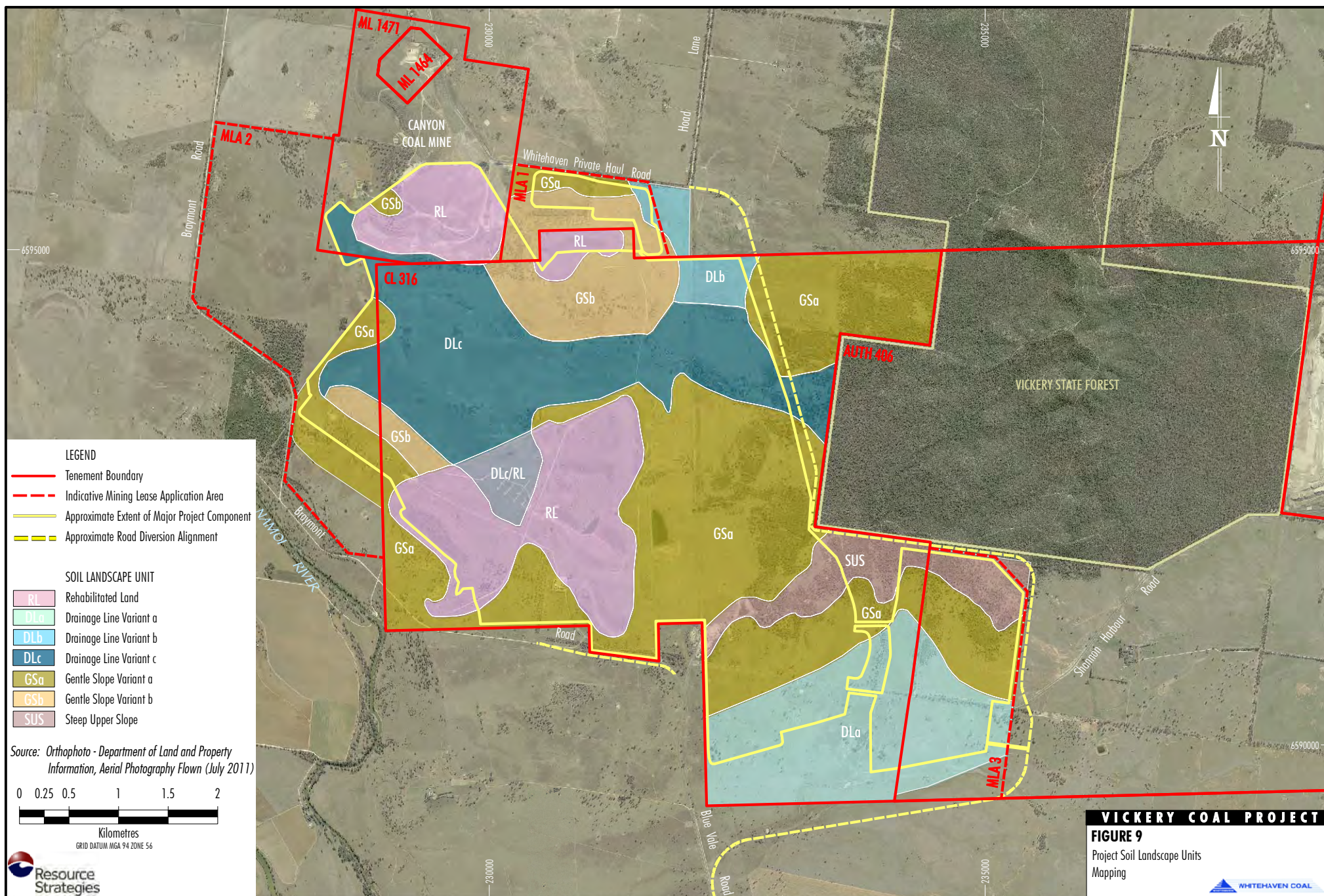
The extent of these soil landscape groupings within the area surveyed and mapped by McKenzie Soil Management (2012) is shown on Figure 9. Further details of the Project soil surveys are provided in Attachment A.

### **Soil Condition**

Physical and chemical constraints for agricultural land use were identified as part of the Project soil survey and are summarised below.

- **Topsoil acidity and associated aluminium toxicity** is a major constraint to agricultural productivity. The widespread acidic topsoil across the Project mining area lacks versatility in terms of agricultural management, however this acidity only extended deep into the subsoil in some central and northern parts of the Project area, associated with volcanic soils.
- **A lack of water holding capacity** where the rehabilitated soil profile on rehabilitated areas is shallow, where there is a large stone content in the soil and/or bedrock close to the soil surface, or poor subsoil structure.
- **Subsoil compaction** was widespread apparently due to heavy mining and farming machinery, however the topsoil was mostly not compacted except along Stratford Creek. Compacted soil strongly restricts plant growth because of poor water entry, poor efficiency of water storage (see water logging below) and poor access to nutrients by plant roots.
- **Dispersive topsoil and subsoil** due to sodicity and excessive exchangeable magnesium percentage and associated water logging leading to a lack of oxygen available to plants, anaerobic conditions causing losses of soil nitrogen and insufficient storage of water due to excessive evaporation losses.
- **Subsoil salinity** was identified in the eastern and southern parts of the Project mining area. 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. However, the shallow topsoil on the rehabilitated mining landforms was found to contain high phosphorous levels, likely due to fertilising as part of the rehabilitation activities.







Further discussion of the above soil constraints is provided in the Project Agricultural Resource Assessment (Attachment A).

### **2.2.5 Rural Land Capability**

The Rural Land Capability classification system (Emery, 1986) is used to delineate the various classes of rural land on the basis of the capability of the land to remain stable under particular uses. Land is allocated to one of the eight classes listed below.

#### **Land Suitable for Regular Cultivation/Cropping**

- Class I: No special soil conservation works or practices necessary.
- Class II: Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotations are necessary.
- Class III: Soil conservation practices such as graded banks and waterways are necessary, together with all the soil conservation practices as in Class II.

#### **Land Suitable Mainly for Grazing**

- Class IV: Soil conservation practices such as pasture improvement, stock control, application of fertiliser, and minimal cultivation for the establishment or re-establishment of permanent pasture, maintenance of good ground cover.
- Class V: Soil conservation works such as diversion banks and contour ripping, in addition to the practices in Class IV.

#### **Land Suitable for Grazing**

- Class VI: Not capable of cultivation. Soil conservation practices include limitation of stock, broadcasting of seed and fertiliser, promotion of native pasture regeneration, prevention of fire, destruction of vermin, maintenance of good ground cover and possibly some structural works.

#### **Land Suitable for Tree Cover**

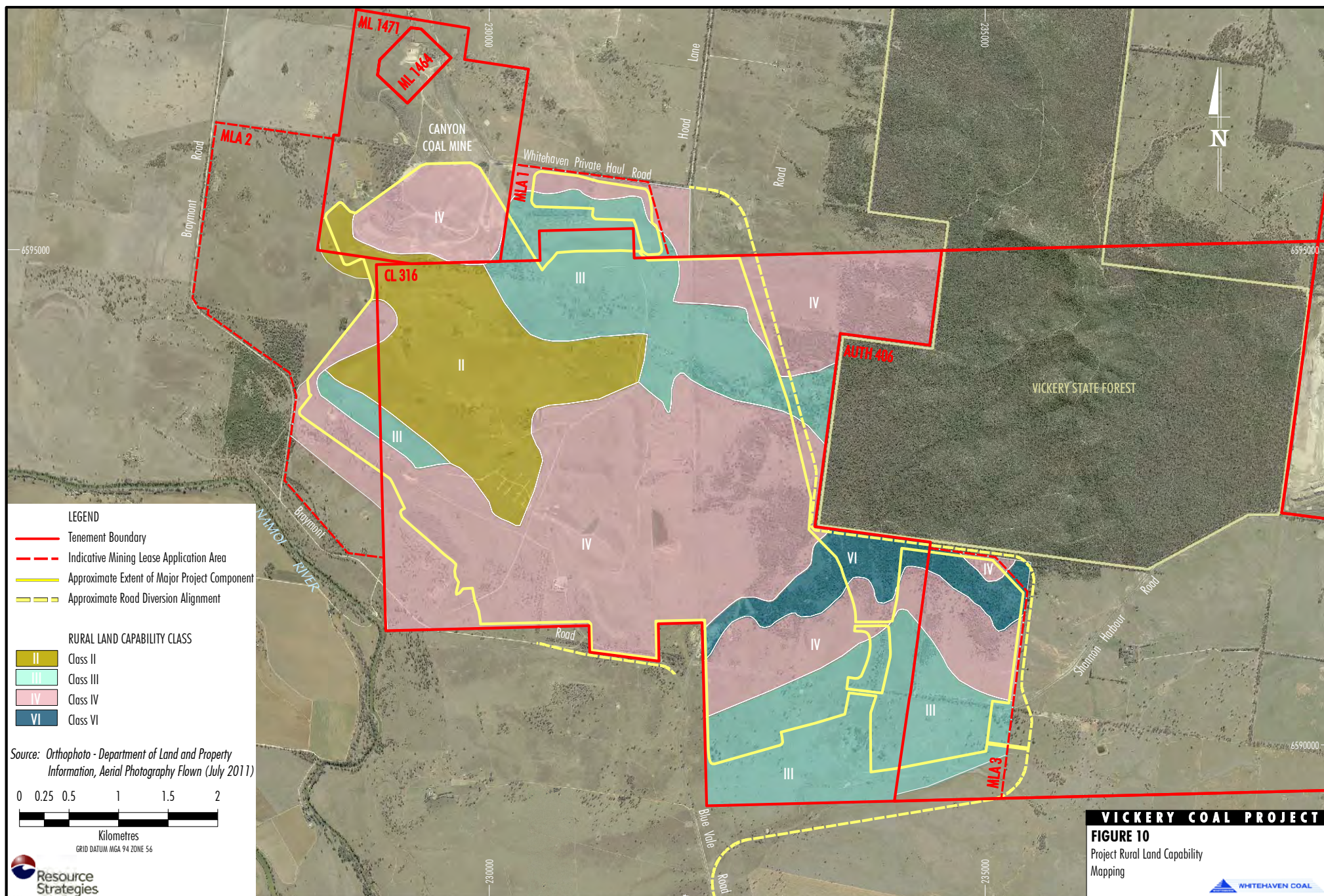
- Class VII: Land best protected by trees.

