Austar Coal Mine

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ENVIRONMENTAL ASSESSMENT

Proposed Stage 3 Extension to Underground Mining & Associated Infrastructure

VOLUME 1

Main Text

Appendices 1 -5

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Umwelt
Environmental Consultants

Austar Coal Mine Project – Stage 3 Environmental Assessment

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Austar Coal Mine Pty Ltd

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Executive Summary

1.0 Proposed Development Context

Austar Coal Mine Pty Ltd (Austar) operates the former Ellalong, Southland and Bellbird South Collieries which are now named the Austar Coal Mine. These operations jointly comprise the Austar Mine Complex. Austar seeks major project approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Stage 3 extension of the mining operations at the Austar Coal Mine. The Stage 3 Project will involve mining of known coal reserves within approximately an 800 hectare area of Austar's Consolidated Mining Lease 2 (CML2) which contains approximately 87% of the proposed Stage 3 coal resource. The remaining 13% of the identified Stage 3 coal resource will be mined from approximately a 200 hectare area that is to the east of the CML2 boundary and that would be sterilised from future extraction if not mined as part of Stage 3. A new mining lease will be required for mining in this area.

The proposed development consists of the following:

1. Extension of underground mining from current Stage 1 and Stage 2 operations into the area described as Stage 3 of the Austar Mine. A maximum of 3 million tonnes per annum (Mtpa) of product coal will be produced by extracting coal from the Greta Coal Seam at depths of 400 to 750 metres using Longwall Top Coal Caving (LTCC) methods. A total of approximately 45.3 million tonnes (Mt) of coal will be produced from longwall panels A6 to A17 over a 21 year mine life. This will involve extraction of up to 3.6 Mt of Run of Mine (ROM) coal per year.

2. Construction and operation of a new Surface Infrastructure Site off Quorrobolong Road south of Kitchener. This site will include an access road, upcast and downcast ventilation shafts, main ventilation fan, bathhouse, workshop, electricity substation and distribution line, service boreholes, offices and store. The Surface Infrastructure Site will be used to provide ventilation to the mine and to provide access to the Stage 3 underground workings for men and materials. No coal will be brought to the surface at this site.

Analysis of LTCC mining operations in Stage 1 of Austar Coal Mine indicates that through using LTCC methods, approximately 63% more coal from the Greta seam can be extracted than by using conventional longwall mining techniques with approximately a 5% increase in energy required to achieve this 63% increase in coal extraction. It is estimated that use of LTCC methods will yield approximately an additional 16 Mt more of high quality coal from the proposed Stage 3 underground mining area than would be extractable using conventional longwall mining techniques. This represents approximately 35% of the identified Stage 3 coal resource.

Coal extracted from Stage 3 will be transported underground to the existing Austar Mine Complex coal conveyance system and will use the existing and approved infrastructure and facilities at the existing Austar Mining Complex as described below to handle, process and transport ROM coal from longwalls A6 to A17. These activities will involve the continued operation and utilisation of:

- the Ellalong Drift and Pit Top and associated infrastructure which has adequate capacity to handle in excess of 3.6 million tonnes per year of ROM coal;

- the Austar Mine complex water management system which has adequate capacity to accommodate the water management needs of the proposed Stage 3 extension to mining;

- the Pelton Coal Handling Preparation Plant (CHPP) for the washing and handling of coal which has capacity to handle and process in excess of 3.6 Mt of ROM coal per year;
- the Austar Railway Line and South Maitland Railway to transport up to 3 Mt of product coal per annum;
- road transport of up to 60,000 tonnes of specialty coal product per annum; and
- emplacement of reject material from Austar's mining operations at Aberdare Extended and Pelton Open Cuts and other sites as approved in the Mining Operation Plan (Austar 2008). Analysis indicates that these sites have sufficient approved emplacement capacity to accommodate all coarse and fine reject from the proposed Stage 3 extension to mining.

A series of continuous improvement programs will be implemented as part of the ongoing utilisation of the Austar Mine Complex infrastructure. These include:

- detailed Mining Operation Plan that will be regularly reviewed and updated throughout the life of the mine;
- detailed Site Water Management Plan that will be updated to include the proposed Stage 3 extension to mining and the operation of the proposed Surface Infrastructure Site;
- ongoing development and implementation of a Voluntary Noise Pollution Reduction Program for Pelton CHPP which will be incorporated into a Noise Management Plan for Austar Mine Complex;
- preparation of consolidated heritage management plans for Austar operations within the Austar Mine Complex and the proposed Stage 3 extension and Surface Infrastructure Site; and
- preparation of an internal energy and Greenhouse Gas (GHG) management plan for Austar Mine Complex.

In preparing this environmental assessment a Preliminary Risk Assessment (Umwelt, 2008a) was undertaken in the initial stages of the Project to identify key issues, risks and consequences of the proposed development. This Preliminary Risk Assessment formed the basis for discussions with relevant government agencies and stakeholders. Following these discussions which included a Planning Focus Meeting with relevant government agencies, the Director-General of Planning issued Director-General's Requirements (DGRs) setting out the key environmental issues to be addressed in this environmental assessment. Each of these issues have been considered and explored through targeted surveys undertaken specifically for the project and through detailed assessment based on site specific data and best practice assessment methods. This is discussed further in **Sections 2** to **5**.

2.0 Stage 3 Underground Mining

Mine Planning Considerations

The proposed Stage 3 underground mining operation will provide access to approximately 45.3 Mt of high quality coal resource from the Greta Coal Seam. The mine has been accessing the Greta Coal Seam since approximately 1916 with mining progressing downdip from the seam outcrop to depths of in excess of 550 metres. Over the life of the mine, a range of mining techniques including bord and pillar, continuous miner, longwall mining and more recently LTCC have been used at the mine. An extensive site specific knowledge base of subsidence characteristics, potential subsidence impacts and the interactions of these impacts with structures on the landform above the mining area, service infrastructure, geology, ecology, land use, surface drainage, groundwater has been built up over the life of the mine.

The proposed Stage 3 development, which seeks to mine coal from the Greta seam at depths of 450 to 740 metres below the surface, has been developed within the context of this site specific knowledge base, taking into account specific characteristics of the coal resource, the overlying geology, significant natural features, land use and improvements.

Landform characteristics of the site have been recorded using Aerial Laser Survey techniques which provide an accurate, high level of definition of not only the land surface but also includes definition of structures on the surface such as buildings and roads and of the vegetation canopy.

Detailed investigations of the site geology and potential geological anomalies such as faults and dykes in the vicinity of the proposed Stage 3 area have been undertaken to enable a conceptual mine plan to be developed. Geological investigation and experience from previous mining within the Greta Coal Seam and Branxton Formation indicate that the Branxton Formation is sufficiently massive to be strong enough to span longwall panel void widths of approximately 227 metres as proposed without collapsing or undergoing significant sagging. As a result, it is expected that the subsidence profile that will result from the proposed mining of Stage 3 will be controlled by the compression of the chain pillars that are left between each longwall. With subsidence being controlled by compression of the chain pillars, the whole of the landform above the Stage 3 longwalls will subside in a relatively uniform manner and as a result the only areas of relative change in landform will be around the perimeter of the group of longwall panels. This relative change is expected to be within the natural variability of slopes in the area.

Subsidence

A detailed subsidence impact assessment for the project has been undertaken by MSEC (2008). The assessment has been based on an Incremental Profile Method (IPM) model that has been calibrated using site specific subsidence information recorded from former mining of the Greta Coal Seam in the Branxton Formation. This data set spans several decades of subsidence monitoring. The modelling and subsidence predictions were peer reviewed by Seedsman Geotechnics. IPM modelling by MSEC (2008) has been used to produce subsidence predictions for the Maximum Predicted subsidence and Upper Bound subsidence. Maximum Predicted subsidence represents the maximum level of subsidence predicted using the IPM subsidence model that has been calibrated using measured subsidence specific to the Greta seam and Branxton Formation geology. The Upper Bound subsidence predictions have been developed for risk assessment purposes and are based on subsidence being equivalent to 65% of the effective extracted seam thickness. MSEC (2008) has stated that based on the height of chain pillar, the longwall void configuration and the massive nature of the Branxton Formation that maximum Upper Bound subsidence is unlikely to be more than 50% of the effective extracted seam thickness rather than the 65% that has been adopted by MSEC (2008).

Subsidence predictions prepared by MSEC indicate that all buildings and structures within the area of subsidence resulting from proposed Stage 3 underground mining will remain within Safe, Serviceable and Repairable criteria. Detailed assessment of infrastructure within the Stage 3 subsidence area including farm dams, roads, tanks, swimming pools, fences, electricity and telecommunication services has been undertaken and indicates that subsidence impacts on this infrastructure will be within acceptable levels and will be readily manageable. Similarly, subsidence predictions indicate that mining will not have a significant impact on land use in the area.

Subsidence Management Plans (SMPs) and Property Subsidence Management Plans (PSMPs) providing details of specific management and monitoring activities on a property by property basis will be prepared in consultation with relevant government agencies and land holders prior to longwall extraction.

Surface and Groundwater

Potential changes to surface flows above the proposed Stage 3 mining area as a result of mining have been assessed for the Maximum Predicted and Upper Bound predicted levels of subsidence. This assessment has been undertaken using a detailed two dimensional hydrodynamic model (RMA-2) that has been developed for the Quorrobolong Valley. The model has been developed using topographic information derived from detailed Aerial Laser Survey data combined with site specific information on the hydraulic properties of the valley derived from site inspection and interpretation of aerial photography. The two dimensional hydrodynamic model has been calibrated to known flood levels for the February 1990 and June 2007 major storm events both of which had Average Recurrence Intervals of approximately 100 years.

Analysis of the Maximum Predicted and Upper Bound subsidence predictions using high definition digital terrain models derived from the Aerial Laser Survey data, indicate that creeklines and drainage lines within the area will remain free draining with no significant increase in instream velocities, even at Upper Bound subsidence levels. As a result subsidence remediation works along creek lines are not expected to be required. Consequently there is unlikely to be any significant disturbance or loss of riparian vegetation or Aboriginal archaeological heritage in proximity to creek lines.

Results of the RMA-2 modelling indicate that:

- The alignment of creeks channels and drainage lines or delineation of catchment boundaries are not expected to significantly change as a result of subsidence for the Maximum Predicted and Upper Bound subsidence cases.

- Flood depths will not increase at any existing dwellings nor will flood hazard categories change at dwellings or on access tracks as a result of the proposed Stage 3 mining for the Maximum Predicted and Upper Bound subsidence cases.

- The duration of inundation during flooding events will generally not increase as a result of the proposed Stage 3 mining except at the junction of Cony Creek and Sandy Creek at the western edge of the proposed mining area. At this location the predicted increase in the time the land is flooded is not of sufficient duration to adversely impact on riparian vegetation or grasses in the area.

As a contingency measure, creek lines and drainage lines will be monitored during and after mining to detect any unforeseen or unpredicted impacts.

Analysis of the existing groundwater regime and geology of the area, undertaken by Connell Wagner (2007) indicates that the potential for vertically interconnected cracking to extend from the mining goaf (resulting from longwall extraction) to the surface is negligible.

Geological drilling indicates that the Branxton Formation which is massive, extends from the Greta Coal Seam to the surface within the Stage 3 area. In addition, the geomorphology of the area has resulted in broad and relatively shallow valleys and exhibits no confined gorges and deep valleys as are evident in the Southern Coalfield. As a result, upsidence and valley closure impacts resulting from mining as have been observed in the Southern Coalfield are unlikely to have a significant impact on the Stage 3 area. Due to the geomorphology of the valley and the massive structure of the Branxton Formation that extends from the Greta Coal Seam to the surface, the potential for upsidence or valley closure impacts to adversely impact on groundwater in the shallow alluvium is also considered to be negligible. This assessment is consistent with the findings of MSEC (2008) and Seedsman Geotechnics (2008). As a result, it is considered that the proposed Stage 3 underground mining will not adversely impact on groundwater resources in the area.

A detailed groundwater monitoring program is proposed to record groundwater levels in the alluvium and underlying strata to monitor for any unexpected impacts. It is considered that potential groundwater impacts as a result of the proposed Stage 3 underground mining are predictable and controllable.

Flora and Fauna

Flora and fauna assessments of the landform above the proposed Stage 3 underground mining area were undertaken as part of the environmental assessment for the proposed development. Results of these surveys and assessment of potential impacts at Upper Bound levels of subsidence, indicate that potential impacts on ecological values as a result of subsidence are likely to be low and will be controllable and manageable.

An ongoing monitoring program of riparian habitats above the proposed Stage 3 mining area is proposed to document the condition of these habitats throughout the life of the proposed mining development.

Aboriginal and Non-Aboriginal Heritage

Aboriginal and non-Aboriginal heritage surveys of the surface of the proposed Stage 3 underground mining area were undertaken as part of the environmental assessment for the proposed development. These surveys identified numerous artefact scatters along drainage lines within the proposed Stage 3 mining area. Subsidence predictions indicate that surface works in these areas are unlikely to be required and that there will be no significant impact on these artefacts. If surface works are required, further archaeological surveys will be undertaken in the areas of proposed works and appropriate management and mitigation measures will be developed.

The surveys also identified one axe grinding groove site that could potentially be impacted by the proposed development. Careful consideration and analysis of the axe grinding groove site and the rock strata on which it is located indicated that there is potential that site could be cracked as a result of subsidence. In consultation with Aboriginal stakeholders and representatives of Department of Environment and Climate Change (DECC), it was agreed that any of the potential mitigation measures identified may not successfully prevent the grinding groove site from cracking.

Following further consultation it was agreed that once all relevant approvals were obtained for mining, Austar would contribute $100,000 to an Aboriginal project or program to be decided by Aboriginal stakeholders as an offset for potential impacts on the grinding groove site. In addition, Austar has committed to the development of Aboriginal Cultural Heritage Management Plan that sets out ongoing management and monitoring requirements for the Austar Mine Complex.

A series of management and monitoring recommendations have also been developed for items of historic heritage. It is considered that with these controls and management measures in place the proposed development can be undertaken without having a significant adverse impact on the heritage of the area.

Visual Amenity

Analysis indicates that subsidence above the proposed Stage 3 underground mining area will tend to be relatively uniform and within the natural slope variability that currently exists in the area, even at Upper Bound levels of subsidence predictions. Similarly analysis indicates that predicted subsidence is unlikely to significantly impact on vegetation or ecological habitats above the proposed mining area. As a result, no significant changes to the visual characteristics or visual amenity of the area are predicted as a result of proposed Stage 3 mining.

3.0 Surface Infrastructure Site

The proposed Surface Infrastructure Site is on a 16 hectare parcel of land that is owned by Austar. The proposed site is located off Quorrobolong Road approximately 1.6 kilometres south of Kitchener and is bounded by Werakata State Conservation Area.

The site is visually screened from surrounding areas and is sufficiently acoustically distant from residential receivers to ensure that the development (with the incorporation of appropriate mitigation measures) can be undertaken without having a significant adverse impact on the amenity of the surrounding area. The site has been selected as it is removed, remote and screened from residential areas and rural properties so as to provide for minimal impact from the construction and operation of the Site.

Geological assessment and mining planning indicates that the site can provide appropriate access to the proposed Stage 3 underground workings for men and materials and can be used to adequately ventilate the underground mine.

Flora and Fauna

The proposed development of the site will disturb approximately 8 to 10 hectares of this site. Environmental assessment and analysis indicates that, with the implementation of control measures as proposed, the site can be developed without having a significant impact on the surrounding Werakata State Conservation Area.

Development of the site will result in disturbance of two threatened species and small sections of Endangered Ecological Communities. These impacts and potential consequences for native fauna and flora species are well understood and controllable. To minimise and offset this impact, a series of clearing controls and requirements for habitat re-establishment in the form of the provision of nest boxes, have been developed. In addition a Biodiversity Offset Area of similar or greater ecological value, has been identified on land that is also owned by Austar and abuts Werakata State Conservation Area. Conservation of the proposed Biodiversity Offset Area will offset ecological impacts of developing the proposed Surface Infrastructure Site.

Soil and Water Management

The proposed Surface Infrastructure Site contains soils that are potentially erosive when disturbed. A series of soil and water management controls have been designed for the construction phase and for ongoing use of the site to ensure that the site can be developed in an acceptable manner. Soil and water management controls along with landscaping and weed management measures will be incorporated into the development to minimise potential long term impacts on the surrounding Werakata State Conservation Area.

A Soil and Water Management Plan providing detailed design of the soil and water management controls to be implemented, will be developed prior to commencement of construction of the site.