#### **Land Unsuitable for Agriculture**

- Class VIII: Cliffs, lakes or swamps where it is impractical to grow crops or graze pasture.

### ***Project Mining Area***

McKenzie Soil Management (2012) assessed the Rural Land Capability of the Project mining area as ranging from Class II to Class VI (Attachment A). The surveyed Rural Land Capability mapping for the Project mining area is shown on Figure 10.





### **Adjoining Lands**

Whitehaven owns several properties adjacent to the Project area. The Rural Land Capability of these properties was not mapped as part of the Project Agricultural Resource Assessment, however, Rural Land Capability mapping prepared by the NSW Office of Environment and Heritage (OEH) is available. This mapping indicates that the adjoining Whitehaven-owned properties are classified as Class II, III and IV land. As expected, the better land is located on the floodplains associated with the Namoi River. Further details of the broader Rural Land Capability mapping (including figures) are provided in Attachment A.

### **Project Biodiversity Offset Area**

Rural Land Capability mapping prepared by the OEH is also available for the Project biodiversity offset area, which is located at the 'Willeroi East' property approximately 35 km to the north-east of the Project mining area. Attachment A shows the location of the proposed Project biodiversity offset area and the regional Rural Land Capability mapping, which indicates that the offset area is mapped as a combination of Class V, VI, VII and VIII land.

### **Private Haul Road and Kamilaroi Highway Overpass**

The available regional Rural Land Capability mapping prepared by the OEH indicates that the area that would be disturbed by the private haul road and Kamilaroi Highway overpass is Class II land (Attachment A).

## **2.2.6 Agricultural Suitability**

The Agricultural Suitability system (Hulme *et al.*, 2002) is used to classify land in terms of its suitability for general agricultural use. Agricultural land is classified by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture. The key characteristics of the five classes are listed below.

- |          |   |
|----------|---|
| 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. It has a moderate to high suitability for agriculture but soil factors or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures.   |
| Class 3: | Grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with sown pasture. The overall production level is moderate because of soil or environmental constraints. Erosion hazard, soil structural breakdown or other factors, including climate, may limit the capacity for cultivation and soil conservation or drainage works may be required. |
| Class 4: | Land suitable for grazing but not for cultivation. Agriculture is based on native pastures and improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.  |
| Class 5: | Land unsuitable for agriculture, or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors which prevent land improvement.   |



**Project Mining Area**

Agricultural Suitability mapping of the Project mining area was prepared by McKenzie Soil Management (2012) based on the results of the soil survey and assessment, and is shown on Figure 11 and in Attachment A.

**Adjoining Lands**

Regional Agricultural Suitability mapping prepared by the DPI is available for adjoining lands. The majority of Whitehaven-owned land adjoining the Project area comprises Agricultural Suitability Classes 2 and 3. Further details of the broader Regional Agricultural Suitability mapping (including figures) are provided in Attachment A.

**Project Biodiversity Offset Area**

The Project biodiversity offset area has been mapped as a combination of Agricultural Suitability Classes 4 and 5 (Attachment A).

**Private Haul Road and Kamilaroi Highway Overpass**

The private haul road and Kamilaroi Highway overpass area has been mapped as a combination of Agricultural Suitability Classes 2 and 3 (Attachment A).

**2.2.7 Biophysical Strategic Agricultural Land**

BSAL is land considered to be highly suitable for agriculture, having the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality (DP&I, 2012b).

The New England North West SRLUP identifies BSAL at a regional scale. Table 2 presents the values and criteria used to define BSAL, as presented in the New England North West SRLUP.

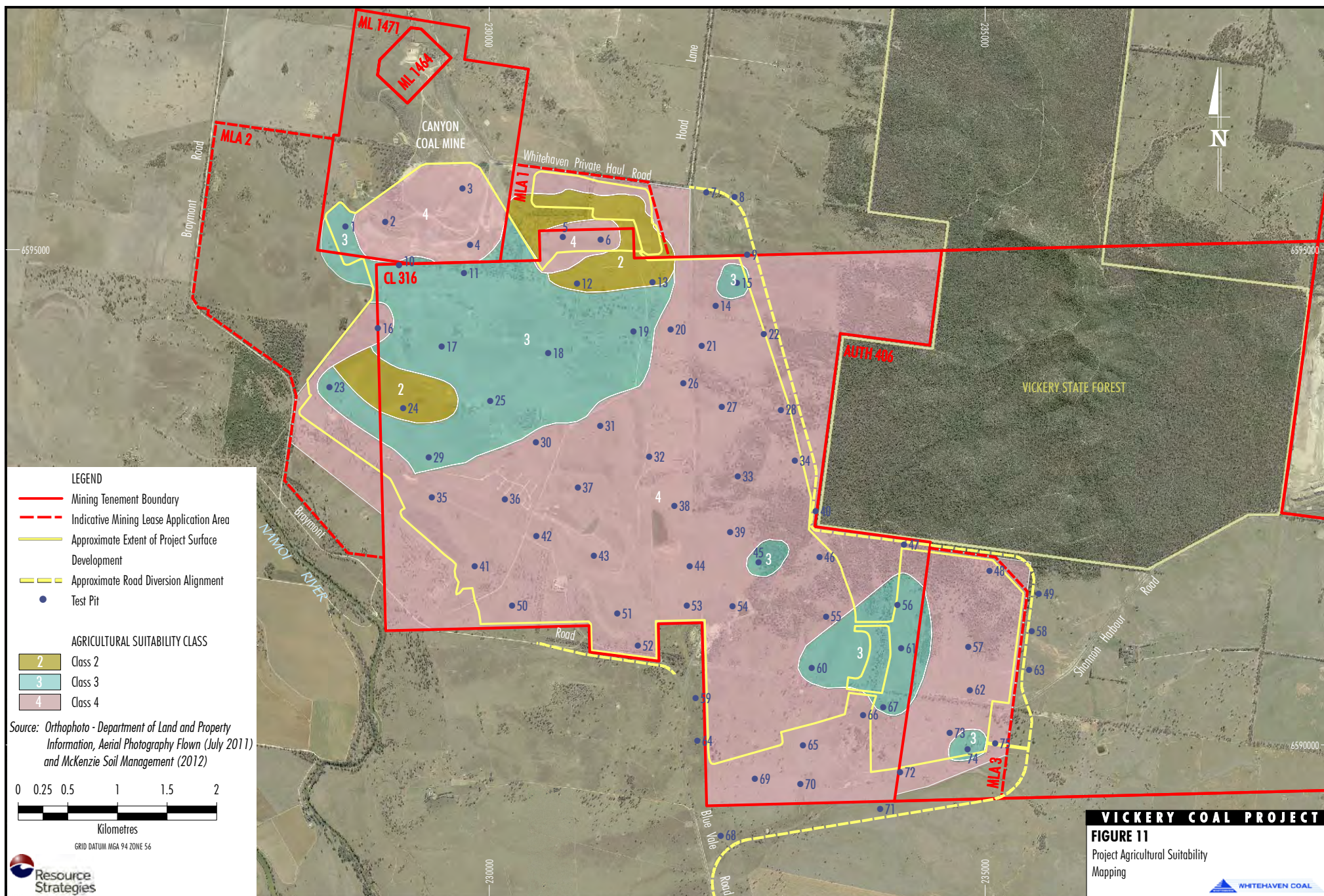
As shown on Figure 3, the New England North West SRLUP has identified and mapped BSAL along the Namoi River. The Project mining area would not affect any of the regionally mapped BSAL, however the proposed private haul road and Kamilaroi Highway overpass is located within an area of BSAL adjacent to the Namoi River (Figure 3).

**Private Haul Road and Kamilaroi Highway Overpass**

The proposed construction of the private haul road and Kamilaroi Highway overpass is considered to have considerable environmental and safety benefits when compared with Whitehaven's existing approved coal haulage route. In particular, it would remove the need for coal trucks to merge with, and turn across, traffic on the Kamilaroi Highway. During the Project consultation program comments received from government agencies and the community regarding the proposed overpass were overwhelmingly positive.

Notwithstanding, and in light of the occurrence of BSAL as well as several other environmental aspects and constraints, a comprehensive environmental impact assessment and design evaluation of the proposed private haul road and Kamilaroi Highway overpass has been conducted.







**Table 2**  
**Values and Criteria used to Identify BSAL**

Value	Criteria
BSAL	<ul style="list-style-type: none"> <li>land that falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH, 2012a); and</li> <li>land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH, 2012b); and</li> <li>reliable water of suitable quality, characterised by having rainfall of 350 mm or more per annum (9 out of 10 years); or properties within 150 m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95<sup>th</sup> percentile flow of each month of the year is greater than zero) or 5<sup>th</sup> order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5 litres per second (L/s) and total dissolved solids of less than 1,500 milligrams per litre (mg/L).</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>land that falls under soil fertility classes 'moderate' under the Draft Inherent General Fertility of NSW (OEH, 2012a); and</li> <li>land capability classes I or II under the Land and Soil Capability Mapping of NSW (OEH, 2012b); and</li> <li>reliable water of suitable quality, characterised by having rainfall of 350 mm or more per annum (9 out of 10 years); or properties within 150m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95<sup>th</sup> percentile flow of each month of the year is greater than zero) or 5<sup>th</sup> order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5 L/s and total dissolved solids of less than 1,500 mg/L.</li> </ul>

Source: DP&I (2012b).

Environmental constraints in the vicinity of the proposed private haul road and Kamilaroi Highway overpass include:

- Agricultural land that is currently used for grazing (north-east side of the Kamilaroi Highway) and cropping (south-west side of the Highway), and which is mapped at a regional scale as Agricultural Suitability Class 2 and 3 land (Attachment A), and as being BSAL (Figure 3).
- Land on the north-east side of the Kamilaroi Highway that is mapped as the *White Box Yellow Box Blakely's Red Gum Woodland* (Box–Gum Woodland) vegetation community, which is listed as a endangered ecological community under the NSW *Threatened Species Conservation Act, 1995* (Appendix E of the EIS).
- Known Aboriginal artefact scatters within the floodplain and along the banks of the Namoi River, especially on the north-east side of the Kamilaroi Highway (Appendix I of the EIS).
- Two privately-owned properties (with residences) adjacent to the Kamilaroi Highway (i.e. approximately 200 to 300 m to the south-west of the proposed private haul road), and several privately owned properties (also with residences) 800 m or more to the east and south-east of the proposed private haul road (Figure 7a).
- Two blocks of Crown Land adjacent to Blue Vale Road and the Kamilaroi Highway that are nominated as TSRs under Part 5 of the NSW *Crown Lands Act, 1989* (Figure 7a).
- Floodways that run parallel to the Namoi River on either side of the Kamilaroi Highway (i.e. main Namoi River floodplain to the north-east, and 'Deadmans Gully' to the south-west), and the Namoi River itself (Appendix B).

Other constraints relevant to the design of the private haul road and Kamilaroi Highway overpass include:

- Need to satisfy the minimum design standards specified by the NSW Roads and Maritime Services (e.g. vertical clearance and number and nature of support columns on the overpass, works authorisation deed and construction traffic management) and other relevant Government agencies (e.g. Gunnedah Shire Council).
- Need for the overpass to be perpendicular to the Kamilaroi Highway at the point where it crosses (in order to minimise the span width and number and nature of support columns).
- Need to design an appropriate intersection with Blue Vale Road, and design the bends on the private haul road to have an appropriate radius and gradient to maintain efficiency and meet minimum safety requirements for coal haulage truck operation.
- Need to construct the private haul road and Kamilaroi Highway overpass on land that Whitehaven owns, or could be reasonably expected to acquire access to.
- Need for the private haul road to access the north-east side of the Whitehaven CHPP.
- Need to minimise impacts and/or disruptions to the Kamilaroi Highway, Blue Vale Road and the Werris Creek Mungindi Railway.

Due to the multiple factors summarised above, a balanced design solution was required (i.e. one that satisfied the minimum design requirements, minimised the net environmental impact but acknowledged that some environmental affect would be unavoidable). The proposed alignment of the private haul road and Kamilaroi Highway overpass is believed to represent the best available solution.

It is recognised that the proposed design would necessitate disturbance to approximately 4 ha of BSAL. However the majority (i.e. 3 ha) of this land is currently only used for grazing, and the small area of cropping land (i.e. 1 ha) is owned by Whitehaven and is not part of a large scale cropping farm. In addition, the disturbance to the area of BSAL would only be for the duration of the Project, and it is expected that the private haul road and Kamilaroi Highway overpass would be decommissioned and the area rehabilitated to its current land use at the end of the 30 year Project life, unless otherwise agreed with the relevant government agencies.

### **Project Mining Area**

As described above and shown on Figure 3, no regionally mapped BSAL occurs within the Project mining area. However, and as required by the New England North West SRLUP, a site specific evaluation of BSAL within the Project mining area has been conducted as part of the environmental impact assessment and is included in Attachment A.

The evaluation was somewhat complicated by the timing of the release of the New England North West SRLUP (i.e. September 2011), and the fact that it uses alternative classification guidelines that were only publicly released in October 2012 (i.e. the Land and Soil Capability Assessment Scheme [OEH, 2012]).

The mapping and classification of the Project mining area by McKenzie Soil Management (2012) was conducted in the first half of 2012 and was based on the Australian Soil Classification system (Isbell, 2002), the Rural Land Capability classification system (Emery, 1986) and the Agricultural Suitability Assessment system developed by Hulme *et al.* (2002). The methods used are consistent with those specified in the DGRs and/or are widely used in NSW for land classification and assessment.



In order to enable a site specific evaluation of BSAL against the criteria in Table 2, McKenzie Soil Management (2012) has correlated the mapped Australian Soil Classification soil types (Isbell, 2002) with the superseded Great Soil Group classes (Stace *et al*, 1968) on which the Inherent General Fertility of NSW classification scheme is based. McKenzie Soil Management (2012) also converted the Rural Land Capability class for each soil test pit location from the Emery (1986) classification system to the new Land and Soil Capability Assessment Scheme (OEH, 2012).

No sites within the Project mining area were considered to have a 'high general fertility' classification. Thirty three of the 75 test pits could possibly have a 'moderately high' or 'moderate' general fertility classification (Attachment A). Of these pits, seven were assessed by McKenzie Soil Management (2012) as possibly having a Class II Land and Soil Capability classification, and therefore potentially meeting the BSAL criteria (i.e. these seven pits meet the bottom three criteria in Table 2). Five of these pits are located in the north-west portion of the Project mining area (i.e. pits 1, 17, 23, 24 and 25), and two occur on the eastern side of the Project mining area (i.e. pits 56 and 61). The location of these pits is shown on Figure 11.

It is notable that although these pits could be classified as BSAL, the land where they are located is currently only used for cattle grazing, and has only been intermittently used for dryland cropping in the past. Discussions local farmers in September 2012, who currently have a licence arrangement to run stock on the 'Vickery West' block (and previously owned it for several generations), indicated that they did not consider this particular mapped area to be 'cropping land', and regarded the area (like the rest of the Project area) to be best suited to grazing.

The local farmers' comments were generally consistent with those made other landholders who own land further to the north and west on the floodplain adjacent to the Project area. For example, owners of the 'Bungalow' property to the north (who also previously owned the 'Whitehaven' property on which the Canyon Coal Mine is now located), indicated that their experience in this area has involved several years of cropping of the block adjacent to north-west corner of the Project ('Bungalow South') (Figure 5), with generally lower yields when compared with the remainder of the Bungalow property (to the north). This is despite intensive attempts to improve the soil and land conditions (i.e. through fertiliser application and tillage). They indicated that they were intending to cease cropping of the Bungalow South area, and would in the future just run cattle on it.

## 2.2.8 Water Resources

### Groundwater

A comprehensive Groundwater Assessment for the Project has been undertaken by Heritage Computing (2012) and is presented in Appendix A of the EIS. A summary of the baseline groundwater environment is provided below.

As described in Section 2.1 and shown on Figure 3, the Project mining area is located within an 'island' of Permian-aged sedimentary rocks of the Maules Creek Formation, which is surrounded by the Upper Namoi Alluvium associated with the floodplains of the Namoi River.

Two main groundwater systems occur within the Project area and surrounds:

- porous and fractured hard rock groundwater systems within the coal measures of the Maules Creek Formation; and
- groundwaters associated with the unconsolidated alluvial sediments of the Namoi River floodplain (i.e. the Upper Namoi Alluvial aquifer).

The Project open cut would be located entirely within the Maules Creek Formation. Previous hydrogeological investigations and monitoring programs have established that the watertable within the Project mining area typically occurs 20 to 50 m below ground level. The groundwater flow direction in this area is towards the west, south-west and north-west (i.e. from the hills of the Vickery State Forest towards the adjoining floodplains). The water quality of the Maules Creek Formation aquifer has been described as being of moderate to poor quality and unsuitable for domestic use, irrigation of salt sensitive crops, and some industrial uses (Vickery Joint Venture, 1986). The water chemistry data indicate that it is moderately saline, with neutral to slightly alkaline pH. In the 1980s (i.e. pre-mining) a few bores equipped with windmills were noted as occurring in the western portion of the Vickery area, but pumping yields at these sites were noted as being low (i.e. in the order of 0.5 to 1 litres per second [L/s]).