Services

The site can be adequately serviced in terms of potable water, sewer, electricity and telecommunications. Access to the site will be via a new road that will be constructed between the site and Quorrobolong Road. An Inholding Access Agreement with DECC will be required for that section of the road between the Surface Infrastructure Site and Quorrobolong Road.

Visual Amenity

Visual assessment undertaken for the proposed Surface Infrastructure Site has included the use of radial analysis and visual transects to identify potential locations in the surrounding area that may have views of the proposed Surface Infrastructure Site once developed. Analysis indicates that only the winder tower, which will be approximately 30 metres high, will be visible from the north. Analysis indicates that this tower is unlikely to be visible from any other direction due to the extensive visual screening that is provided by the forested areas surrounding the development site. When viewed from the north, the winder tower will be seen against a backdrop of green forested vegetation. The tower will be painted with an appropriate colour to blend into this backdrop.

Security lighting and night lighting will be required at the site as it will operate 24 hours per day seven days be week. To minimise the potential for light spill to the surrounding area it is proposed to keep lighting to the minimum height necessary to provide adequate lighting and to direct all lighting into the Surface Infrastructure Site.

With these control measures in place, it is considered that the proposed construction and operation of the Surface Infrastructure Site will not adversely impact on the visual amenity of the surrounding area.

Noise and Vibration

A detailed noise and vibration assessment has been undertaken for the construction and operation of the proposed Surface Infrastructure Site. This assessment indicates that noise and vibration aspects of the proposed development are well understood and controllable and that with the implementation of some minor noise and vibration controls will not have an adverse impact on surrounding residences.

Traffic and Transport

Construction and operation of the proposed Surface Infrastructure Site will effectively redirect mine traffic that is currently accessing Austar Coal Mine’s Ellalong Drift and Pit Top off Middle Road, Paxton to Quorrobolong Road, Kitchener. As a result, the proposed development will not increase regional traffic. The potential impacts of this redirecting of traffic are well understood and predictable.

Traffic assessment undertaken by GHD (2008) indicates that with the provision of warning signs on the southern approach to the proposed access road intersection on Quorrobolong Road and street lighting at the intersection, the intersection will comply with relevant design and safety standards.

The development traffic using Quorrobolong Road to access the proposed Surface Infrastructure Site will be predominantly passenger vehicles transporting workers to and from the site with only a small number of heavy vehicles per day required for deliveries. As a result the proposed development is not expected to have a significant adverse impact on the structural capacity of the road pavements.

Traffic impact assessment (GHD 2008) undertaken for the project indicates that traffic impacts are controllable and with the implementation of standard specified control measures will not have an adverse impact on traffic flows or traffic safety.

The GHD (2008) traffic assessment indicated that the intersection of Wollombi Road and West Avenue in Cessnock has an existing traffic problem that could be improved through some intersection works. Austar has undertaken to make a contribution to these works.

Air Quality

Construction of the Surface Infrastructure Site and establishment of ventilation shafts at the site to ventilate the underground mine has the potential to impact on air quality of the immediately surrounding area. Detailed analysis indicates that this potential impact is negligible and readily controlled.

4.0 Greenhouse Gas and Energy

A detailed Greenhouse Gas (GHG) and Energy assessment has been undertaken for the proposed Stage 3 development. This assessment indicates that the energy value of the coal from the Greta seam to be mined is high (28 GJ/t) and as a result is likely to produce less GHG per unit of energy derived when burnt, than other lower energy value coals. Analysis indicates that based on 2005 world coal production figures, combustion of coal from Stage 3 at full production of 3 Mtpa would produce approximately 0.0006% of the world's annual GHG emissions from the consumption of coal.

Greta seam coal in the proposed Stage 3 has low in-seam gas levels and as a result, fugitive GHG emissions from the coal seam during coal extraction will be relatively low.

Analysis indicates that mining of coal using the LTCC equipment can extract approximately 61% more coal per unit of energy used, than could be extracted using conventional longwall mining equipment. As a result the LTCC process is highly energy efficient and results in less GHG being emitted per tonne of coal extracted than other methods.

As part of the proposed development, Austar will develop and maintain an internal energy and GHG management plan for Stage 3 operations. This Plan will focus on further reducing energy usage and GHG emissions over the life of the project.

5.0 Social and Economic

The Austar Coal Mine is the sole remaining coal mine within the Cessnock Local Government Area (LGA) and has a long and productive history as part of the Cessnock community. Over the past 90 years the mine has, contributed significantly to the prosperity, employment and security of the local and surrounding areas. Austar currently employs approximately 200 people from the following LGAs:

- Cessnock/Singleton – 50%
- Lake Macquarie – 28%
- Newcastle – 9%
- Maitland – 13%

During Stage 3 Austar will continue to provide employment for 200 people with employment rising to approximately 275 people at full production of 3 Mtpa. The Stage 3 coal resource (based on 2007 coal prices) has an estimated export value of approximately $5.6 billion. Approximately 16 Mt of this coal is accessible due to the use of LTCC mining equipment and would not be accessible if conventional longwall mining equipment was used. It is estimated that based on 2007 coal prices, this additional 16 Mt of coal is worth approximately $2.1 billion in export earnings.

At a production levels of approximately 1.6 Mtpa of product coal, Austar Coal Mine generates approximately $200 million per year in revenue with this expected to increase to approximately $400 million per year (based on 2007 coal prices) at full production of 3 Mtpa.

A significant component of this revenue is expended in the local, regional and state economies. This expenditure includes approximately:

- $31.5 million per year in wages and salaries with this expected to increase to approximately $46 million per year (2007 prices) at full production;
- $6.3 million per year in contractors and consultants with this expected to increase to approximately $11.6 million per year (2007 prices) at full production;
- $17.3 million per year in repairs and maintenance with this expected to increase to approximately $32.4 million per year (2007 prices) at full production;
- $15 million per year in electricity and consumables with this expected to increase to approximately $28.1 million per year (2007 prices) at full production;
- $3.8 million per year in plant hire with this expected to increase to approximately $7.1 million per year (2007 prices) at full production; and
- $8 million per year in Local and State government charges and royalties with this expected to increase to in excess of $15 million per year at full production.

Approval to mine Stage 3 will also enable the continued utilisation and therefore benefit from significant existing infrastructure that has been established at Austar Mine Complex over the 90 year life of the mine. This infrastructure has an estimated replacement value of approximately $800 million and includes:

- Ellalong Drift and Pit Top, associated underground and above coal conveyance infrastructure and roadways;

- the overland conveyor system to Pelton CHPP;
- air ventilation infrastructure;
- coal handling, preparation, stockpiling at Pelton CHPP and associated rail loading infrastructure;
- Austar water management and dewatering infrastructure;
- reject emplacement areas at Pelton CHPP and Aberdare Extended; and
- Austar Branch Line.

Access to Stage 3 will also provide for the continued utilisation of South Maitland Railway which is currently used solely to haul coal from Austar Coal Mine. This infrastructure is also of significant value and represents a significant investment that current and future generations will benefit from, if Stage 3 is approved.

The potential social and economic impacts and benefits of the proposed development have been considered throughout the environmental assessment process. This has included ongoing discussion with government agencies and the community since the mine was purchased by Austar in 2005. This consultation process has included briefings, meetings, one on one discussion with land holders, the provision of information material in the form of flyers and website material. This consultation process in conjunction with risk identification and assessment has been used to understand the potential socio-economic impacts of the proposed development.

Consultation with land holders, community and government agency representatives will be ongoing throughout the life of the mine and will include liaison with and through the Community Consultative Committee. Consultation will also occur through the ongoing development of Subsidence Management Plans and Property Subsidence Management Plans that will be developed in consultation with land holders and relevant government agencies. These Plans will detail environmental control and mitigation measures to be implemented on a property by property basis.

The proposed development is an extension of the existing Austar mining operations and will effectively involve a relocation of workers from the Ellalong Drift and Pit Top off Middle Road, Paxton to the proposed Surface Infrastructure Site. Consequently the proposed development is unlikely to result in an increased demand for infrastructure and services in the region.

The proposed development will require the extension of water, sewerage, electricity and telecommunications to the proposed infrastructure site. These works will be funded by the Project and are not expected to place an increased demand on community resources.

As set out above, the continuation and extension of the Austar Mine Complex into the proposed Stage 3 mining area will provide considerable social and economic benefits for the Cessnock area, the State of New South Wales and Australia.

TABLE OF CONTENTS

FIGURES

PLATES

APPENDICES

1.0 Introduction

1.1 Project Overview

Austar Coal Mine Pty Ltd (Austar), a subsidiary of Yancoal Australia Pty Limited (Yancoal), operates Austar Coal mine, an underground coal mine located approximately 10 kilometres south of Cessnock in the Lower Hunter Valley in NSW (refer to **Figure 1.1**). The mine is an aggregate of the former Ellalong, Pelton, Cessnock No.1 and Bellbird South Collieries and is located in the South Maitland Coalfields. These operations including coal extraction, handling, processing and transport collectively form the Austar Mining Complex (see **Figure 1.2**).

The underground mining component of the Austar Mining Complex is currently being undertaken within Consolidated Mining Lease 2 (CML2) (refer to **Figure 1.1**) under development consent DA 29/95. DA 29/95 was granted by the Minister for Urban Affairs and Planning in 1996, enabling coal extraction from the Greta Seam using a conventional retreat longwall extraction method to a height of up to 4.5 metres.

A modification to DA 29/95 was granted by the Minister for Planning in September 2006 to allow extraction of up to 6.5 metres of coal from two longwall panels (Longwalls A1 and A2) in the Stage 1 area (refer to **Figure 1.1**) using an enhanced form of conventional retreat longwall extraction known as Longwall Top Coal Caving (LTCC). Extraction of coal using LTCC technology is currently occurring in Longwall A2 in the Stage 1 area. Further details regarding resource recovery using LTCC technology are provided in **Section 1.2.2**.

A second modification to DA 29/95 was approved by the Minister for Planning in June 2008 to allow the use of LTCC technology in the Stage 2 area (see **Figure 1.1**). Stage 2 comprises Longwalls A3 to A5 and is wholly located within CML2. It is anticipated that mining in the Stage 2 area will commence in early 2009. It is envisaged that mining within the Stage 2 area will be completed by the end of 2011.

The remainder of Austar operations utilises Austar's existing coal handling and processing infrastructure and facilities. A description of Austar's existing infrastructure and facilities is provided in **Section 2.3**.

To enable underground mining using LTCC technology to continue beyond Stage 2, Austar seeks a new approval to extend underground mining into the Stage 3 area. The location of the Stage 3 area and the conceptual Stage 3 mine plan is shown in **Figure 1.3**. The Stage 3 Project consists of the following components:

1. The longwall extraction of up to 7 metres of coal from longwall panels A6 to A17 within the Greta Coal Seam (refer to **Figure 1.3**) using LTCC technology. It is proposed that longwall extraction will occur at a rate of up to 3.6 million tonnes per annum (Mtpa) of Run of Mine coal (ROM) to facilitate a maximum product coal production rate of 3 Mtpa from Austar's existing Pelton Coal Handling and Preparation Plant (CHPP) over a 21 year mine life.

2. The construction and operation of a new Surface Infrastructure Site and access road off Quorrobolong Road, south-west of Kitchener (refer to **Figures 1.3** and **1.4**). The proposed Surface Infrastructure Site will include upcast and downcast ventilation shafts, main ventilation fan, bathhouse, workshop, electricity substation and distribution line, service boreholes, offices and store. Access to longwalls in the Stage 3 area for men and materials will be via the proposed new Surface Infrastructure Site.

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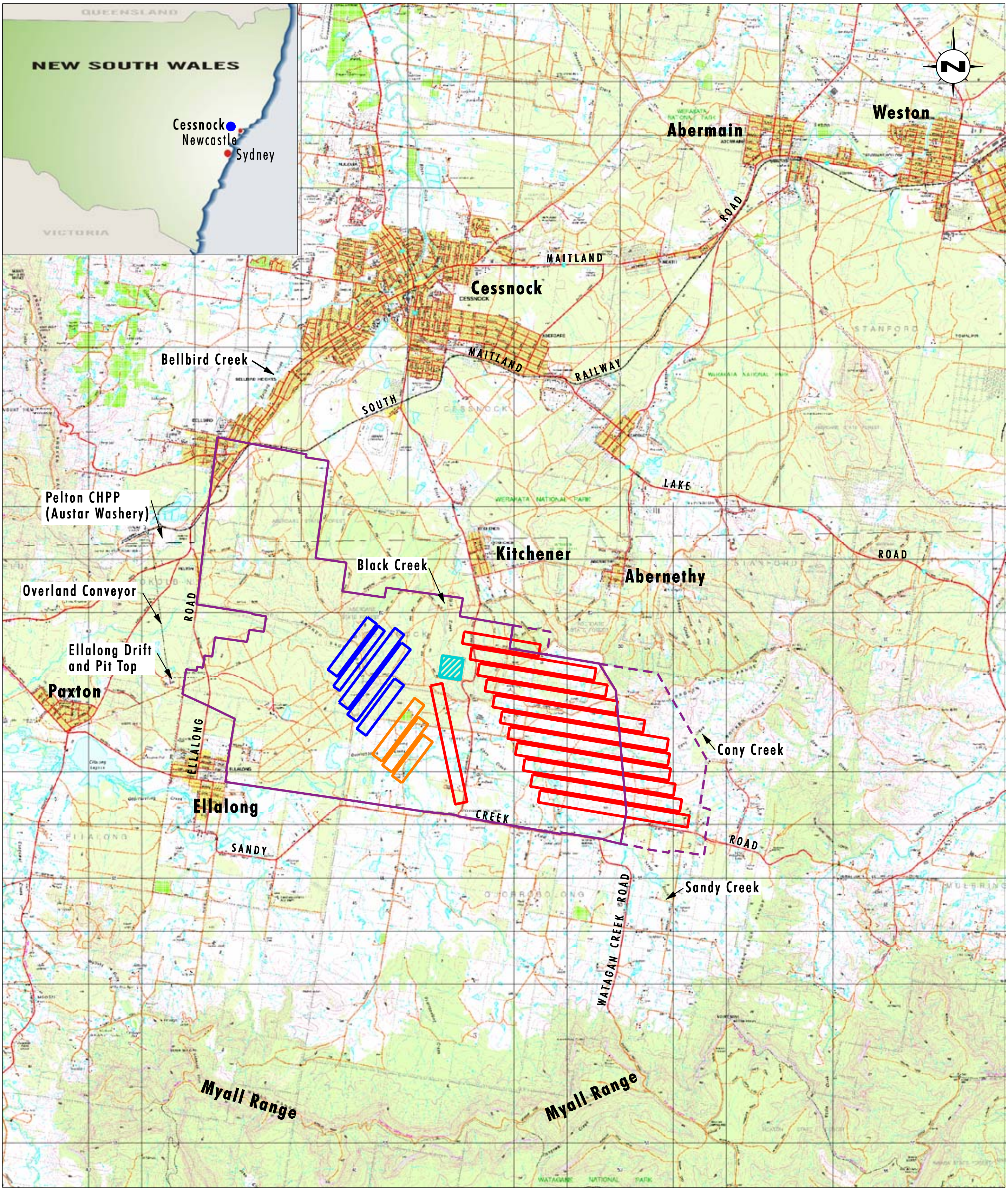