The Upper Namoi Alluvium groundwater system occurs within the alluvial sediments associated with the Namoi River and its floodplain. The Upper Namoi Alluvium is Cainozoic in age and consists of two principal zones: an upper zone of sandy gravels which is widespread; and a lower zone of sands which is confined to a deeper 'palaeochannel'. These two zones of the alluvium groundwater system are known as the Narrabri Formation (upper zone) and Gunnedah Formation (lower zone).

Groundwater levels within the Upper Namoi Alluvium in the vicinity of the Project mining area are typically 10 to 14 m below ground level.

Shallow groundwater to the immediate south of the open cut is saline on most occasions and would not be suitable for agricultural or farming purposes (e.g. the median Electrical Conductivity [EC] value for the 2012 sampling was 13,600 microsiemens per centimetre, and the pumping test conducted at bore VKY3092 indicated a yield of 0.25 L/s). Further to the south (and on the western side of the Namoi River) the water quality and yield of bores improves significantly.

The Project Groundwater Assessment (Appendix A of the EIS) included a search of the NOW Pinneena Groundwater Works Database in order to identify registered groundwater bores in the vicinity of the Project. The search identified 670 registered bores within the 33 km by 29 km area covered by the regional numerical groundwater model. The majority of the registered bores are located within the Upper Namoi Alluvium.

In order to identify active privately-owned bores in the vicinity of the Project and to gather more groundwater information, Whitehaven conducted a Project bore census in March 2012. The census included 53 privately-owned bores/wells on 21 properties in the vicinity of the Project mining area. The locations of the privately-owned bores within 4 km of the planned open cut, as identified by the census, are shown on Figure 12. Registered production bores identified through the Pinneena Groundwater Works Database are also illustrated on the figure.

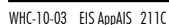
Potential impacts to existing groundwater resources and users are summarised in Section 3.2.3, and are discussed in detail in Appendix A of the EIS.

### **Surface Water**

A Surface Water Assessment for the Project was undertaken by Evans & Peck (2012) and is presented in Appendix B of the EIS. A summary of the baseline surface water environment is provided below.

The Project area is drained by several streams that descend onto the Namoi River floodplain and lagoons which fringe the Namoi River. These include Driggle Draggie Creek, Stratford Creek, South Creek, the north-west drainage line and west drainage line. The local streams in the Project mining area are highly ephemeral, respond quickly to rainfall, flow for relatively short periods after rainfall events and exhibit little flow persistence.





The 'Bungalow' and 'Braymont' properties are the closest privately-owned properties downstream of the Project and are located to the north and north-east of the Project mining area (Figure 4a). There are no surface water licences issued on Driggle Draggie Creek (which drains through these properties). There are, however, numerous active surface water access licences in force on the Namoi River, the closest of which are at the 'Mirrabinda' property to the west of the Project mining area on the western side of the Namoi River. The approximate locations of the two 'Mirrabinda' surface water pumping stations are shown on Figure 12.

Surface water resources used for agricultural purposes in the Project mining area to date have been taken through the landholders' harvestable rights (i.e. rainfall runoff collected in dams) and/or stock rights (i.e. stock watering). There are approximately 30 farm dams of varying sizes scattered across the Project mining area.

Surface water quality monitoring data has been collected within, and surrounding the Project area as part of the Surface Water Assessment (Evans & Peck, 2012). There is some variation between the monitoring sites, however the surface water in the vicinity of the Project typically has:

- low EC indicating negligible sources of salt in the catchments;
- pH levels generally consistent with the Australian and New Zealand Environment Conservation Council default trigger ranges for upland rivers in south-eastern Australia; and
- low levels of total suspended solids, with occasional higher values reflecting the episodic nature of sediment transport in ephemeral streams.

Potential impacts to existing surface water resources and users are summarised in Section 3.2.3, and are discussed in detail in Appendix B of the EIS.



### **3 POTENTIAL IMPACTS**

This section describes the risk evaluation and provides an assessment of the potential impacts of the Project on agricultural resources and enterprises.

#### **3.1 ENVIRONMENTAL RISK ASSESSMENT**

As part of the preparation of the EIS, an Environmental Risk Assessment was undertaken by SP Solutions in accordance with the DGRs (Appendix M of the EIS). This included a facilitated, risk-based workshop in July 2012 involving experts across a range of disciplines and experienced Whitehaven personnel. The objective of the risk assessment was to identify key potential environmental issues for further assessment in the EIS. The following key potential soil, land and agricultural resource-related issues were identified and have been further assessed in this AIS and/or the EIS:

- long-term geotechnical stability of final landforms;
- success/performance of rehabilitation post-mining;
- suitable topsoil management and storage for use in rehabilitation;
- impacts on agricultural resources disturbed as a result of mining activities; and
- changes to the potential land uses directly disturbed or otherwise impacted as a result of mining activities.

#### **3.2 AGRICULTURAL RESOURCES**

##### **3.2.1 Impacts on Agricultural and Land Resources during the Project Life**

###### ***Project Mining Area***

The Project mining area would disturb a total area of approximately 2,238 ha, of which approximately 405 ha is rehabilitated land associated with the previous Vickery Coal Mine. For the purposes of this agricultural impact assessment, all of the proposed disturbance area has been classified as 'agricultural land', even though approximately 464 ha consists of scattered remnants of native woodland vegetation, or it is currently disturbed (i.e. the existing infrastructure area and the Blue Vale and Shannon Harbour Roads).

Development of the Project mining area would result in disturbance to 1,520 ha of Class 4 Agricultural Suitability land, 595 ha of Class 3 land, and 123 ha of Class 2 land. These areas would be progressively disturbed during the 30 year life of the Project as the open cut advances. Areas of the Project mining area that would not be disturbed until later in the mine life would continue to be used for cattle grazing until such time as they are required (subject to relevant mine safety requirements).

###### ***Adjoining Lands***

Whitehaven-owned lands that adjoin the Project would continue to be used for cropping and grazing purposes (e.g. via agistment of stock, leasing or agreements with previous landholders). Many of the Whitehaven properties are managed by farmers who owned them previously or have farmed in the local area for generations. As a result, the farming practices on Whitehaven-owned lands would be generally the same as those that occurred when the land was privately owned.

### **Project Biodiversity Offset Area**

The majority of the Project biodiversity offset area (i.e. 1,231 ha) is covered by woodland vegetation and has Class 5 Agricultural Suitability. These areas are not considered suitable for agricultural activities. The remainder of the Project biodiversity offset area (i.e. 436 ha) is mapped as being Class 4 Agricultural Suitability land, of which slightly more than half is cleared grassland (i.e. 250 ha).

No grazing or cropping is currently conducted within the Project biodiversity offset area, however cattle have been grazed on the property in the past on the Class 4 Agricultural Suitability cleared grassland areas. The productivity of these previous grazing activities is unknown, but is likely to have been low due to the low land capability and agricultural suitability of the area.

If the Project is approved, agricultural activities would be permanently excluded from the Project biodiversity offset area, and regeneration of cleared areas with native vegetation would be encouraged. It is therefore assumed that the 250 ha of former grazing lands in the Project biodiversity offset area would be permanently lost.

### **Private Haul Road and Kamilaroi Highway Overpass**

The construction of the private haul road and Kamilaroi Highway overpass would result in the disturbance of an additional 4 ha of Class 2 and 3 Agricultural Suitability land, of which approximately 3 ha is currently used for grazing and approximately 1 ha is used for cropping. The overpass would be designed with sufficient space so that livestock could be moved between grazing areas either side of the infrastructure during the life of the Project.

## **3.2.2 Land Resources Post-Mining**

### **Overall Change to Agricultural Lands as a Result of the Project**

Table 3 summarises the existing and proposed (post-mining) Agricultural Suitability classes within the Project disturbance areas and Project biodiversity offset area.

**Table 3**  
**Summary of Agricultural Lands Before and After Mining**

Area	Agricultural Suitability Classification	Area of Agricultural Land (ha)		
		Before Mining	After Mining	Net Change
<b>Project Mining Area</b>	Class 4	1,520	508	-1,012
	Class 3	595	245	-350
	Class 2	123	23	-100
<i>Sub Total A</i>		2,238*	776**	-1,462
<b>Overpass and Haul Road</b>	Class 2 and 3	4	4 <sup>#</sup>	0
<i>Sub Total B</i>		2,242	780	-1,462
<b>Project Biodiversity Offset Area</b>	Class 4	250	0	-250
<b>TOTAL</b>		<b>2,492</b>	<b>780**</b>	<b>-1,712</b>

\* The total existing agricultural area (approximately 2,238 ha) includes approximately 464 ha of scattered remnants of native woodland, semi-cleared woodland, and White Cypress Pine re-growth.

\*\* The remainder of the Project mining area would be rehabilitated to native woodland vegetation (approximately 1,360 ha) plus the road re-alignments (approximately 27 ha) and the two pit lakes (approximately 75 ha).

<sup>#</sup> Based on the overpass being decommissioned and removed following completion of the Project.



### **Project Mining Area**

As described in Section 2.2, to the east of the Project mining area is the Vickery State Forest, which contains native woodland vegetation. To the west is a patch of remnant vegetation along Braymont road that is contiguous with the Namoi River.

The overall rehabilitation and mine closure goal for the Project mining area is to enhance the cover and connectivity of native woodland, while retaining areas of agricultural land capable of supporting cattle grazing and cropping in rotation with sown pastures. This would be achieved by revegetating the northern half of the Western Emplacement with native tree, shrub and grass species, creating a native woodland/forest corridor that would connect the existing native vegetation in the Vickery State Forest with the Namoi River. The entire Eastern Emplacement would also be rehabilitated to native woodland/forest.

The southern half of the Western Emplacement and the MIA would be rehabilitated with native grass species and scattered native trees. These areas would be used for agriculture following mine closure (i.e. cattle grazing on unimproved native pastures, and/or cultivated or cropped in rotation).

A schematic diagram of the Project final landform is provided in Figure 13. The proposed land use and Agricultural Suitability classes for the Project mining disturbance areas are shown in Figure 14.

Section 5 in the Main Report of the EIS provides details of the rehabilitation and mine closure strategy for the Project.

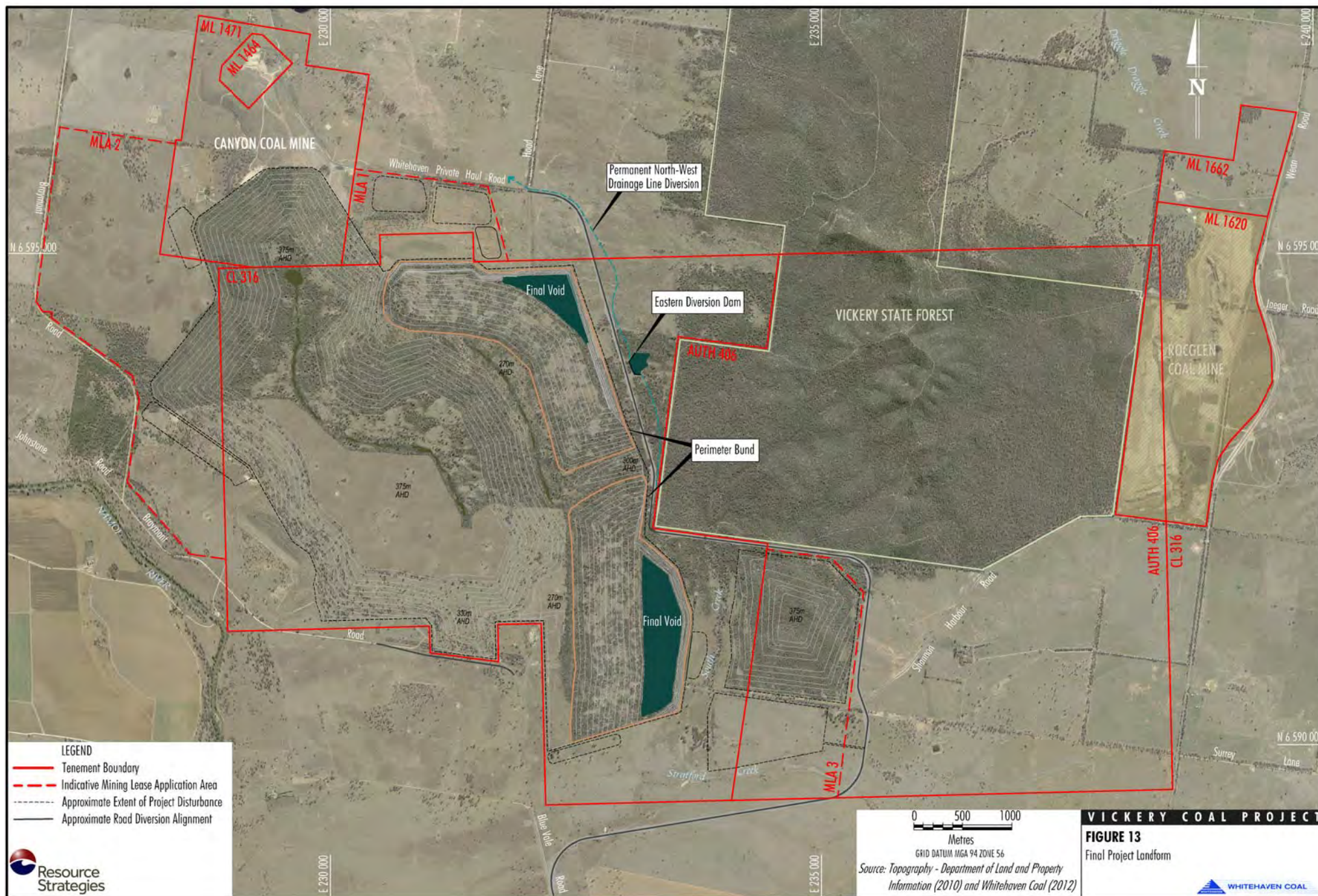
As illustrated in Figure 14, the southern half of the top surface of the Western Emplacement would be rehabilitated to Class 3 Agricultural Suitability land. The batters of the southern half of the Western Emplacement would be rehabilitated to Class 4 Agricultural Suitability land. With the exception of the native woodland areas and final pit lakes, all other rehabilitated areas (e.g. topsoil stockpiles, MIA) would be returned to their pre-mine Agricultural Suitability Class (Figure 14). Table 3 summarises the proposed post-mining Agricultural Suitability classes within the Project disturbance areas.

Existing rehabilitation in the Project area has demonstrated that disturbed areas can be successfully returned to land suitable for livestock production. As described in Section 2.1, local landholders currently use the rehabilitated areas of the Vickery Coal Mine for cattle grazing, and these farmers have indicated that the grazing capability of the rehabilitated areas is equal to, or better than other areas in the Project area not previously disturbed by mining.

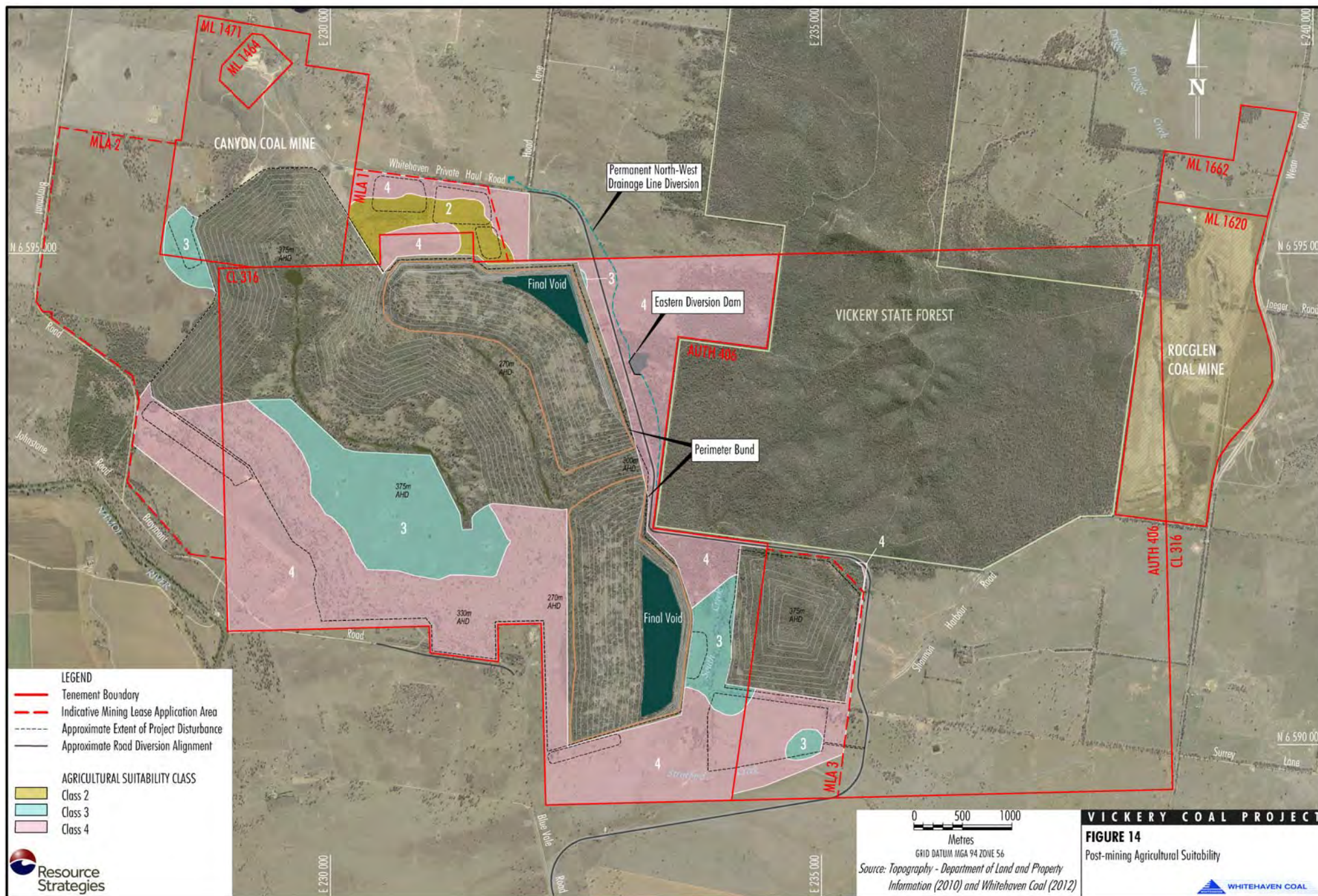
A review of the physical and chemical properties of the Project soil resources by McKenzie Soil Management (2012) has established that they are suitable as a rehabilitation medium for agricultural and native vegetation land uses, provided suitable soil management measures and amelioration is implemented (Attachment A and Section 4.3.3 in the Main Report of the EIS). Based on the current grazing carried out on existing rehabilitated areas, Whitehaven anticipates that rehabilitated grazing lands would be of comparable Agricultural Suitability to the majority of the existing rehabilitated and agricultural land within the Project area (i.e. Class 4 or Class 3 Agricultural Suitability) (Table 3).