Source: Topo Maps: LPI NSW, Longwall Layout: Austar Coal Mine

0 1.0 2.0 4km
1:100 000

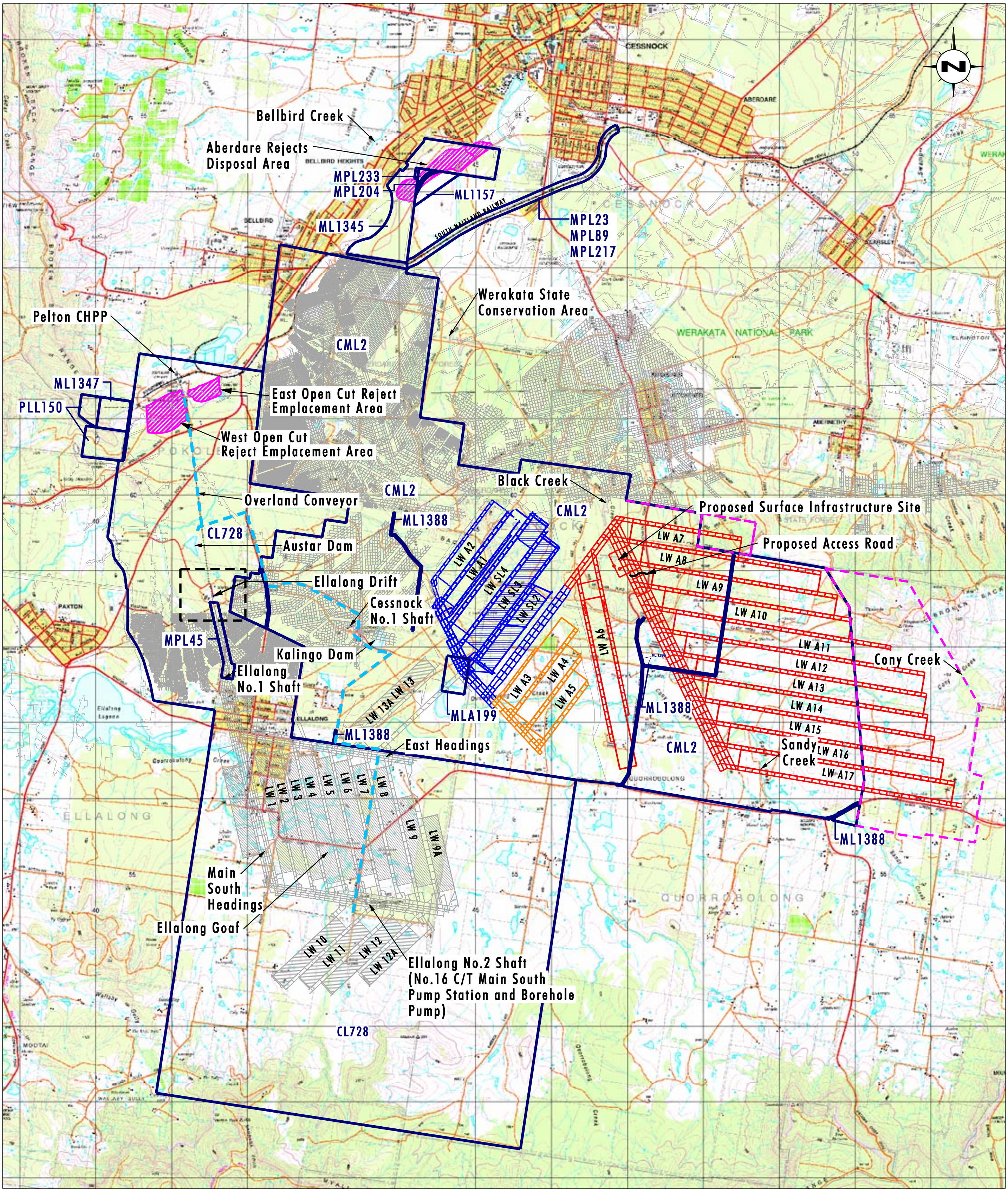
Legend

- Layout for Stage 1 Longwall Panels
- Layout for Stage 2 Longwall Panels
- Conceptual Layout for Stage 3 Longwall Panels
- Surface Infrastructure Site
- Consolidated Mining Lease (CML) 2
- Proposed Stage 3 Extension Boundary

FIGURE 1.1

Locality Plan

File Name (A4): R10_V1/2274_345.dgn



Source: Topo Maps: LPI NSW, Longwall Layouts: Austar Coal Mine

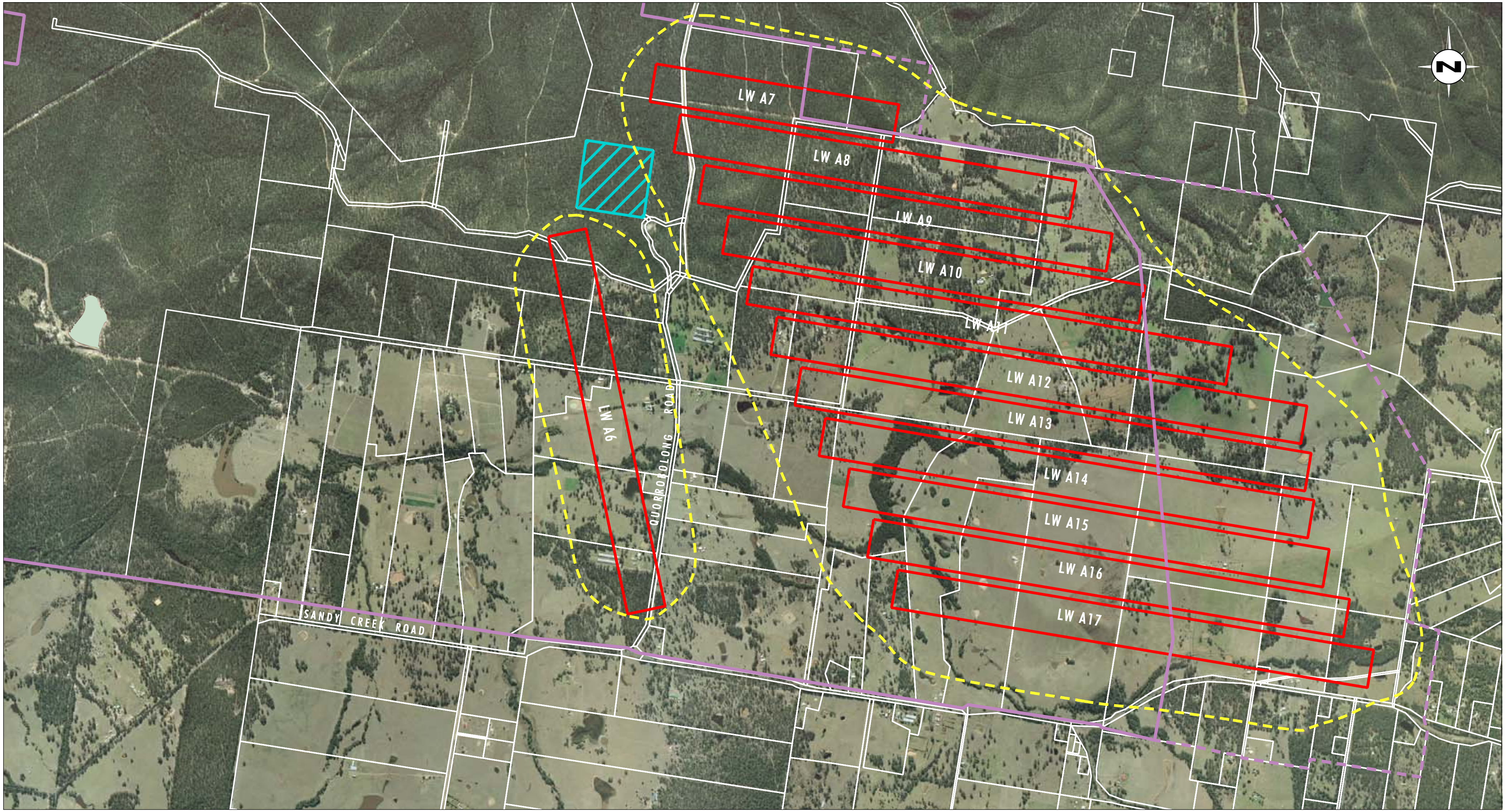
0 1 2 3km
1:70 000

Legend

- Layout for Stage 1 Longwall Panels
- Layout for Stage 2 Longwall Panels
- Conceptual Layout for Stage 3 Longwall Panels
- Proposed Stage 3 Extension Boundary
- Reject Emplacement Areas
- Old Workings
- Mining Leases
- Water Pipeline

FIGURE 1.2

Austar Mine Complex



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.5 1 1.5km
1:32 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Consolidated Mining Lease (CML) 2
- Proposed Stage 3 Extension Boundary

FIGURE 1.3

Stage 3 Conceptual Mine Plan

File Name (A4): R10_V1/2274_346.dgn

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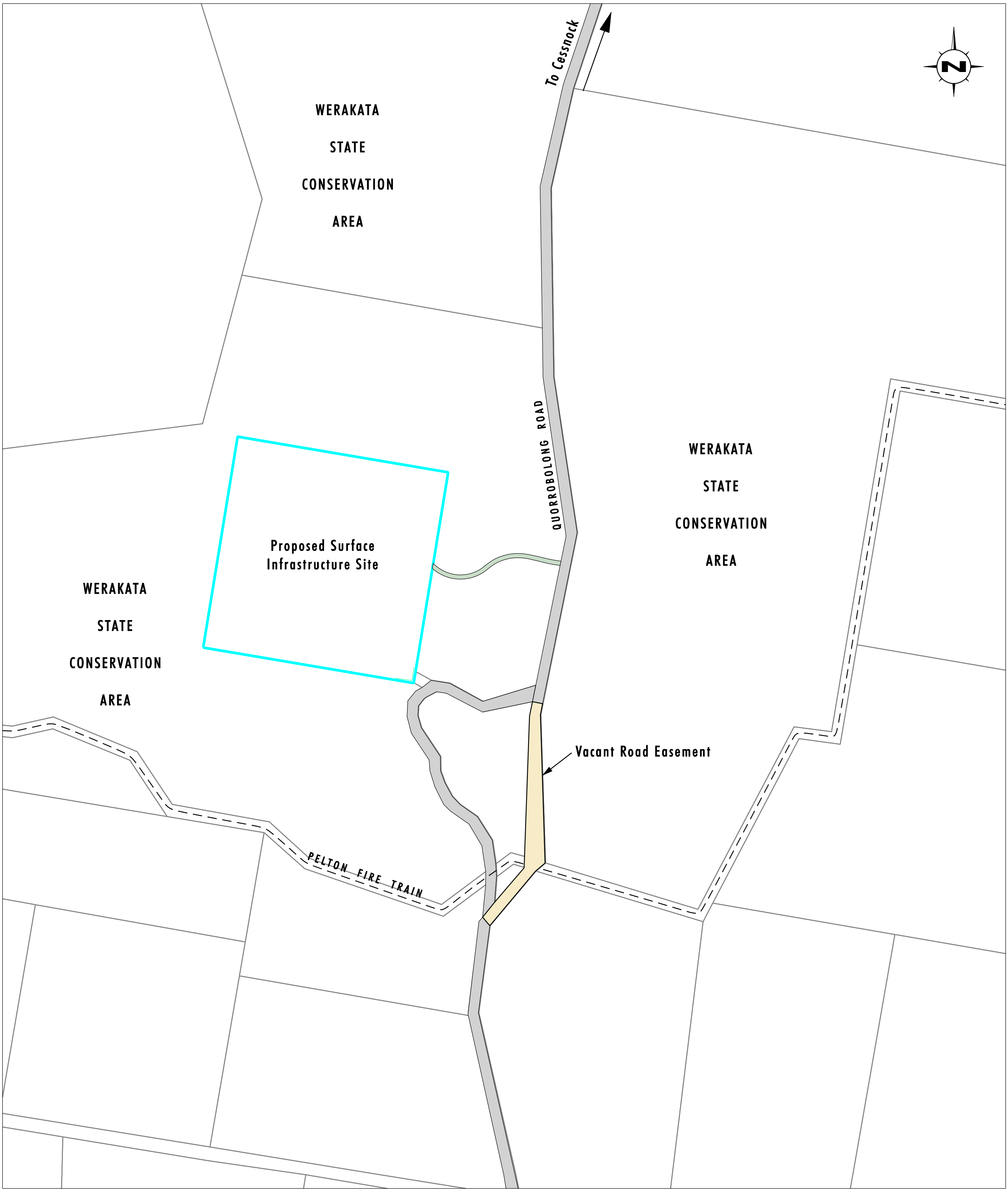

Source: Cadastre: LPI NSW, Surface Infrastructure Site: Austar Coal Mine

0 0 0 0
1:10 000

Legend
Proposed Access

FIGURE 1.4

Location of the Proposed Surface Infrastructure Site

File Name (A4): R10_V1/2274_094.dgn

The proposed conceptual mine plan for Stage 3 and the location of the proposed Surface Infrastructure Site are shown in **Figure 1.3**. The majority of the Stage 3 mining area is within the area approved under DA 29/95 and is within CML2.

Coal extracted from the Stage 3 area will be handled and processed utilising Austar's existing infrastructure and facilities (as detailed in **Section 2.3**) in accordance with the approved Austar *Mining Operations Plan 2008-2015* (MOP). This includes use of the existing underground conveyor system, Ellalong Drift and Pit Top Facilities, the overland conveyor system to Pelton CHPP, coal handling, preparation and stockpiling at Pelton CHPP, reject emplacement areas at Pelton CHPP and Aberdare Extended and the continued use of transport infrastructure including rail and road loading facilities and rail lines.

The continued use of LTCC technology in the Stage 3 area will provide for increased operational efficiency and the establishment of an integrated mining system that maximises the use of existing infrastructure and optimises resource extraction from the Greta Coal Seam.

Austar mine currently employs a workforce of around 200 people. It is estimated that at maximum production, the operation could employ a workforce of 275 people during the life of the Stage 3 Project.

A separate development consent is sought for the Stage 3 Project. The Stage 3 Project is a Major Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and will require the approval of the NSW Minister for Planning. This environmental assessment (EA) will accompany the development application to the NSW Minister for Planning and has been prepared in accordance with the Director-General's Requirements (DGRs) as set out in **Appendix 1**.

1.2 Project Justification

1.2.1 Social and Economic Benefits

Austar mine is the last coal mine in the Cessnock area, which was once dominated by underground coal mining. The high quality coal remaining in the mining area is a valuable community resource. The continuation and extension of the Austar mine will provide considerable social and economic benefits for the Cessnock area, the State of New South Wales and Australia.

The project is situated within a known coal reserve and is a logical continuation of an existing mine. Existing approved infrastructure will be utilised, which will ensure that coal production is achieved in an economic and energy efficient manner. It will also minimise the potential for environmental and community impacts associated with construction of substantial new infrastructure.

The project will provide a number of significant economic benefits to the state of NSW and Australia, including:

- continued employment of approximately 200 employees and contractors. When the mine reaches full production, up to 275 people will be employed with many more indirect jobs created through flow-on effects;
- economic recovery of approximately 3 Mtpa of export quality coal;
- payment of significant ongoing royalties to the State of NSW;

- significant ongoing export earnings for Australia through the export of approximately $5.6 billion of coal reserve; and

- significant ongoing economic benefits to the local community through local employment, purchase of goods and services, and local expenditure, both directly and through employee wages with an annual turnover of approximately $200 million in terms of local expenditure.

1.2.2 Ecologically Sustainable Development

The Cessnock area has a long history of underground mining, and related environmental impacts. Analysis indicates that the proposed Stage 3 coal resource can be extracted without having a significant impact on the ecology of the surrounding area. Consequently, the maximisation of the coal recovery by the extension of mining at Austar, the use of existing coal handling and processing infrastructure and the use of the high recovery LTCC method adheres to the principles of ecologically sustainable development.

The principle advantage of the LTCC mining method is that it allows for the optimal recovery of coal resource in the up to 7 metre thick Greta Coal Seam at depths of 400 to 750 metres below ground level. LTCC technology has the capacity to recover up to 85% of the coal resource located above the reach of conventional longwall technology. Prior to 2006, longwall equipment used at Austar mine was limited to an extraction height of 3.5 metres. In a panel by panel comparison, this would equate to a recovery of only 53.7% of resource that could otherwise be extracted by LTCC technology based on an average seam thickness of 6.5 metres. In achieving the increased level of recovery the LTCC method addresses a key principle of ecologically sustainable development that requires the optimising of the value of the recovery of natural resources.

1.3 Austar Coal Mine Pty Limited

As discussed in **Section 1.1**, Austar Coal Mine Pty Ltd is a subsidiary of Yancoal Australia Pty Limited (Yancoal). Yancoal is a subsidiary of Yanzhou Coal Mining Company Limited (Yanzhou) and is one of the largest coal mining companies in China. Yanzhou has significant experience in the application of LTCC technology in thick seam recovery and longwall mining in China, and has brought this technology and application to Australia.

1.4 Stage 3 Project Environment

1.4.1 Overview of Environmental Features

The majority of the Stage 3 area is located to the south of Broken Back Range a major landform extending from west of Pokolbin to Mulbring. The landform above the Stage 3 mining area is within the Quorrobolong Creek catchment area, with two tributaries of Quorrobolong Creek, Sandy Creek and Cony Creek running through the area. A small section of the proposed Stage 3 underground mining area is located in Black Creek catchment which is located to the north of Broken Back Range. The topography in the north of the Stage 3 area is characterised by the steep slopes, narrow ridges and deep gullies of the Broken Back Range, descending to undulating hills and alluvial flats in the central and southern portions of the Stage 3 area.

The climate of the region is classified as warm temperate, characterised by seasonal variations from hot wet summers to mild dry winters. Rainfall is summer dominant, often occurring as short duration high intensity storms, with an average of 800 to 950 millimetres of rain falling in the region per annum. A more detailed description of the environmental features of the proposed Stage 3 area is provided in **Sections 5** and **6**.

1.4.2 Land Ownership and Tenure

Land ownership within and proximate to the Stage 3 area is shown in **Figure 1.5**. As indicated on **Figure 1.5**, Austar owns the proposed Surface Infrastructure Site, while the Stage 3 longwall extraction area is primarily located beneath rural land holdings. The northern portion of the mine plan extends underneath the Werakata State Conservation Area and sections of Crown land, as well as an area of Austar owned land.

The dominant land uses within and adjacent to the project area include grazing, forestry and mining. The majority of the proposed underground mining area and proposed surface infrastructure is located within CML2 (refer to **Figure 1.1**). Land in the northern section of the mining lease forms part of the Werakata State Conservation Area. Land use in the south of the mining lease consists of rural cattle grazing and poultry production. The villages of Kitchener, Abernethy, Bellbird, Paxton, Pelton and Ellalong (refer to **Figure 1.1**) are located in proximity to the proposed Stage 3 mining area.

1.5 Environmental Assessment Team

This EA was prepared by Umwelt (Australia) Pty Limited on behalf of Austar with specialist input provided by the following organisations/specialists:

- Connell Wagner Pty Ltd — Groundwater Assessment
- Heggies (Australia) Pty Ltd — Noise & Vibration Assessment
- GHD Pty Ltd — Traffic Impact Assessment
- Mine Subsidence Engineering Consultants Pty Ltd — Mine Subsidence Impact Assessment
- Seedsman Geotechnics Pty Ltd — Peer Review of Subsidence Predictions

EA Statement of Authorship and a full listing of the project team members and their respective roles are provided in **Appendix 2**.

1.6 Environmental Assessment Structure

The EA has been conducted in accordance with the Director-General's Requirements (DGRs) issued in June 2008 for Application Number 08_0111, under Section 75F of the EP&A Act 1979. The DGRs which include the relevant government agency requirements are provided in **Appendix 1**.

The EA comprises a main text component and supporting studies, which include **Appendices 1** to **17**. An overview of the layout of the main text is presented in **Table 1.1** below.

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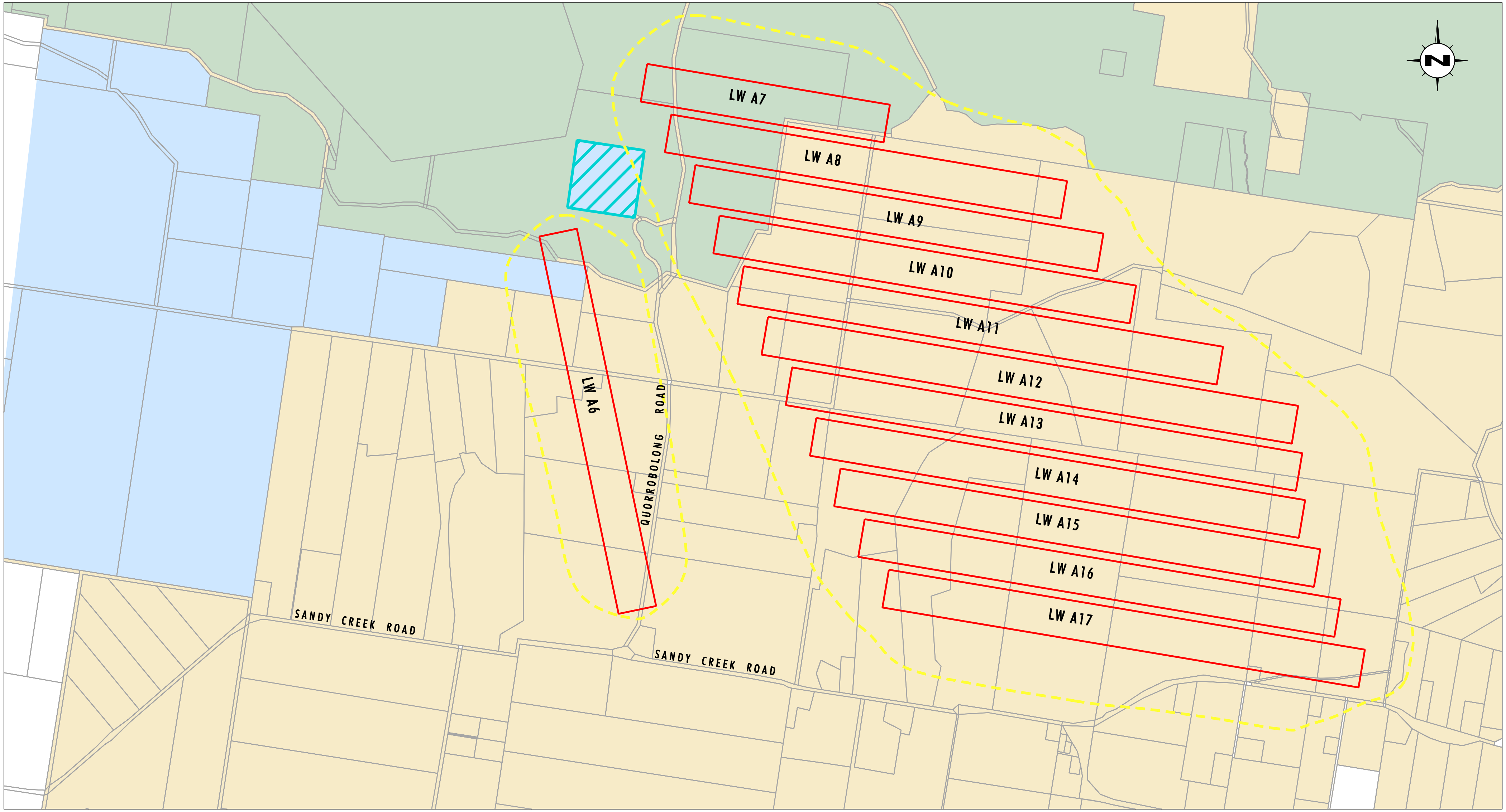

Source: Cadastre: LPI NSW, Land Ownership: Mineral Resources 2003, Longwall Layout: Austar Coal Mine

0 0.5 1 1.5km
1:32 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Austar Owned Land
- Werakata State Conservation Area / Crown Land
- Privately Owned Land

FIGURE 1.5

Land Ownership

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Table 1.1 – Environmental Assessment Structure

EA Section	Environmental Assessment Details
Executive Summary	Executive Summary.
Section 1	A summary of the existing Austar operations, a general overview of the Project, key project components, the Project proponent. A Stage 3 site context, indication of the environmental assessment (EA) team and structure is also provided with an overview of the approval process, authority consultation and project timing.
Section 2	Description of the existing Austar operations and the approvals for the current approved mining operations and pre-Austar mine operations including a review of the current water management, coal processing and transportation, reject and tailings management, site infrastructure and workforce and hours of operation at the Austar Mine Complex.
Section 3	Austar Stage 3 Project description including a summary of the proposed underground mining development and operations, the resource description, workforce and hours of operation and proposed development and operations at the Surface Infrastructure Site.
Section 4	Detailed assessment of the current planning context, the Commonwealth and State legislation, State Environmental Planning Policies, the Draft Lower Hunter and Regional Strategy and the Cessnock Shire Local Environment Plan.
Section 5	Description of the environmental context and risk analysis for the proposal and potential environmental risks that need to be considered in planning and assessing the project
Section 6	The Environmental Assessment and management for the proposed Stage 3 mining area including subsidence, surface water and drainage, groundwater, noise, air quality, ecology, heritage, greenhouse gas and energy, socio-economic aspects.
Section 7	The Environmental Assessment and management for the proposed Surface Infrastructure Site including construction phase, surface water and drainage, noise, air quality, ecology, heritage, greenhouse gas and energy assessment, socio-economic assessment, visual amenity, traffic and transport and Surface Infrastructure Site decommissioning.
Section 8	Statement of Commitments from Austar for Stage 3.
Section 9	A detailed overview and justification of the Project including environmental impacts, site suitability, project alternatives, the need for the Project, benefits of the Project and ecologically sustainable development.
Section 10	References.

2.0 Description of Existing Mine Operations

2.1 Mine History

Austar Coal Mine is an amalgamation of several older mines and operates within a number of mining leases under 12 separate development consents issued by Cessnock City Council between 1974 and 2002 and development consent DA 29/95 granted by the NSW Minister for Urban Affairs and Planning in 1996 and was modified in 2008 to provide for LTCC mining in Stage 2 area. A full listing and description of current operations and the various consent and approvals under which the mine operates is provided in **Appendix 3**.

Austar mine and its associated infrastructure has a long and productive history. A chronology of mining within the Greta Coal Seam at the site and related activities is presented in **Table 2.1**. The locations of previous underground workings in the area are shown on **Figure 2.1**. The location of infrastructure currently used in the handling and processing of coal from the Austar is shown on **Figure 1.2**. Mining leases currently held by Austar are shown in **Figure 2.2** and listed in **Appendix 3**.

Table 2.1 – History of Mining Activities at Austar Coal Mine

Year	Historical Details
1916	Underground mining commenced at Pelton Colliery.
1918	The Pelton Railway was constructed in 1918.
1921	Underground mining commenced at Cessnock No. 1 (Kalingo) Colliery
1960/1961	Pelton CHPP constructed.
1961	Underground mining ceased at Cessnock No. 1 Colliery.
Late 1960s	Cessnock No. 1 Colliery amalgamated into Pelton Colliery.
1978	Underground mining commenced at Ellalong Colliery with coal being delivered by overland conveyor to the coal preparation plant, raw and washed coal handling systems and train loading facilities at Pelton Colliery.
1983	Longwall production commenced at Ellalong Colliery.
1992	Underground mining ceased at Pelton Colliery.
1994	High levels of gas (primarily carbon dioxide) encountered in the underground workings at Ellalong Colliery, preventing further mining of additional seams to the south-east.
1995	Pelton Open Cut Coal Mine established.
1996	DA 29/95 approved by the Minister for Urban Affairs and Planning and underground operations from the Ellalong Colliery extended into the Bellbird South Colliery area.
1998	Ellalong and Pelton Collieries amalgamated with Bellbird South Colliery and re-named Southland Colliery.
2003	Spontaneous combustion event resulting in a fire in the underground workings in Bellbird South. Mine placed in 'care-and-maintenance' for approximately 18 months.
2004	Yancoal purchased Southland Colliery and changed the name to Austar Coal Mine.
2005	Austar recommenced underground mining in the former Bellbird South Colliery area.
2006	DA 29/95 modified to allow Austar to commence underground mining using LTCC technology in the Stage 1 area.
2008	DA 29/95 modified to allow Austar to commence underground mining using LTCC technology in the Stage 2 area.

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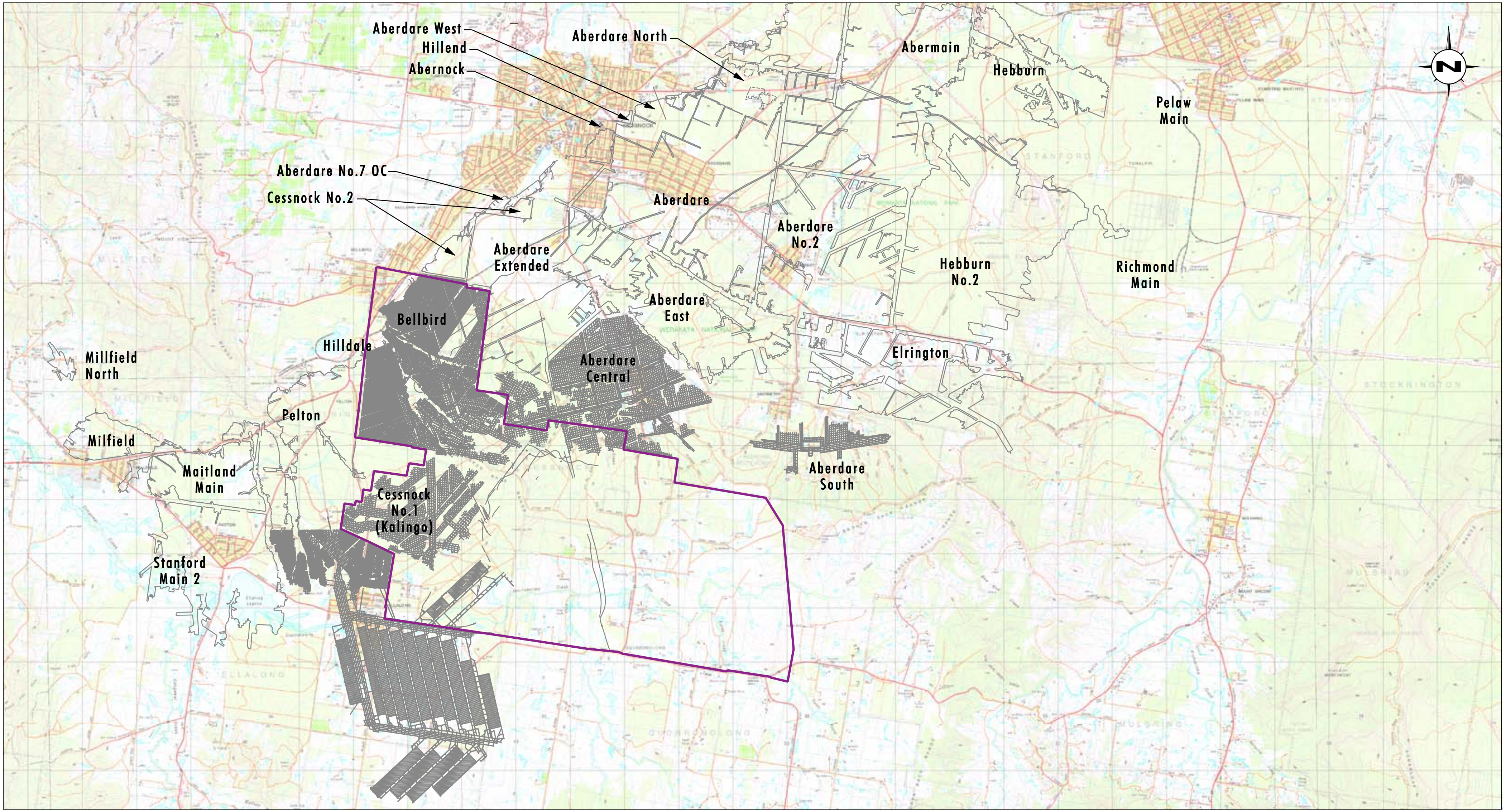