A topsoil inventory has been developed based on field investigations by McKenzie Soil Management (2012) and has identified that up to 0.9 m of soil could be placed on agricultural land use rehabilitation areas and 0.3 m of soil could be applied to the native vegetation woodland/forest (Attachment A).











An assessment of the opportunity costs associated with the loss of agricultural land due to the Project has been conducted by Gillespie Economics (2012a) and is included in Attachment B. The assessment was conservative in that it assumed that agricultural production from the entire Project disturbance area (i.e. 2,242 ha) would cease at the commencement of the Project. In reality, the undisturbed parts of the Project area would continue to be used for cattle grazing until such time as they are required, which could be 10 to 20 years for the eastern areas of the Project mining area.

The opportunity cost assessment assumed that 1,462 ha of agricultural land would be lost in perpetuity (i.e. 780 ha of the 2,242 ha Project disturbance area would be rehabilitated to agricultural land and the remainder would be rehabilitated to native woodland/forest). The assessment was based on the existing and proposed agricultural areas being used for beef cattle grazing on unimproved pastures (inland weaners). The NSW DPI (2012a) identify inland weaner production on native pasture as generating \$125.55 of revenue per ha per year and a gross margin of \$96.05 per ha per year (Attachment B).

Based on these gross margin values and Project disturbance areas, Gillespie Economics (2012a) estimated that the gross margin of production foregone would be \$215,000 per annum during the mine life and \$140,000 per annum post-mining. The present value of foregone agricultural gross margin from the Project area, in perpetuity (at a 7% discount rate) was estimated to be \$2.9M (Attachment B).

### ***Adjoining Lands***

As described in Section 3.2.1, during the mine life the Whitehaven-owned lands that adjoin the Project would continue to be used for cropping and grazing purposes (e.g. via agistment of stock, leasing or agreements with previous landholders). At the completion of the Project, Whitehaven may no longer require company-owned lands that adjoin the Project site. It is therefore expected that these properties would be sold and therefore would continue to be used for agricultural purposes in the future. The Project is therefore not predicted to result in any opportunity costs associated with changes to agricultural practices (or loss of agricultural land) in the existing farms that adjoin the Project area.

### ***Project Biodiversity Offset Area***

As described in Section 3.2.1, agricultural activities (i.e. beef cattle grazing) would be permanently excluded from the Project biodiversity offset area. An evaluation of the potential opportunity costs associated with this loss of agricultural land has been undertaken (Attachment B). Gillespie Economics (2012a) estimated that the gross margin of agricultural production foregone would be \$42,000 per annum (\$593,000 present value at a 7% discount rate).

The evaluation was based on the assumption that beef cattle grazing within the Class 4 Agricultural Suitability land (i.e. 436 ha) would permanently cease. This assumption is considered to be conservative as only 250 ha of the 436 ha is cleared grassland (i.e. there is a large portion of the regionally mapped Class 4 Agricultural Suitability land that is actually bushland and would have limited to no agricultural productivity unless it were cleared in the future).

### ***Private Haul Road and Kamilaroi Highway Overpass***

Following mine closure the private haul road and Kamilaroi Highway overpass would be decommissioned and the disturbed land would be rehabilitated to a condition of comparable Agricultural Suitability to the surrounding land (i.e. Class 2 and 3), unless otherwise agreed with the relevant government agencies.

The opportunity cost assessment of agricultural land within the Project disturbance area conducted by Gillespie Economics (2012a) and described above, included the 4 ha of agricultural land to be disturbed by the private haul road and Kamilaroi Highway overpass.

### **3.2.3 Availability of Water for Agriculture**

#### ***Potential drawdown effects on groundwater users***

The numerical regional groundwater modelling conducted by Heritage Computing (2012) predicts that the zone of groundwater drawdown surrounding the Project open cut during operations and post-closure would be largely restricted to the Maules Creek Formation.

There is one privately-owned bore within the island of Maules Creek Formation in which the Project is located (i.e. SK1) (Figure 12). This bore has been drilled to a depth of between 85 and 87 m, which coincides with layer 7 in the regional numerical groundwater model. Accordingly the predicted groundwater impact at this location has been conservatively based on the drawdown contour for model layer 8 (Appendix A). Bore SK1 is predicted to experience a drawdown of 1 to 5 m.

Drawdown effects of up to 5 m and 10 m are also predicted to occur at WG1 and WL1 respectively, however these bores are located on Whitehaven-owned land. Bore WG1 is unregistered, and consists of a currently disused windmill. Bore WL1 is a registered bore equipped with a pump and storage tank.

No privately-owned census bores within the Upper Namoi Alluvium groundwater system surrounding the Project are predicted to be materially impacted during mining operations or post closure (i.e. any drawdown effect would be less than 1 m and is therefore considered to be negligible). The Project would therefore not impact the agricultural use of the Upper Namoi Alluvium groundwater system for irrigation or other agricultural purposes (Appendix A of the EIS).

A groundwater monitoring program would be developed and implemented for the Project as part of the Groundwater Management Plan. This program, and ongoing validation of the regional numerical groundwater model, would be used to identify, assess, and manage potential impacts on groundwater users in the vicinity of the Project.

For the privately-owned bore within the Maules Creek Formation that is predicted to experience material drawdown effects (i.e. SK1), Whitehaven would provide mitigation/compensation/offset measures commensurate with the level of impact. These measures could include, but are not necessarily limited to lowering of the pump, deepening of the bore, or provision of a new bore/alternative water supplies.

The Groundwater Management Plan would describe the contingent mitigation/compensation/offset options that would be enacted in the unlikely event that other groundwater users are adversely affected by the Project.

In the event that a complaint is received during the life of the Project in relation to depressurisation of a privately-owned bore or well, the results of the groundwater monitoring program would be reviewed by Whitehaven as part of a preliminary evaluation to determine if further investigation, notification, mitigation (e.g. bore re-conditioning), compensation (e.g. alternative water supply) or other contingency measures (refer below) are required.

Further details of the groundwater impact assessment and proposed measures to minimise the potential impacts of the project on groundwater users is provided in Appendix A and Section 4.4 in the Main Report of the EIS.



Further details of the groundwater impact assessment and proposed measures to minimise the potential impacts of the project on groundwater users is provided in Appendix A and Section 4.4 in the Main Report of the EIS.

### ***Potential impacts on surface water users***

The maximum predicted reduction in contributing catchment over the life of the Project is 6.8% of the total catchment of Driggle Draggie Creek (Appendix B of the EIS). Following the completion of rehabilitation post-mining, only the catchment area of the final voids would remain excised from the Driggle Draggie Creek catchment (approximately 4.3% of the total catchment of Driggle Draggie Creek at the confluence with the North-west drainage line) (Appendix B of the EIS).

The proposed diversion of the north-west drainage line would increase the catchment of Driggle Draggie Creek at the point where the flows from the diversion would meet Driggle Draggie Creek by approximately 1.5% (i.e. an increase of 2.5 km<sup>2</sup> of the existing 169.5 km<sup>2</sup> catchment) (Appendix B of the EIS). This additional catchment is anticipated to have an insignificant impact on the average annual runoff at the confluence of the north drainage line and Driggle Draggie Creek, and would increase the maximum year runoff (i.e. the wettest year expected) by 1%.

The two privately-owned licensed extraction points on the Namoi River adjacent to the Project mining area are used to supply irrigation water to the 'Mirrabinda' property. The Project is not predicted to alter the flows or water quality in the Namoi River, and as a result no impacts on these extraction points are anticipated to occur.

Licensed extraction of water from the Namoi River for the Project would be authorised and regulated by the NOW, and as a result would not disadvantage other licensed users on the Namoi River.

A Water Management Plan would be developed for the Project and would incorporate the site water balance, an erosion and sediment control plan, surface water and groundwater monitoring and a Surface Water and Groundwater Response Plan. This plan would describe how Whitehaven would respond to any potential exceedances of surface water related criteria, and it would describe the contingency mitigation/compensation/offset measures that would be implemented in the event that downstream surface water users or riparian vegetation is adversely affected by the Project.

Further details of the surface water impact assessment and proposed measures to minimise the potential impacts of the project on surface water users is provided in Appendix B and Section 4.5 in the Main Report of the EIS.

### ***Potential impacts associated with the use of water for mining rather than agriculture***

Gillespie Economics (2012a) has conducted an evaluation of the opportunity cost associated with the Project using groundwater and surface water resources that could otherwise be used for agricultural purposes (Attachment A). Based on the findings of the groundwater and surface water assessments (i.e. Appendices A and B of the EIS respectively), the average amount of water used by the Project during operations would be 2,035 megalitres per annum (ML/annum). This includes the predicted average amount of licensed groundwater required from the Maules Creek Formation groundwater system (for which Whitehaven would obtain an appropriate licence) (provided in Section 4.4.3 in the Main Report of the EIS) plus the amount of groundwater and surface water licences that Whitehaven already hold for the Project.

Post-closure, the residual final voids and associated pit lakes are predicted to form groundwater sinks which would result in a permanent groundwater loss (Appendix A of the EIS). This loss would be licensed by Whitehaven and would predominantly be from the Maules Creek Formation groundwater system (i.e. maximum of 430 ML/annum), with a smaller predicted loss from the Upper Namoi Alluvium groundwater system (i.e. maximum of 98 ML/annum).

Gillespie Economics' (2012a) evaluation was conservative in that it assumed that the all water used by the Project would otherwise have been used for irrigating cotton at a rate of 7 megalitres per hectare (DPI, 2012b). The surface and groundwater diverted by the Project could therefore otherwise contribute to an estimated 291 ha of irrigated cotton per year during the mine life and 75 ha of irrigated cotton following mine closure. This irrigated cotton would have a gross margin of \$890,000 per annum over the 30 year Project life and \$229,000 per annum following mine closure (\$11.4M present value at 7% discount rate). However, in the absence of this water being available for irrigated cotton Gillespie Economics (2012a) has assumed that the land would be used for dryland cotton farming with a gross margin of \$300,000 per annum during the 30 year Project life and \$77,000 per annum following mine closure (\$3.9M present value at 7% discount rate).

Based on the above, the net impact on agricultural production during the life of the Project would be the difference between value of irrigated cotton and dryland cotton (i.e. gross margin of \$590,000 per annum or \$7.6M present value at 7% discount rate).

#### **3.2.4 Potential Air Quality Impacts on Agriculture**

A comprehensive assessment of potential air quality impacts associated with the Project has been conducted by PAEHolmes (2012) and is contained in Appendix D of the EIS. The assessment included detailed modelling of potential impacts under a wide range of climatic conditions and in accordance with the relevant methodologies and assessment criteria.

As described in Appendix D of the EIS, previous studies have shown that dust deposition levels from coal mines well in excess of those predicted for the Project resulted in no impacts to agricultural production. As a result, the effect of Project-related dust on agricultural enterprises in the vicinity of the Project is predicted to be minimal.

#### **3.2.5 Potential Road Transport Impacts on Agriculture**

A comprehensive assessment of potential impacts of the Project on traffic and transport networks has been conducted by GTA Consultants (2012) and is contained in Appendix F of the EIS. The assessment concluded that no significant impacts on the performance, capacity, efficiency and safety of the local road network are expected to arise as a result of the Project. Whitehaven would continue to implement its road maintenance agreements with the Narrabri Shire Council and the Gunnedah Shire Council during the life of the Project.

The Project would not materially affect the regional transport road networks that are used to service agricultural enterprises in the region. The Kamilaroi Highway is the closest regional road to the Project and would not be impacted by the proposed mining activities. In fact, the Project would result in a reduction of mine-related traffic on the Kamilaroi Highway due to the construction of the private haul road and Kamilaroi Highway overpass.

The Project would also not result in any additional impacts to the regional rail network as the amount of coal loaded and railed from the Whitehaven CHPP would be within the existing approved capacity of the facility.



### 3.3 AGRICULTURAL PRODUCTION ENTERPRISES AND INFRASTRUCTURE

The area of agricultural lands that would be temporarily removed by the Project (a maximum of approximately 2,242 ha over the life of the Project), and consideration of the area of comparable grazing lands that would be re-instated with the Project rehabilitation programme (approximately 780 ha), along with sterilisation of existing grazing agricultural lands in the Project biodiversity offset area (approximately 250 ha) can be considered in the context of the area of land under agricultural production in the State of NSW and in the Gunnedah/Narrabri region (Table 4).

**Table 4**  
**Potential Impacts of the Project on Regional and State Agricultural Land Area**

Region	Approximate Area under Agricultural Use (ha)	Project Maximum Impact*		Residual Impact of Project Final Landform*	
		(ha)	(%)	(ha)	(%)
NSW	60,900,000	2,492	0.004%	1,712	0.003%
Gunnedah/Narrabri	1,255,000		0.2%		0.13%

Source: After Gillespie Economics (2012a).

\* Including agricultural lands in Project biodiversity offset area.

As shown in Table 4, the potential impact of the Project on the area of land that is subject to agricultural use in NSW and in the Gunnedah/Narrabri region would be very small.

As described in Sections 3.2.2 and 3.2.3, Gillespie Economics (2012a) has evaluated the potential impacts of the Project sterilising agricultural land and using some water resources that may otherwise have been available for agriculture on the Gunnedah/Narrabri region. This analysis indicates that the total impact (gross margin) of the Project on agriculture (in perpetuity) would be \$11.1M.

Regional economic impacts were also evaluated and indicate that the Project use of agricultural land and water could reduce direct agricultural employment in the Gunnedah/Narrabri region by approximately 9 people, and reduce agricultural output by some \$1.5M per annum (Attachment B).

The Gunnedah Saleyards are the largest cattle saleyards in the region, with a historical throughput of around 120,000 head of cattle per year, although the throughput was approximately 96,000 cattle during the 2012 financial year (pers. comms. D. Morrison, October 2012). Approximately 60-70% of the cattle sold through the saleyards come from the local region (Coonabarabran-Tamworth region) and the remainder come from further afield. Cattle sold through the saleyards are distributed to farms and abattoirs across the east coast of Australia, from Victoria to Rockhampton.

Road trains were recently approved to travel along the Kamilaroi Highway through Narrabri to Gunnedah which has prompted an expansion of the Gunnedah Saleyards. It is anticipated that the throughput and range that cattle are sourced from would increase once completion of the expansion of the saleyards is completed.

Redevelopment of the Tamworth Regional Saleyards commenced in mid-2012. The facility will hold up to 3,000 cattle and is anticipated to be completed by mid-2013. The saleyards will process cattle from the local region, however would primarily receive livestock from the area to the east, south and north of Tamworth. Cattle from west of Tamworth are anticipated to continue to be sold through the Gunnedah Saleyards.

The closest abattoir to the Project is located in Tamworth, which processes approximately 700 to 800 cattle per day sourcing cattle from across the state, including the Gunnedah Saleyards. A large abattoir was operated in Gunnedah, however the facility was closed in the late 1990s.

Consideration of the above indicates that the Project has very little potential to materially affect regional agriculture enterprises or infrastructure at a local or regional level.

Consideration of the potential impacts of the Project on the availability of employees in the agricultural sector (i.e. flow-on effects of Project employment demand in a tight labour market) and potential impacts to population and housing are provided in Attachment B and Appendix K of the EIS.



## **4 MITIGATION AND MANAGEMENT MEASURES**

As described in Section 3, the potential impacts of the Project on agricultural resources and associated employment and support industries would be small in the context of the existing agricultural activities in the region. Notwithstanding, Whitehaven would implement comprehensive mitigation and management measures that would reduce the potential impacts of the Project on agriculture as described below.

### **4.1 MINIMISATION OF DISTURBANCE TO AGRICULTURAL LANDS**

The area of agricultural land disturbed by the Project at any one time would be minimised so that beneficial agricultural uses (i.e. cattle grazing) can continue to be undertaken on available grazing lands within the Project area. As demonstrated by Whitehaven at existing mining operations in the region, grazing agricultural activities can be readily undertaken in conjunction with the operation of a mine.

### **4.2 MANAGEMENT OF SOIL RESOURCES**

Soil stripping, stockpiling and application management measures that would be implemented at the Project are detailed in Attachment A, and in Section 4.3.3 in the Main Report of the EIS. A summary of these measures is provided below.

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 Project site 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 at the Project:

- areas of disturbance would be stripped progressively, as required, to reduce the potential for erosion and sediment generation, and to minimise the extent of topsoil stockpiles and the period of soil storage;
- areas of disturbance requiring soil stripping would be clearly defined following vegetation clearing;
- 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; and
- in preference to stockpiling, stripped soil would be directly replaced on completed sections of the final landforms wherever practicable.

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.
- Where additions such as lime, gypsum and fertiliser are needed to improve the condition of stripped soil, they would be applied to the stockpiles in-between the application of separate layers from the scrapers.
- Wherever practicable, soil would not be trafficked, deep ripped or removed in wet conditions to avoid breakdown in soil structure.
- 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) on the Project site would be maintained and reconciled annually with rehabilitation requirements.
- Weed control programmes would be implemented on soil stockpiles if required.

The Biodiversity Management Plan, Rehabilitation Management Plan, and Mining Operations Plan would describe soil management measures relevant to the various stages of mine development (i.e. stripping, stockpiling and rehabilitation). The management measures would include identification of soil constraints and use of appropriate amelioration measures, as per the recommendations contained in the Agricultural Resources Assessment (Attachment A).

#### **4.3 MANAGEMENT OF ADJOINING WHITEHAVEN-OWNED LANDS**

Land owned by Whitehaven outside of the Project area would continue to be used for agricultural uses, where practicable.

A Farm Management Plan would be prepared by a suitably qualified person(s) to facilitate the management of agricultural land in the Project area and surrounding Whitehaven-owned land. The Farm Management Plan would include property, grazing and cropping management measures, as well as erosion, weed and pest controls to be applied.

Management measures under the Farm Management Plan would be implemented progressively on properties under licence agreement with Whitehaven, consistent with the terms of the licence and in consultation with the licensee.

At the completion of the Project, it is expected that Whitehaven would sell the adjoining properties it holds and as a result they would continue to be used for agricultural purposes.