Source: Topo Maps: LPI NSW, Mine Workings: Austar Coal Mine

0 1.25 2.5 5km
1:100 000

Legend

Consolidated Mining Lease (CML) 2
Previous Underground Workings

FIGURE 2.1

Previous Underground Workings

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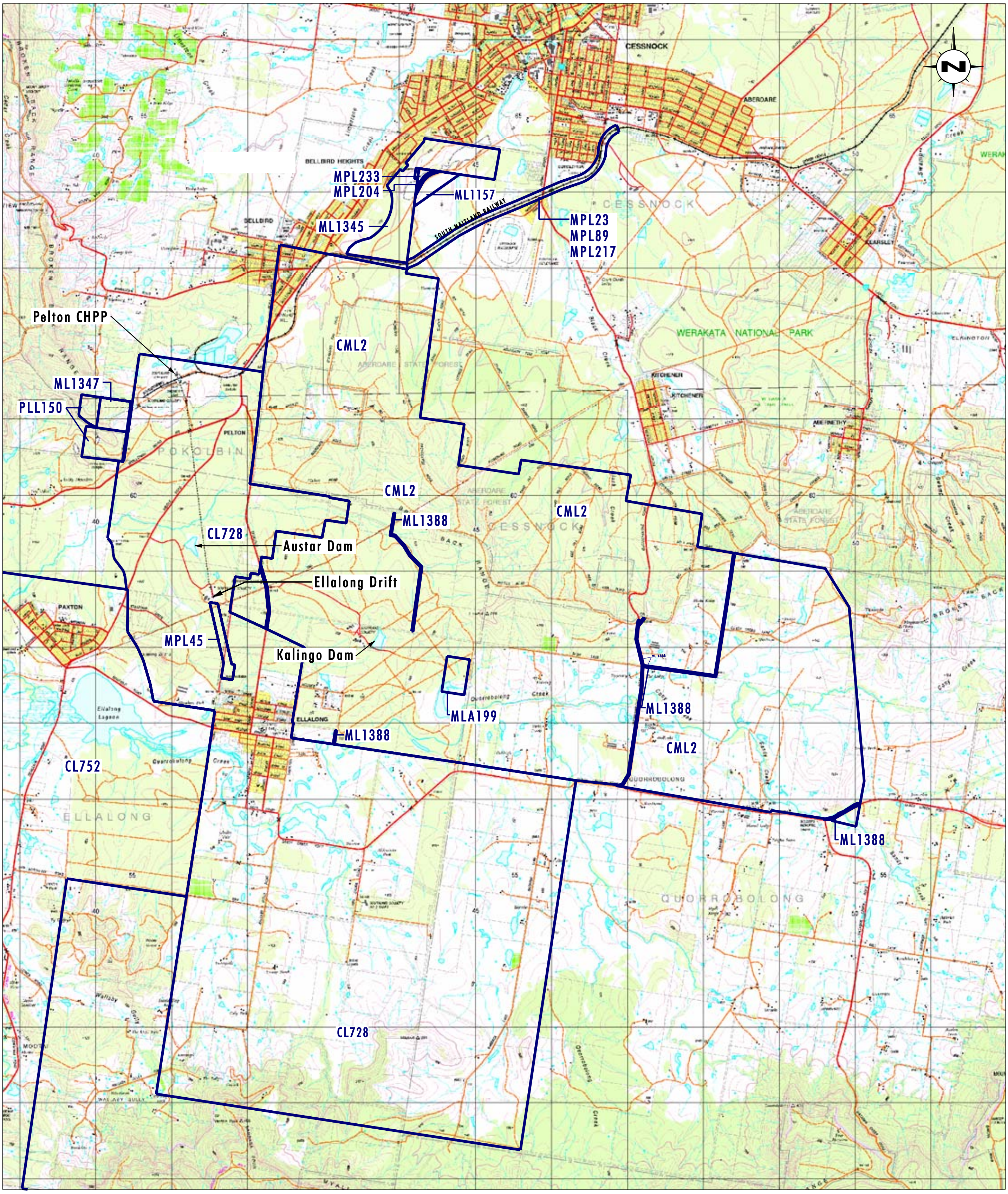


Source: Topo Maps: LPI NSW, Mine Leases: Austar Coal Mine

0 1 2 3km
1:70 000

Legend

Mining Leases

FIGURE 2.2

Existing Austar Mining Leases

As set out in **Table 2.1**, underground mining commenced at Pelton Colliery in 1916. Pelton CHPP was constructed in about 1960/1961 for the washing of Pelton Colliery coal. No development consent or other planning approval for the initial construction of Pelton Colliery or the Pelton CHPP has been located. As Pelton Colliery was commenced in 1916 and the CHPP was constructed in 1960-61 before the commencement of planning controls in all likelihood no planning approval for the initial construction exists or was required. Pelton Colliery was amalgamated with the neighbouring Cessnock No.1 Colliery in the late 1960s.

In 1975 development consent for Ellalong Colliery was granted under Part X11 of the *Local Government Act 1919* and the mine was officially opened in July 1979. The 1975 development consent envisaged that coal from Ellalong Colliery would be transported by conveyor from the Ellalong Drift and Pit Top to Pelton CHPP. Longwall production commenced at Ellalong Colliery in 1983.

In early 1994 high gas levels were encountered in the southern part of Ellalong Colliery. In 1996 development consent (DA 29/95) was granted by the Minister for Urban Affairs and Planning to extend Ellalong Colliery to the north-east into the Bellbird South area to allow development in an area not affected by high levels of coal seam gas.

The Minister for Urban Affairs and Planning granted development consent (DA 29/95) for mining within CML2 by conventional retreat longwall mining to produce up to 3 Mtpa of product coal with an approved extraction height of up to 4.5 metres. Approximately 98 Mt of coal was identified in the approved Bellbird South Colliery Extension. The approved mining area that formed part of DA 29/95 is shown in **Figure 2.3**.

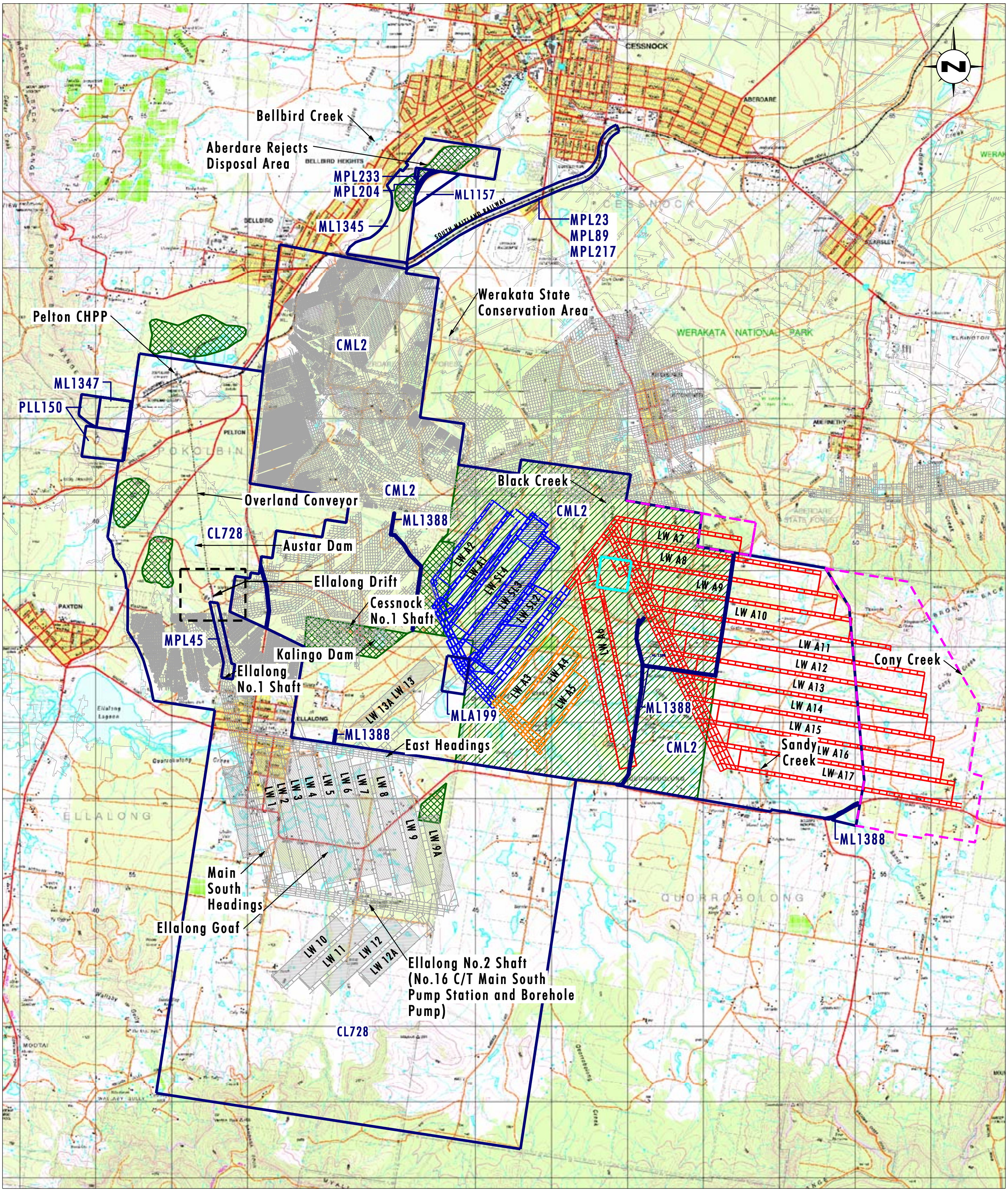
The key activities that were approved under the 1996 consent include:

- mining of up to 3 Mt of product coal per annum within CML2 (refer to **Figure 1.2**);
- transfer of the coal by underground conveyor to the surface;
- washing and preparation of coal at Pelton CHPP;
- stockpiling of raw and washed coal at Pelton CHPP;
- reject emplacement in accordance with the Austar MOP;
- transport of 3 Mtpa of product coal by rail to the Port of Newcastle; and
- transport of up to 60,000 tonnes per annum of specialty coal product by road.

In 1998 Southland Coal Pty Limited acquired Ellalong and Pelton Collieries and amalgamated them with Bellbird South Colliery. Ellalong, Pelton and Bellbird South Collieries became known as the Southland Colliery. Southland Colliery was operated until 2003 when fire broke out in the underground workings. Subsequently, the mine was placed into receivership and operations were placed on care and maintenance.

Southland Colliery and its associated infrastructure was acquired by Yancoal in December 2004 and was renamed Austar Coal Mine.

Mining proceeded in the reconfigured Stage 1 area (consisting of Longwalls A1 and A2 as shown on **Figure 1.2**) following a modification of the 1996 Minister's Consent to allow for the extraction of coal to a height of 6.5 metres using LTCC technology. A further section 96 Modification (Stage 2) has been approved by the Minister of Planning to allow LTCC



Source: Topo Maps: LPI NSW, Longwall Layouts: Austar Coal Mine

Legend

- Layout for Stage 1 Longwall Panels
- Layout for Stage 2 Longwall Panels
- Conceptual Layout for Stage 3 Longwall Panels
- Surface Infrastructure Site
- Proposed Stage 3 Extension Boundary
- Old Workings
- Mining Leases
- Surface Application Area (DA 29/95)
- Subsurface Application Area (DA 29/95)

FIGURE 2.3

Mining Area Approved under DA 29/95

extraction of Longwall panels A3 to A5 in Stage 2 (see **Figure 2.2**). Extraction of coal using LTCC technology is currently occurring in Longwall A2 within the Stage 1 area.

The Austar Mine Complex is located south of the old Aberdare Extended, Cessnock No.2 and Bellbird mine workings (refer to **Figure 2.1**) and works within the parameters of the Austar MOP using established infrastructure (refer to **Figure 1.2**). The Abermain No.2, Hebburn No. 2 and Elrington mine workings are all located north-east of Austar, whilst the Maitland Main and Stanford Main workings are located to the west (refer to **Figure 2.1**).

2.2 Current Operations, Consents and Approvals

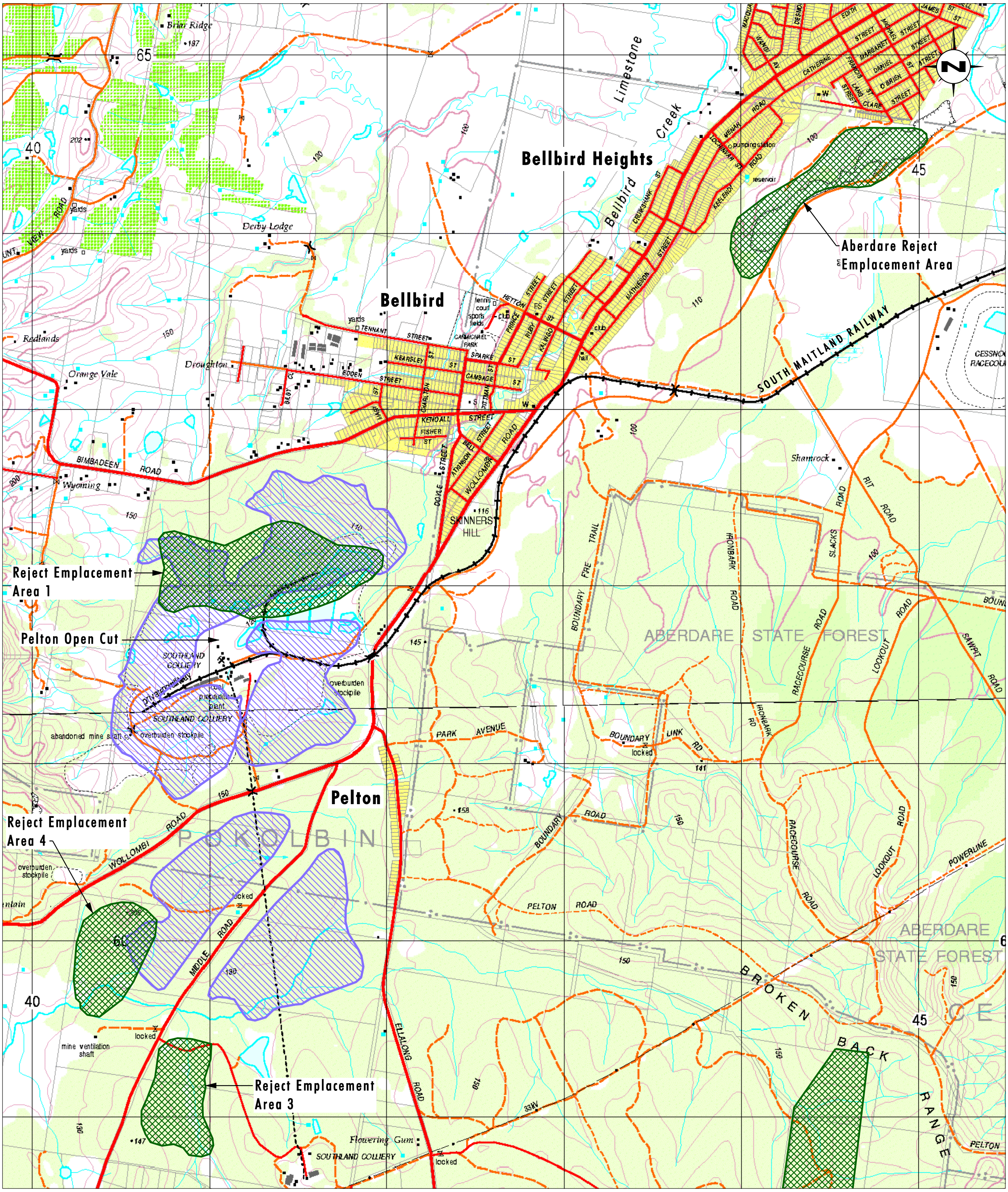
Coal from Austar Coal Mine is bought to the surface at the Ellalong Drift and Pit Top via an underground conveyor through the Ellalong East Headings. Coal is then conveyed to the Pelton CHPP via an overland conveyor system, processed and handled at Pelton CHPP and railed to the Port of Newcastle via Austar Rail Line, the South Maitland Railway and the Main Northern Rail Line. Up to 60,000 tonnes of specialty coal product is also transported by road from Pelton CHPP.

Reject from Pelton CHPP is emplaced at approved emplacement areas at Pelton CHPP and Aberdare Extended. The location of current project emplacement areas is shown on **Figure 1.2**. Additional approved reject emplacement areas are shown on **Figure 2.4**.

Full details of Austar's current operations are provided in **Appendix 3**. A summary of current operations is provided in **Table 2.2**.

Table 2.2 – Summary of Approved Operations

	Approved Operations
Approved Production	Production of 3 Mtpa of coal per year
Operating Hours	24 hours, 7 days per week
Number of Employees	200 to 275
Mining Methods	Conventional retreat long wall mining and LTCC
Infrastructure	• Drift sites at Ellalong and Pelton Collieries; • CHPP at Pelton; • Overland conveyor from Ellalong to Pelton CHPP; • Rail loading facility and rail spur adjacent to Pelton Colliery; • Various ventilation and access shafts – (including Ellalong No.1 Shaft, Ellalong No.2 Shaft, an upcast ventilation fan at Shaft No. 3 and Downcast at Shaft No. 4 both located at the Kalingo infrastructure site) (refer to **Figure 1.2**); • Offices and amenity buildings at Ellalong and Pelton Collieries, No. 1 and No. 2 shafts; • Water management systems including: drains, diversion banks, sedimentation, treatment and clean water dams, lime treatment plant and water treatment plant; • Electrical sub-stations and compressors; • Nitrogen inertisation plant; and • Diesel and emulsion fluid storage area and dispatch system.
Coal Processing	All coal is processed at the Pelton CHPP which has a nameplate capacity of 600 tonnes per hour. The plant currently processes up to approximately 520 tonnes per hour giving it a functional production capacity of approximately 4.2 million tonnes per year.



Source: Topo Maps: LPI NSW

0 0.5 1.0 1.5km
1:30 000

Legend

- Reject Emplacement Area (DA 29/95)
- Reject Emplacement Area (DA 74/75/79)

FIGURE 2.4

Reject Emplacement Areas

Table 2.2 – Summary of Approved Operations (cont)

	Approved Operations
Tailings and Reject Management	Reject and tailings are emplaced at the disused Aberdare Extended Open Cut voids, and at Pelton Colliery in approved areas shown in **Figure 1.2**. As shown on **Figure 2.4**, additional reject emplacement areas have development consent and may be utilised if required.
External Coal Transport	Product coal can be transported by rail to the Port of Newcastle at a rate of up to 3.0 Mtpa (using up to 6 trains per day). Up to 60,000 tonnes per annum can be transported by road.
Underground Access	Main mine entrance is at the Ellalong Drift and Pit Top, Middle Road, which runs off Wollombi Road.

Since purchasing the mine in 2005, Austar has been implementing a program of continuous improvement for its operations. This program is being undertaken principally through the ongoing development and review of the Austar:

- Mining Operations Plan (MOP);
- Site Water Management Plan (SWMP);
- Voluntary Pollution Reduction Program (PRP) that is being implemented as part of Environment Protection Licence (EPL) 416; and
- Environmental Monitoring Program (EMP).

Details of these Plans and Programs are provided in **Section 2.3.**

2.3 Environmental Management of Existing Operations

The environmental management of existing operations at Austar mine is undertaken within the framework of the Austar MOP, a suite of environmental management and monitoring plans including the Site Water Management Plan, and the Environment Protection Licence for the mine (EPL 416). This section provides an overview of the environmental management framework at Austar mine and its current environmental performance.

2.3.1 Austar Mining Operations Plan

All aspects of current Austar operations, including environmental management and rehabilitation, are managed in accordance with the current Austar MOP, which was approved by the Department of Primary Industries (DPI) in May 2008. The current MOP covers all mining operations at Austar over a seven year period from 2008 to 2015. The MOP encompasses all mining activities within Austar's mining leases including:

- underground mining;
- activities at Ellalong Drift and Pit Top;
- overland transport of ROM coal from Ellalong Drift to Pelton CHPP;
- processing and handling of coal at Pelton CHPP;
- reject management and emplacement activities;

- water management;
- use and management of Austar's remote infrastructure sites (No. 1, 2, 3 and 4 shafts and the Kalingo site); and
- rehabilitation activities.

Review and reporting of Austar's performance against the MOP is provided through Annual Environmental Management Reports (AEMR) and DPI inspections.

2.3.1.1 Coal Reject Management

The Austar MOP provides the framework for the management of coal reject from Pelton CHPP for the life of Austar mine. In accordance with the MOP, fine coal tailings from Pelton CHPP are discharged into underground workings while coarse rejects are emplaced at three approved reject emplacement areas (refer to **Figure 1.2**). There is sufficient capacity within the existing reject emplacement areas shown on **Figure 1.2** to accommodate all coarse reject from Stage 1, Stage 2 and the Stage 3 Project.

In addition to the existing reject emplacement areas, Austar has planning consent to construct and use additional reject emplacement areas to the south of Wollombi Road and to the east of Middle Road (refer to **Figure 2.4**) under DA 74/75/79 and DA 29/95. The approved reject emplacement areas at Austar have a total capacity of approximately 17.5 Mt. While it is not proposed to utilise approved reject emplacement areas to the south of Wollombi Road or to the east of Middle Road, significant additional reject emplacement capacity is available should the need for additional reject emplacement areas arise. Analysis indicates that a life of mine coarse reject capacity of approximately 3.6 Mt will be required. Analysis indicates that approximately 5.5 Mt of reject emplacement capacity is available within the existing three reject emplacement areas (see **Figure 1.2**).

2.3.1.2 Rehabilitation

Rehabilitation Activities

Rehabilitation activities at Austar mine are undertaken in accordance with the Austar MOP. The Austar MOP sets out rehabilitation activities to be undertaken during the seven year period from 2008 to 2015 and provides final rehabilitated landforms for Pelton CHPP, reject emplacement areas, Ellalong Drift and Pit Top and the remote infrastructure sites. Rehabilitation at the end of mine life will be undertaken in accordance with the provisions of the Austar MOP.

Final Land Use Strategy

The final land use plans for life of mine operations have been developed for the three reject emplacement areas and surface infrastructure areas shown on **Figure 1.2** as part of the MOP (Austar 2008). These plans have been developed to be consistent with land use strategies for the surrounding areas.

2.3.2 Environmental Management and Monitoring

Current environmental management and monitoring plans for Austar mine provide a methodical and integrated approach to fulfilling Austar's environmental objectives and ensure the ongoing management of the site in accordance with the principles of ecologically sustainable development. The existing plans include:

- Environmental Management Strategy;
- Environmental Monitoring Program;
- Subsidence Management Plans for the Stage 1 and Stage 2 areas;
- Vibration Monitoring Plan;
- Air Quality Monitoring Plan;
- Noise Monitoring Program ; and
- Site Water Management Plan.

Austar's environmental management plans have been prepared in accordance with the conditions of DA 29/95 to the satisfaction of the Director-General of Planning.

A summary of environmental management and monitoring activities relating to air quality, noise and water undertaken at Austar mine is provided in **Sections 2.3.2.1** to **2.3.2.3** below.

2.3.2.1 Air Quality Management and Monitoring

In accordance with the Air Quality Management and Monitoring Plan, Austar operates five dust depositional dust gauges and two high volume air samplers (HVAS), which measure PM_{10}. Results from the dust gauges and HVAS during 2007 and 2008 demonstrate compliance with the ambient air quality goals set out in DA 29/95.

2.3.2.2 Noise Monitoring

Quarterly noise monitoring is undertaken at three locations surrounding Pelton CHPP in accordance with EPL 416 (refer to **Section 2.3.3**) and at two locations in proximity to No. 3 and 4 Shafts in accordance with DA 29/95. Noise monitoring is undertaken within the framework set out in Austar's approved Noise Monitoring Program.

Noise monitoring undertaken in 2007 and 2008 has indicated compliance with Austar's project specific criteria at monitoring locations near Pelton CHPP and No 3 and 4 Shafts. However, community complaints relating to noise from Pelton CHPP have indicated that further investigation of noise impacts from Pelton CHPP is warranted. A program of directed noise studies has been undertaken by Austar in response to community complaints, and more recently Austar has entered into a Noise Pollution Reduction Program for Pelton CHPP. These initiatives are a part of Austar's program of continuous environmental improvement.

2.3.2.3 Site Water Management

Austar has prepared a Site Water Management Plan (SWMP) for its current operations in accordance with the requirements of Conditions 11 to 16 of DA 29/95. The SWMP details the water management system in place at Austar mine with the aim of ensuring that the mining operation does not result in unacceptable impacts on water quality in the area. The SWMP was prepared in 2007 for Stage 1 operations and was updated for the Stage 2 area in 2008. The SWMP has been instrumental in facilitating continuous environmental improvement in terms of water management at Austar mine.

The water management system at Austar mine comprises three main components being the underground surface water management system, surface water storage systems and Pelton CHPP water management system. Details of these systems are provided in **Appendix 3**. The locations of the main components of Austar's water management infrastructure are shown on **Figure 1.2**. The water management system at Pelton CHPP is shown on **Figure 2.5**.

Monthly monitoring of surface water quality is undertaken at six surface water monitoring locations at Pelton CHPP in accordance with EPL 416. Monitoring undertaken during 2007 and 2008 indicated two exceedences of water quality monitoring criteria at the clean water licensed discharge point into Bellbird Creek. An investigation undertaken by Austar personnel indicated that the permeate tank which received clean water from the water treatment system was undersized, meaning that the water treatment system did not produce a consistent quality of clean water for discharge to Bellbird Creek.

In response to the exceedences, the permeate system was upgraded in April 2008 to a two stage permeate tank system with a significantly larger storage and mixing capacity. Water quality monitoring results from May 2008 indicate that the new permeate system is performing appropriately.

An unlicensed discharge event occurred at Austar mine during severe storms on the June 2007 long weekend. A total of 196 mm of rainfall was recorded at the site in a 36 hour period. This coincided with a power outage which stopped pumps used to manage water and as a result an unlicensed discharge from Austar Dam occurred. As a result of this discharge event Austar reviewed its site water management plan to ensure that additional capacity is available within storage dams to cope with runoff associated with severe storm events.

2.3.3 Environment Protection Licence

Austar holds an Environmental Protection Licence (EPL 416) for its operations. EPL 416 was granted 7 May 2002 and is reviewed annually. The EPL includes provisions for the discharge of water from Pelton CHPP (refer to **Section 2.3.2.3**), surface water monitoring at Pelton CHPP (refer to **Section 2.3.2.3**) and noise limits surrounding Pelton CHPP (refer to **Section 2.3.2.2**). An annual return for EPL 416, including a statement of compliance and a summary of environmental monitoring and complaints is submitted to the Department of Environment and Climate Change (DECC) at the end of each reporting period.

2.3.3.1 Community Complaints

In accordance with the requirements of EPL 416, Austar maintains a 24-hour telephone complaints line (number is 1800 701 986). Complaints received on the complaints line have been largely related to noise from Pelton CHPP and have been generally from residents to the north and west of the CHPP. Complaints are investigated and addressed by Austar as they are received.

Since acquiring the mine and associated surface infrastructure, Austar has been investigating the potential noise sources that have been the subject of community complaints through two directed noise studies and quarterly noise monitoring in accordance with EPL 416. These studies have formed a part of Austar's program of continuing environmental improvement. As a result of the first of these studies, Austar replaced a Caterpillar bulldozer

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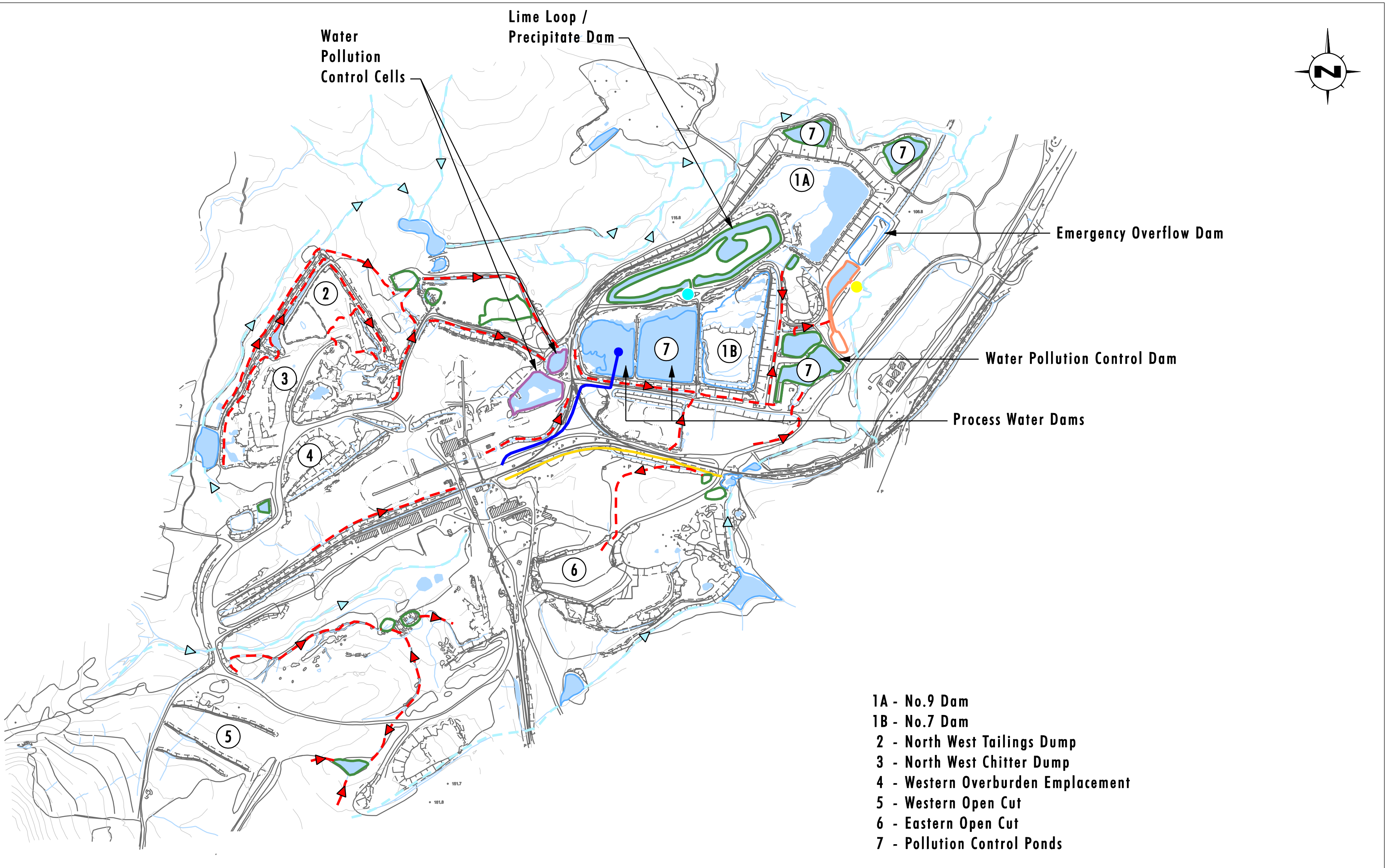

Source: Southland Colliery / Geospectrum 1998, Adapted from Figure 4, 2005 Austar MOP
Note: Contour Interval 5m

Legend

- Licensed Discharge Point
- Lime Dosing Plant
- Clean Water Dam
- Clean Water Flow
- Contaminated Water Dam
- Contaminated Water Flow
- Discharge Channel
- Emergency Dam
- Pipeline
- Pollution Control Dam

FIGURE 2.5

Current Water Management System Pelton CHPP

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which was found to have noisy tracks with a Komatsu to reduce track noise when the bulldozer is operating on coal stockpiles. This bulldozer was chosen following noise tests which demonstrated that track noise during operation was significantly quieter than the Caterpillar. Subsequent to noise complaints received in December 2007, Austar contracted Komatsu to assess the bulldozer noise emissions. Subsequent investigations have also been undertaken to investigate what additional noise reduction measures can be implemented to further quieten the Komatsu bulldozer.

Austar has also implemented a Driving Policy to prevent excessive noise when operating the Komatsu bulldozer. The Policy includes the limiting of reversing speed and instructing operators to reverse in first gear only. Additionally, Austar has implemented a stockpile management procedure in order to provide greater night time noise shielding between the bulldozer and residents to the west of Pelton CHPP.

2.3.3.2 Voluntary Noise Pollution Reduction Program

In response to noise complaints regarding Pelton CHPP and as a part of Austar's continuous environmental improvement program, Austar has entered into a Voluntary Noise Pollution Reduction Program (Noise PRP) for Pelton CHPP in accordance with Section 10 of the DECC *Industrial Noise Policy 2000* (INP). The Noise PRP is a staged program aimed at progressively improving the noise performance of the CHPP. EPL 416 has been amended to include the first stages of the Noise PRP.

2.4 Coal Transport

2.4.1 Rail Transport

The majority of coal from Pelton CHPP is transported by rail to the Port of Newcastle for export overseas via the Austar Railway Line, the South Maitland Railway Line and the Main Northern Railway. Austar has approval to transport up to 3 Mtpa of coal per year by rail (ERM, 2006). Coal is loaded on a 24 hours per day, 7 days per week basis. Normally the coal is transported in a 4-locomotive configuration, carrying approximately 2200 tonnes of coal freight per trip. The system has capacity to load and despatch up to eight trains per day.

2.4.2 Road Transport

Austar Coal Mine transports up to 60,000 tonnes per year of coal product and coal fines by road to markets that are not currently practical to service using rail. This includes small coal loading facilities at the Port of Newcastle that service ships that can not be loaded by Port Waratah Coal Services and some specialist end users that require special sized coal that needs to be transported by road to protect the sizing integrity. Coal is also transported by road to end users who require coal to be transported by road owing to location and/or facility constraints. Historically small amounts of coal fines that have restricted markets to which they can be supplied (i.e. power stations) have also been transported by road from the mine.

Road haulage of coal is undertaken Monday to Friday between the hours of 6.00 am and 5.00 pm. No road haulage is undertaken on weekends or Public Holidays.

Transport of 60,000 tonnes of coal product per year by road requires an average of approximately 48 laden truck movements per week for 50 weeks of the year if the coal was transported on a continuous basis.

3.0 Project Description

As stated in **Section 1.1**, Austar is seeking approval to extend underground mining into the Stage 3 area using LTCC technology. The Stage 3 Project consists of two components:

- longwall extraction of coal from longwall panels A6 to A17 using LTCC technology; and
- the construction and operation of new Surface Infrastructure facilities and access road to be constructed off Quorrobolong Road, south-west of Kitchener.