#### **4.4 RE-ESTABLISHMENT OF AGRICULTURAL LANDS**

As described in Section 3.2.2, the rehabilitation and mine closure strategy for the Project includes restoration of approximately 780 ha of agricultural land (Figures 13 and 14). The rehabilitation of this land reduces the area of agricultural land that would be sterilised by the Project.

This re-establishment of agricultural lands would be undertaken progressively as a component of the Project rehabilitation programme as described in Section 5 in the Main Report of the EIS.

As has already been successfully demonstrated at the Vickery Coal Mine, Whitehaven anticipates that re-established grazing lands would be of comparable Agricultural Suitability to the majority of the existing rehabilitated and agricultural land within the Project area (i.e. Class 3 or Class 4 Agricultural Suitability).

Following mine closure the private haul road and Kamilaroi Highway overpass be decommissioned and the disturbed land would be rehabilitated to a condition of comparable Agricultural Suitability to the surrounding land (i.e. Class 2 and 3), unless otherwise agreed with the relevant government agencies.

## **4.5 WATER RESOURCES**

### ***Groundwater***

As described in Section 3.2.3, Whitehaven would develop and implement a Groundwater Management Plan for the Project. It would include, but would not necessarily be limited to, the following:

- baseline data of groundwater levels, yield and quality in the region, and privately owned bores that could be affected by the Project;
- details of the groundwater monitoring program including monitoring locations, parameters and frequency of sampling;
- details of the proposed final voids and the methods to be used to place coal rejects and acid forming material within the mine waste rock emplacements;
- groundwater assessment criteria for investigating any potentially adverse groundwater impacts; and
- a program to validate the regional numerical groundwater model for the Project.

It would also describe the contingent mitigation/compensation/offset options that would be enacted in the unlikely event that other groundwater users are adversely affected by the Project.

### ***Surface Water***

As described in Section 3.2.3, a Water Management Plan would be developed for the Project and would incorporate the site water balance, an erosion and sediment control plan, surface water and groundwater monitoring and a surface water and groundwater response plan.

#### ***Site Water Balance***

Periodic review and revision of the site water balance would be undertaken over the life of the Project to record and document the status of inflows (water capture), storage and consumption (e.g. dust suppression and crushing activities) and to optimise water management performance. Monitoring would be undertaken over the life of the Project to provide data for refinement of the site water balance, including:

- records of pumped water volumes;
- storage levels in mine water dams and other containment storages;
- dust suppression water usage rates;
- crusher and vehicle washdown usage rates; and
- irrigation usage rates on rehabilitation areas.



### *Erosion and Sediment Control*

The proposed sediment control storages would have sufficient capacity to manage disturbed area runoff in accordance with design criteria recommended in the relevant guidelines (Appendix B).

The Project sediment and erosion control system would be managed through the Water Management Plan. The Water Management Plan would be reviewed and revised periodically to address changes over the Project life.

### *Surface Water Monitoring*

Surface water monitoring would include the following:

- continuation of monitoring at existing water quality monitoring sites;
- surface water discharge monitoring at four proposed discharge locations around the Project; and
- additional monitoring points on watercourses which drain from the Project area.

Two meteorological monitoring stations have been established in the vicinity of the Project area and would continue to be operated.

## **4.6 OTHER MEASURES**

Section 4 in the Main Report of the EIS describes the management and mitigation measures for other potential environmental impacts arising from the Project, including management measures pertaining to visual impacts, traffic impacts, noise and air quality impacts.

## 5 JUSTIFICATION OF PROPOSED CHANGES TO AGRICULTURAL LANDS

The Project would result in the sterilisation of approximately 1,712 ha of agricultural lands (including the biodiversity offset area) (Section 3.2.2). This represents approximately 0.1% of the total agricultural lands in the Narrabri and Gunnedah LGAs. Although some parts of the agricultural lands within the Project mining area have been mapped as having moderate to moderately high agricultural suitability, they are currently only used for cattle grazing and are regarded by local farmers as being relatively low yielding.

Table 5 compares the annual regional production and economic impacts associated with the Project with the maximum level of annual agricultural production that would be forgone as a result of the Project.

**Table 5**  
**Maximum Annual Regional Production/Economic Impacts**  
**of the Forgone Agricultural Production and the Project**

	<b>Forgone Agriculture Production</b>	<b>Project</b>
Direct Output Value	\$1.5M	\$492M
Direct Income	\$0.35M	\$17M
Direct Employment	9	145
Direct and Indirect Output Value	\$2.2M	\$588M
Direct and Indirect Income	\$0.52M	\$38M
Direct and Indirect Employment	12	423

Source: After Gillespie Economics (2012a, 2012b).

The Project is estimated to provide considerable stimulus to the Gunnedah and Narrabri regional economy of that is far in excess of the regional economic impacts associated with the maximum level of annual agricultural production that would be forgone as a result of the Project (Table 5).

The direct annual output of the Project (at 4.5 Mtpa of ROM coal production) is estimated at \$492M. This is greater than the annual value of all agriculture production in both the Gunnedah and Narrabri LGAs in 2006 (i.e. \$386M) (Section 3.3). The annual agricultural production forgone from the land and water resources that would be impacted by the Project is \$1.5M (Table 5).

The direct and indirect employment provided by the Project would be approximately 423 compared to approximately 12 agricultural-related jobs that would be forgone as a result of the Project (Table 5).

A benefit cost analysis has been prepared for the Project (Appendix K of the EA). The present value of net production benefits of the Project are estimated at \$915M (Gillespie Economics, 2012b). In contrast the present value of forgone future agricultural resources is estimated at approximately \$11.1M (Attachment B).

There are a number of potential negative and positive externalities associated with the Project. Including all externalities (including the opportunity cost of agricultural production) the Project is estimated to have net benefits to Australia of \$1,056M (Gillespie Economics, 2012b) and therefore the Project is considered to be more efficient than the agricultural production that would be displaced.

Given that only agricultural land used for cattle grazing would be sterilised by the Project and that the Project is more efficient than the continued agricultural production, it is considered that the reallocation of existing agricultural resources to the Project is justified (Attachment B).

## 6 REFERENCES

- Department of Planning and Infrastructure (2012a) *Guideline for Agricultural Impact Statements*.
- Department of Planning and Infrastructure (2012b) *Strategic Regional Land Use Plan – New England North West*.
- Department of Primary Industries (2012a) *Beef Cattle Gross Margin, Inland Weaners – Stores*.
- Department of Primary Industries (2012b) *Surface Irrigated Cotton (Roundup Ready, Flex)*.
- Emery KA (1986) *Rural Land Capability Mapping*. Soil Conservation Service of New South Wales: Sydney.
- Evans & Peck (2012) *Vickery Coal Project Surface Water Assessment*. Report prepared for Whitehaven Coal Limited.
- Gillespie Economics (2012a) *Economic Review of Potential Agricultural Impacts*. Report prepared for Whitehaven Coal Limited.
- Gillespie Economics (2012b) *Vickery Coal Project Socio-Economic Assessment*. Report prepared for Whitehaven Coal Limited.
- GSS Environmental (2010c) *Maules Creek Coal Project Soil and Land Capability Assessment*.
- GTA Consultants (2012) *Vickery Coal Project Road Transport Assessment*. Report prepared for Whitehaven Coal Limited.
- Heritage Computing (2012) *Vickery Coal Project Groundwater Assessment*. Report prepared for Whitehaven Coal Limited.
- Heritage Management Consultants (2012) *Vickery Coal Project Non-Aboriginal Heritage Assessment*. Report prepared for Whitehaven Coal Limited.
- Hulme T, Grosskopf T, Hindle J (2002) *Agricultural Land Classification; Agfact AC. 25. NSW Agriculture: Orange*.
- Fluvial Systems (2012) *Fluvial Geomorphological Assessment for Vickery Coal Project*.
- Isbell, RF (2002) *Australian Soil Classification System, Revised Edition*. CSIRO: Melbourne.
- Landscape (2012) *Vickery Coal Project Aboriginal Cultural Heritage Assessment*. Report prepared for Whitehaven Coal Limited.
- McKenzie Soil Management (2012) *Vickery Coal Project Agricultural Resource Assessment*. Report prepared for Whitehaven Coal Limited.
- Namoi Catchment Management Authority (2007) *Namoi Catchment Action Plan*.
- Niche Environment and Heritage (2012) *Vickery Coal Mine Ecological Assessment*. Report prepared for Whitehaven Coal Limited.
- Office of Environment and Heritage (2012) *The Land and Soil Capability Assessment Scheme: Second Approximation*.



PAEHolmes (2012) *Vickery Coal Project Air Quality and Greenhouse Gas Assessment*. Report prepared for Whitehaven Coal Limited.

SP Solutions (2012) *Vickery Coal Project Environmental Risk Assessment*. Report prepared for Whitehaven Coal Limited.

Stace HCT, Hubble GD, Brewer R, Northcote KH, Sleeman JR, Mulcahy MJ, Hallsworth EG (1968) *A Handbook of Australian Soils*.

Urbis (2012) *Vickery Coal Project Visual Assessment*. Report prepared for Whitehaven Coal Limited.

Vickery Joint Venture (1986) *Namoi Valley Coal Project Environmental Impact Statement*.

Wilkinson Murray (2012) *Vickery Coal Project Noise and Blasting Impact Assessment*. Report prepared for Whitehaven Coal Limited.