The proposed conceptual mine plan for Stage 3 and the location of the proposed Surface Infrastructure Site are shown in **Figure 1.2**. The majority of the Stage 3 mining area is within the area approved under DA 29/95 and is within Consolidated Mining Lease 2 (CML2).

Coal from the Stage 3 Project will be handled and processed utilising existing infrastructure and facilities (as detailed in **Section 2** and **Appendix 3**). Approval for the Project is sought by early 2009 which will allow for the construction of the new ventilation upcast shaft to commence in operational support of LTCC longwall mining beyond 2010.

3.1 Underground Mining

The key features of the underground mining component of the Stage 3 Project are as follows:

- longwall extraction of panels A6 to A17 in the Greta Seam using LTCC technology;
- extraction of coal in longwall panels to a maximum height of 7 metres; and
- mining at a rate to produce a maximum of 3 Mtpa of product coal over a mine life of approximately 21 years. This will involve mining up to 3.6 Mtpa of ROM coal.

3.1.1 Geology and Resources

3.1.1.1 Geological Setting

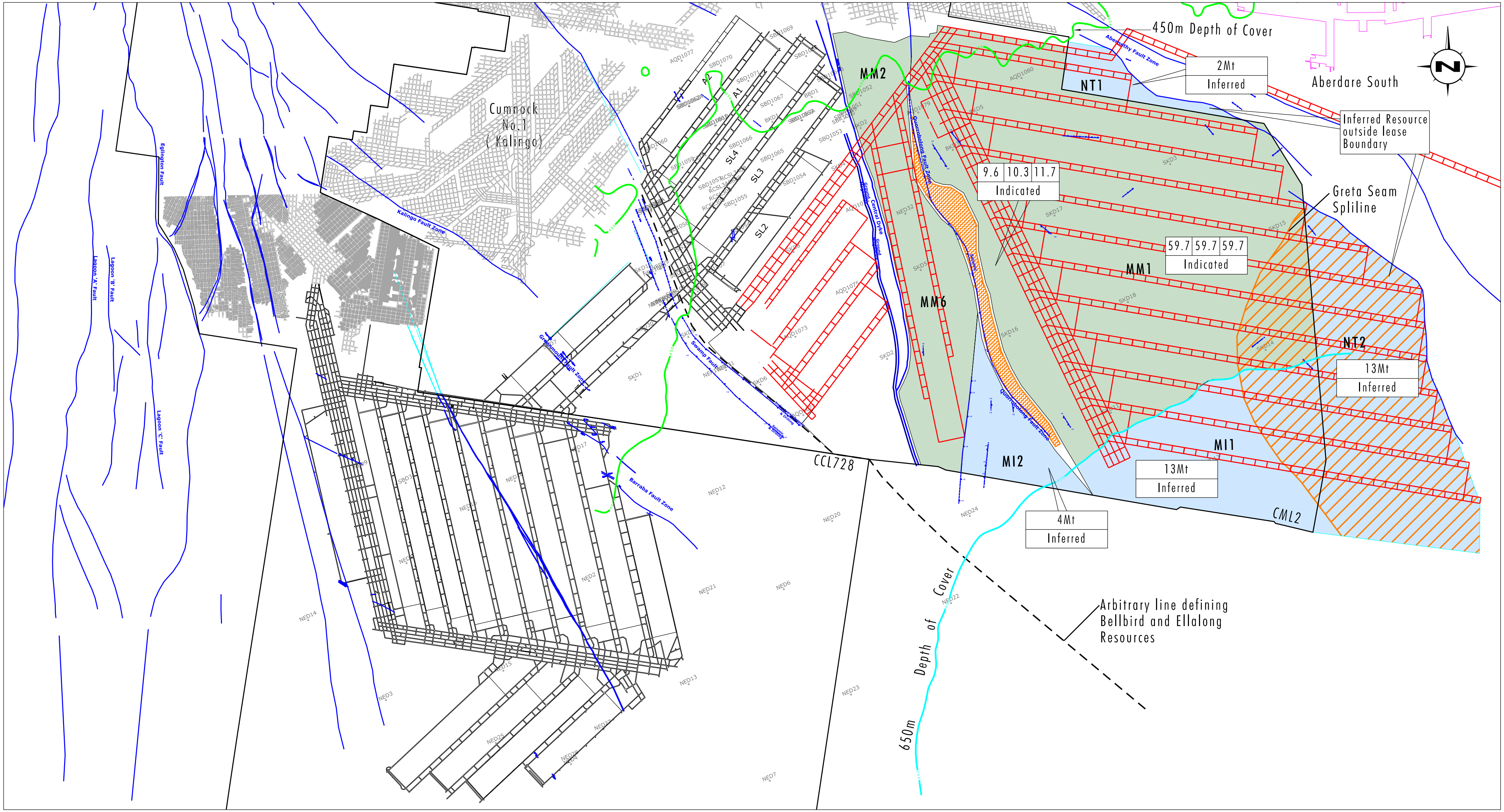
The Stage 3 underground mining area is located in the Greta Coal Seam in the South Maitland Coalfields. The Greta Coal Seam generally dips to the south-east at about 1 in 15. Within CML2, the seam dips at 1 in 13 to 1 in 16 to the east and south-east, with local dips in the south-eastern corner of 1 in 6.5 to the east and 1 in 8 to the north.

The Greta Coal Seam is a stratigraphic unit of the Greta Coal Measures, occurring at depths within the proposed Stage 3 mining area of approximately 400 to 740 metres, with marine sandstones and siltstones of the Maitland Group extending from coal measures to the surface. Coal resources are shown on **Figure 3.1**. The depth to the coal seam across the proposed Stage 3 mining area is shown on **Figure 3.2**. This thickness range is suited to support high productivity from LTCC operations and allows management of coal quality and mining conditions.

3.1.1.2 Resource Exploration and Drilling

Austar has established a conceptual plan for exploration drilling that compliments the existing exploration boreholes in the area. A new exploration program of one cored and nine non-cored holes with core tails was undertaken over the proposed Stage 3 area in January 2007 and is ongoing.

Umwelt
Environmental Consultants



Source: Austar Coal Mine

0 0.5 1 2km
1:45 000

Legend

- Indicative Resource (full seam)
- Inferred Resource (full seam)
- Overburden thickness to Greta Seam
- Fault zone Interpreted by Andrew Knight and John Saunders (IGEC)
- Greta seam splits east of splitline. Coal resources have been estimated for upper portion only

FIGURE 3.1

Stage 3 Coal Resources

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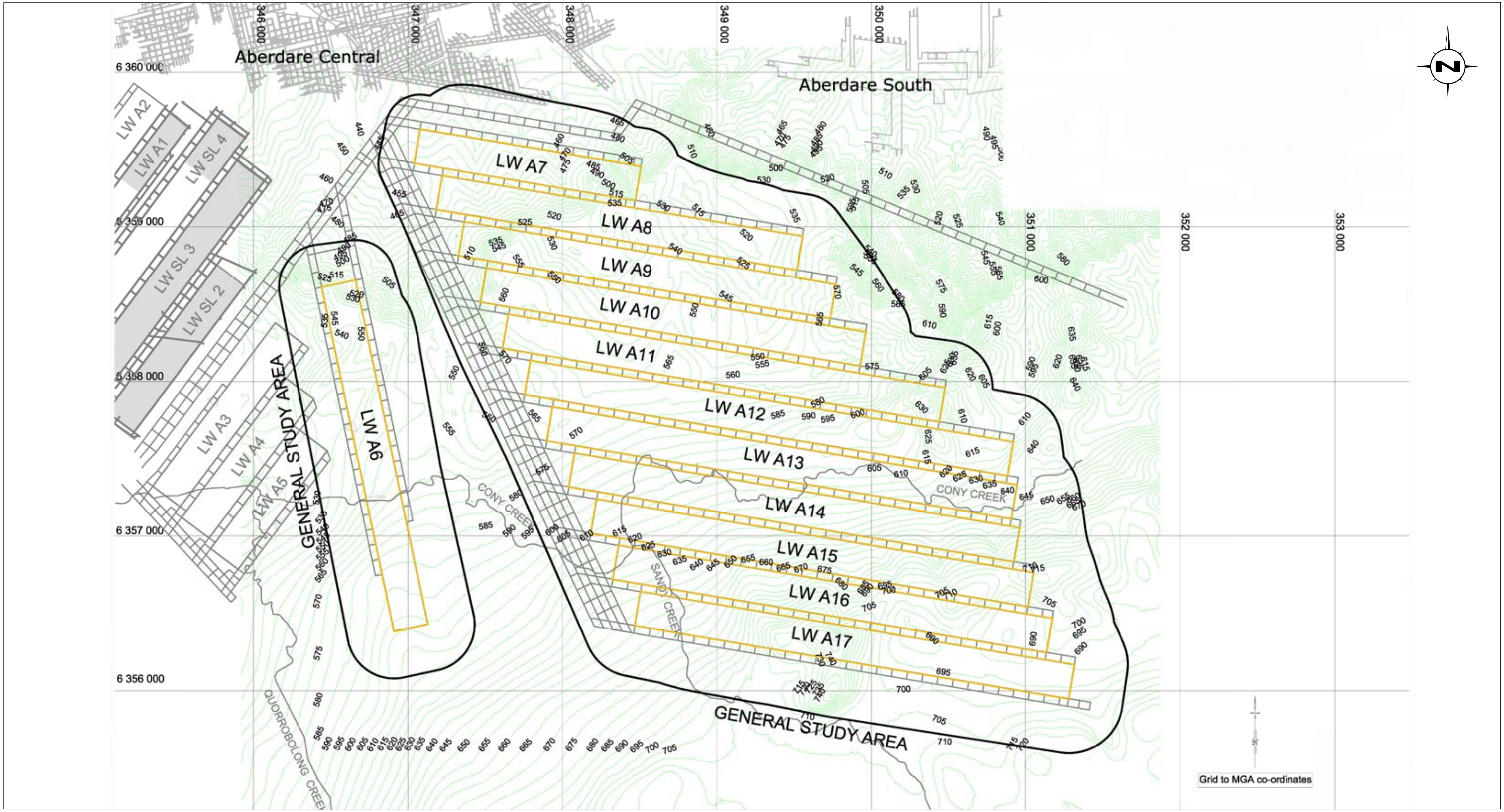


Source: Austar Coal Mine

0 0.5 1 1.5km
1:35 000

FIGURE 3.2

Depth of Cover

Exploration drilling is scheduled to be ongoing throughout 2008 to elevate resources in the proposed Stage 3 area to measured status. The hole location and timing is subject to results of previous holes and site access and availability. In addition to surface drilling, 6 to 20 metres of roof core and 2 to 3 metres of floor core is obtained at each gate road cut-through for geotechnical assessment and coal quality analysis in combination with strip samples.

3.1.1.3 Project Resources

Resource assessment is ongoing and will be refined over the life of the mine. As shown on **Figure 3.1**, the proposed Stage 3 underground mining area includes an Indicated Resource of 74.1 Mt of coal and an additional Inferred Resource of 28 Mt of coal as at February 2008. Of this approximately 87.1 Mt of coal resource with an average seam thickness of approximately 6.2 metres is within CML2. An additional approximately 2 Mt of inferred coal resource with an average seam thickness of approximately 6 metres is located to the north of CML2 and an additional approximately 13 Mt of inferred coal resource with an average seam thickness of approximately 4 metres is located to the east of CML2.

The latest Resource Assessment (February 2008) for the conceptual layout of Longwall 6 to Longwall 17 within the Stage 3 mining identifies estimated extractable ROM coal resource of 45.3 Mt within the Greta Coal Seam in Stage 3 (accounting for coal with less than 1.5% sulphur).

Coal produced at Austar is typically high volatile, low ash bituminous, high specific energy, high fluidity coal which can be utilised in a range of blends for the soft coking, semi-soft coking and thermal markets (HLA, 1995). The coal has a medium to high sulphur content with the sulphur generally occurring in the top sections of the seam. Both organic and pyritic sulphur are present in the seam. The total sulphur in the product coal is typically marketed at less than 1.5% by controlling the working section and by screening and washing of the raw coal delivered to the CHPP.

3.1.2 Mine Planning and Mining Methodology

3.1.2.1 Conceptual Mine Plan

The conceptual mine plan for Stage 3 is shown on **Figure 1.3**, and includes 12 longwalls with a maximum width of 227 metres and a maximum height of 7 metres. The Longwalls of the conceptual mine plan (refer to **Figure 1.3**) vary in length between 1455 metres (LWA7) and 3175 metres (LWA12). The solid chain pillar between each longwall has been designed to be 45 metres wide. **Table 3.1** details the conceptual geometry of proposed longwalls (MSEC, 2008:2).

Table 3.1 - Proposed Stage 3 Longwall Geometry

Longwall	Length	Void Width (m)	Solid Chain Pillar Width (m)
LWA6	2280	227	*NA*
LWA7	1455	227	*NA*
LWA8	2370	227	45
LWA9	2445	227	45
LWA10	2495	227	45
LWA11	2870	227	45
LWA12	3175	227	45
LWA13	3055	227	45
LWA14	2930	227	45
LWA15	2875	227	45
LWA16	2850	227	45
LWA17	2850	227	45

3.1.2.2 LTCC Mining Methodology

In Australia all coal seams of 5 metres in thickness or greater have not been able to be fully extracted by conventional methods of coal mining. LTCC is a method of mining that has been in practice in one form or another for over 130 years and is designed to extract thicker coal seams by recovering coal that would otherwise be lost in traditional forms of longwall mining.

LTCC was introduced to China approximately 15 years ago and to Austar (Stage 1) in October 2006. Recent modifications to the technique at a number of underground coal mines in China have resulted in impressive coal recovery rates and performances (Xu, 2001).

LTCC has provided enormous interest to both the regulators and operators within Australia as it allows for significant improvements in the safe and reliable extraction of thick coal seams, optimising resource recovery, reducing energy required per tonne of coal to extract coal and affording a lower operating cost per tonne of coal extracted.

LTCC combines a conventional retreat longwall face with a second armoured face conveyor (AFC) towed behind the shield to recover coal that falls into the goaf. The roof supports are of a modified design incorporating a system of hydraulically operated tail-canopies at the rear of the support which can be moved up and down to allow the broken coal in the goaf area to spill onto a second AFC. This process continues until all of the coal is recovered and waste rock appears. Once waste rock appears the tail canopies are lowered and the AFC pulled forward to stop the recovery of rock from the goaf (ERM, 2006).

LTCC consists of the following operational steps:

- shearing coal in front of the AFC;
- pushing the front conveyor;
- setting the support forward;

- opening the tail-canopy of support to allow broken coal to spill onto the rear conveyor; and
- pulling the rear conveyor.

A schematic outlining the LTCC process is shown in **Figure 3.3.**

3.1.2.3 Longwall Mining Schedule

The indicative longwall mining schedule for underground mining in Stage 3 and estimated ROM coal to be extracted by longwall is outlined in **Table 3.2.** It is proposed that mining will commence in 2012 and continue until approximately 2028.

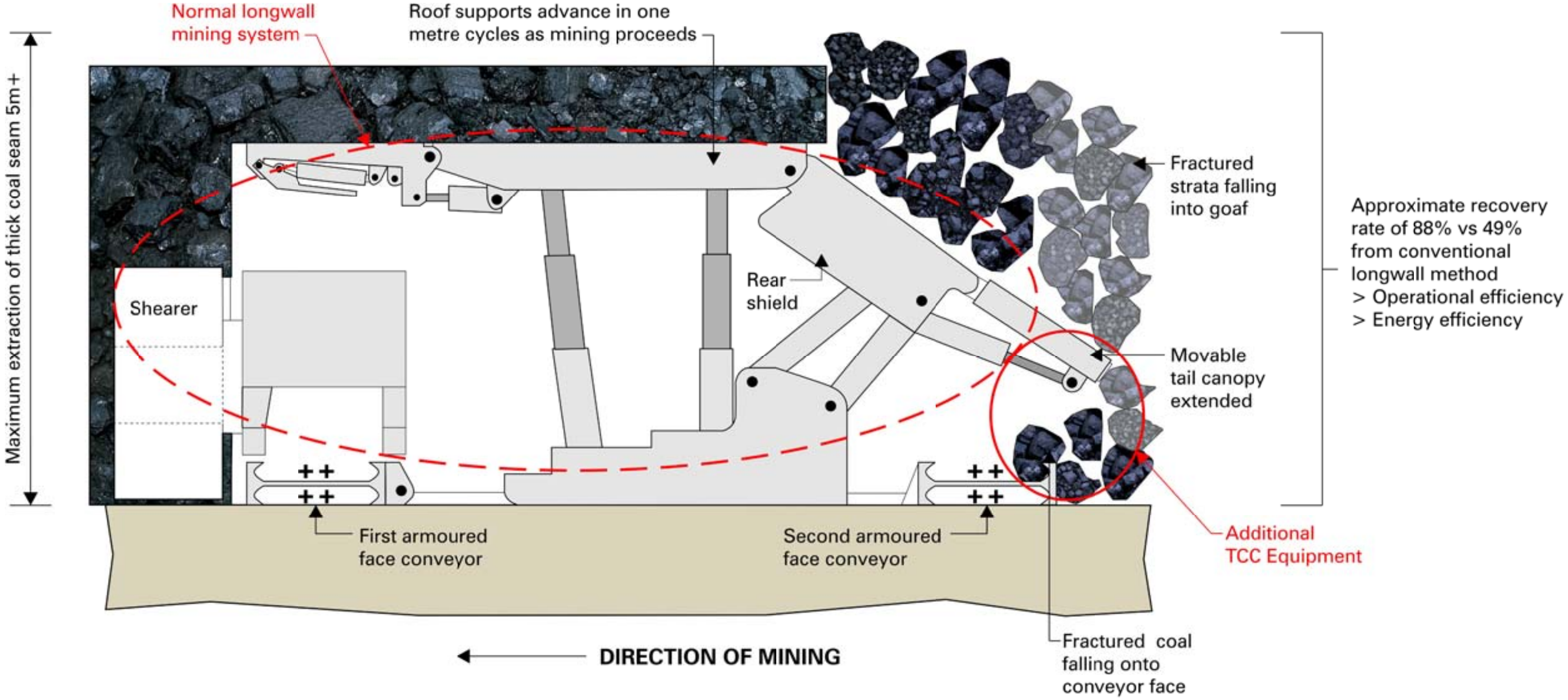
Table 3.2 – Indicative Longwall Mining Schedule

Longwall	Start	Finish	Estimated ROM Coal (Mt)
LWA6	14 Mar 2012	26 Aug 2013	4.2
LWA7	6 Oct 2013	30 Aug 2014	2.6
LWA8	10 Oct 2014	21 Feb 2016	4.1
LWA9	24 Mar 2016	14 Jul 2017	4.0
LWA10	16 Aug 2017	15 Nov 2018	3.8
LWA11	20 Dec 2018	17 Apr 2020	4.1
LWA12	21 May 2020	24 Sep 2021	4.2
LWA13	28 Oct 2021	24 Jan 2023	3.9
LWA14	27 Feb 2023	9 May 2024	3.6
LWA15	12 Jun 2024	28 Aug 2025	3.6
LWA16	29 Sep 2025	11 Dec 2026	3.6
LWA17	15 Jan 2027	14 Mar 2028	3.6
Total			**45.3**

3.2 Surface Infrastructure Site

The proposed Austar Stage 3 Project will require the construction of new Surface Infrastructure facilities on a 16 hectare parcel of land to the south-west of Kitchener. The Surface Infrastructure Site is located on land that is owned by Austar and is bordered by Werakata State Conservation Area. The proposed location and layout of the site is shown on **Figures 1.4** and **3.4**. The Surface Infrastructure Site will include the following components (refer to **Figure 3.4**):

- upcast and downcast ventilation shafts;
- access to the mine for personnel;
- workshop;
- store;
- service boreholes;
- bathhouse;



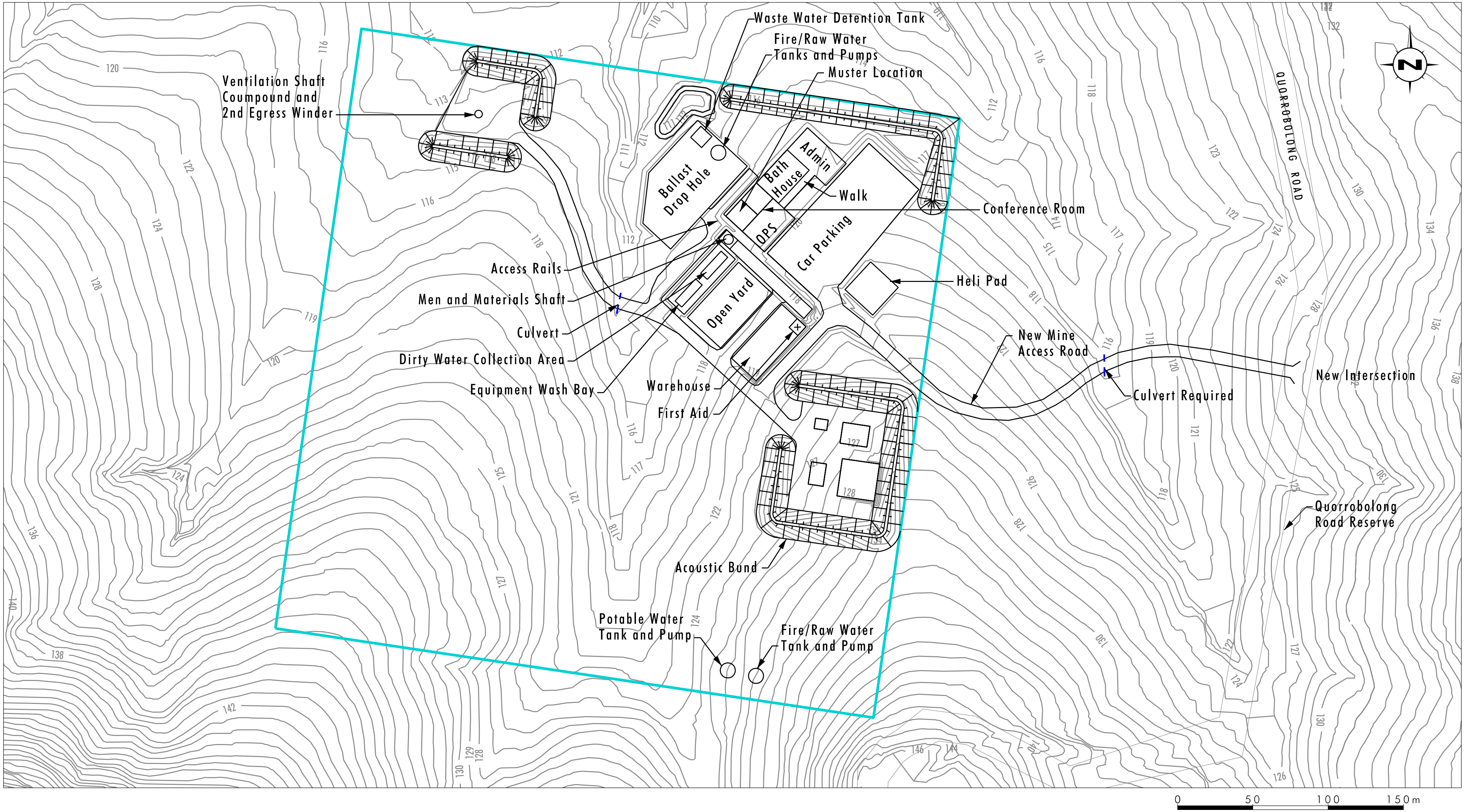
Longwall Top Coal Caving LTCC Method

Combination of conventional retreat longwall face with second armoured face to recover coal that falls into goaf

Base Source: Austar Coal Mine (2007)

FIGURE 3.3

Longwall Top Coal Caving Method



Legend

Surface Infrastructure Site

FIGURE 3.4

Conceptual Layout for Proposed Surface Infrastructure Site

Note: Contour Interval 1m

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- offices;
- car parking; and
- services such as an electricity sub-station.

Access for men and materials will be via the proposed Surface Infrastructure Site. Heavy equipment will continue to access the underground mining operations via the Ellalong Drift and Pit Top facilities.

3.2.1 Infrastructure

3.2.1.1 Site Access

Access to the Surface Infrastructure Site will be via Quorrobolong Road. Austar proposes to construct a new intersection on Quorrobolong Road to allow for the safe entry and exit of all vehicles to and from the Surface Infrastructure Site.

The Surface Infrastructure Site is located on land that is owned by Austar and is bordered by Werakata State Conservation Area, with no feasible physical access to Quorrobolong Road. As a result, a request was submitted to the Minister for the DECC for the granting of an inholding access agreement between Austar and DECC.

3.2.1.2 Car Parking

A car park will be provided on site to accommodate underground workforce, surface workforce, office staff and visitor parking needs. Car parking will be located in the north-eastern corner of the Surface Infrastructure Site as shown in **Figure 3.4**.

3.2.1.3 Offices, Bathhouse, Workshop and Store

The Surface Infrastructure Site will include an office and bath house building to the east of the car parking area and a workshop and store to the south-east of the car parking area as shown on **Figure 3.4**. Soil and water controls associated with the workshop and store are discussed further in **Section 7.5**.

3.2.1.4 Shafts and Boreholes

The proposed upcast and downcast ventilation shafts will be approximately 4.5 metres and 6.5 metres in diameter respectively and will be constructed to a depth of approximately 460 metres. The shafts will be constructed using raised bore techniques, drill and blast techniques or a combination of both. A third construction bore used to raise the cuttings from the large shafts during boring will also be required. This shaft will be approximately 2.4 metres in diameter. The downcast shaft will allow access for men and materials and provide additional air to enter the mine. The upcast ventilation shaft will allow air to be extracted from the mine and two exhaust fans will be placed over the shaft in order to draw air out of the workings. A second egress winder is proposed to be fitted to this shaft.

3.2.1.5 Services

The following services will be required at the Surface Infrastructure Site:

- installation of a 5 MVA small sub-station and an electricity distribution line;
- installation of potable water and reticulated sewerage services connected to Hunter Water Corporation infrastructure; and
- installation of telecommunication services.

3.2.2 Construction

Construction of the proposed Surface Infrastructure Site will take approximately 18 months to complete and will require the sinking of three shafts as well as the construction of surface infrastructure. Potential construction impacts are discussed in **Section 7.4**.

3.3 Employment

Austar mine currently employs a workforce of around 200 people. It is estimated that at maximum production, the operation could employ a workforce of 275 people during the life of the Stage 3 Project.

3.4 Hours of Operation

Underground mining within the Stage 3 area will be a 24 hour, seven day per week operation.

3.5 Project Timing and Life of Operation

Austar proposes to commence longwall mining in the Stage 3 area in 2012, following completion of longwall mining in the Stage 1 and Stage 2 areas. At scheduled production levels, mining of longwalls A6 to A17 will take 16 years to complete (refer to **Section 3.1.6**).

Construction of the Surface Infrastructure Site will take approximately 18 months and must be completed prior to the commencement of longwall mining in the Stage 3 area to provide for mine ventilation and enable access for men and materials. Construction is therefore proposed to commence in mid 2009 subject to gaining the relevant approvals.

4.0 Planning Context

4.1 Commonwealth Legislation

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) has established a national assessment framework based on the principles of ecologically sustainable development. Proposed action, including projects, developments, activities and alterations that are considered likely to have a significant impact on matters protected by and listed under the EPBC Act need approval from the Minister for the Environment, Water, Heritage and the Arts.

Only those actions are that are deemed to have significant environment impact needed to be referred to Department of the Environment, Water, Heritage and the Arts (DEWHA) for assessment. The Project EA process has included assessment of significant impact under the EPBC Act of the following aspects:

- World Heritage properties (not applicable);
- National Heritage properties (not applicable);
- wetlands of international importance (not applicable);
- threatened species and ecological communities (see **Sections 5.5, 6.6** and **7.2**);
- migratory species (see **Sections 5.5, 6.6** and **7.2**);
- Commonwealth marine areas (not applicable); and
- nuclear actions (including uranium mines) (not applicable).

The proposed development will not have a significant impact on any of the matters of National Environmental Significance listed above. Details of the Ecological Assessment undertaken for the Stage 3 Project are provided in **Sections 5.5, 6.6** and **7.2**.

4.1.2 Commonwealth Native Title Act 1993

The Commonwealth *Native Title Act 1993* (NT Act) is a set of rights and interests in relation to land or waters that have qualities identified and administered by the National Native Title Tribunal. The Tribunal is responsible for maintaining a National Native Title Register (NNTR) of native title claimants and bodies to whom native title rights have been granted. These native title holders and claimants must be consulted prior to the granting of a mining lease over land to which the native title claim or right applies.

The NT Act prescribes that native title can be extinguished under certain circumstances, including the granting of freehold land. A search of the NNTR was conducted as part of the Stage 3 EA to determine whether land and water ways within the Stage 3 project area may be affected by a native title determination, application or indigenous land use agreement (ILUA).

No native title claims are known to exist over the land or water system within the proposed Stage 3 mining area or the proposed Surface Infrastructure Site.

4.2 NSW State Legislation

4.2.1 Environmental Planning and Assessment Act 1979

Planning and development is carried out under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Environmental Planning and Assessment Regulation 2000. The development assessment system in NSW is set out in Parts 3A, 4 and 5 of the EP&A Act. In addition, a system of significant reform to planning legislation is underway with the release of the Draft Exposure Environmental Planning and Assessment Amendment Bill 2008.

The preparation of this EA will address in-force legislation and planning as administered by the NSW Department of Planning (DoP).

Austar Stage 3 Part 3A Major Project Application (MP08_0111) must be assessed by the Minister for Planning. Implementation of the EP&A Act also ensures an integrated approach to project assessment and approval and ensures stakeholders contribution and ecologically sustainable development with the following objectives:

(a) to encourage:

  (i) the proper management, development and conservation of natural and artificial resources,
  (ii) the promotion and co-ordination of the orderly and economic use and development of land,
  (iii) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and
  (iv) ecologically sustainable development, and

(b) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

As outlined in **Table 4.1**, the Project fulfils the EP&A Act objectives.

Table 4.1 – Austar Stage 3 Assessment of EP&A Act Objectives

EP&A Act Objective	Austar Stage 3 Assessment
• encourage the proper management, development and conservation of natural and artificial resources • encourage the promotion and co-ordination of the orderly and economic use and development of land • encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats • encourage ecologically sustainable development	• proposed planning and development for the safe and economic recovery of NSW coal resource; • effective management of the environmental impacts; • ongoing robust implementation of the principles of ecologically sustainable development; and • a series of management plans prior to and resultant from the Stage 3 EA process.

Table 4.1 – Austar Stage 3 Assessment of EP&A Act Objectives (cont)

EP&A Act Objective	Austar Stage 3 Assessment
• to provide increased opportunity for public involvement and participation in environmental planning and assessment	• establishment of a community consultation program; • establishment of a community consultation committee allowing for community involvement opportunities; and • further opportunities established with the public exhibition of the EA, facilitated by DoP.

Austar has been consulting with the community about the Project since 2007. Feedback from this consultation process has provided input into conceptual mine planning and has enabled Austar to explore methods of minimising potential environmental impacts.

The community consultation program that has been undertaken during the Project has included the following:

- meetings and discussions with individual residents and landholders;
- presentations to the Community Consultative Committee;
- presentations to and consultation with local community groups;
- distribution of community information sheets;
- establishment of a website which provides regular project updates; and
- information and open days.

4.2.1.1 Part 3A Major Projects Assessment

Austar Stage 3 DA, as a Major Project, must be assessed by the Minister for Planning. Part 3A of the EP&A Act defines the Project assessment methodology and the State Environmental Planning Policy (Major Projects) 2005 (SEPP) outlines criteria used to identify projects as Part 3A. By applying an integrated methodology the Department of Planning seeks to capture the complexities of the major project proposals and ensure that stakeholder communication and consultation is ongoing.

The proposed development is classified as 'mining' in Schedule 1 of the State Environmental Planning Policy (SEPP) (Major Projects) 2005.

Approvals and Legislation Not Applicable under Part 3A

Should the proposed development be granted Project Approval under Part 3A of the EP&A Act, Clause 75U of the EP&A Act applies. **Table 4.2** outlines the authorisations that are not required under Clause 75U.

Table 4.2 – Approvals and Legislation Not Applicable under Part 3A

Act	Approval
Fisheries Management Act 1994	Permit for works or structures within a waterway a permit under section 201, 205 or 219
Heritage Act 1977	Disturbance to an item listed on State Heritage Register or Interim Heritage Order; Excavation permit an approval under Part 4, or an excavation permit under section 139 Division 8 of Part 6 of the *Heritage Act 1977* does not apply to prevent or interfere with the carrying out of an approved project.
National Parks & Wildlife Act 1974	A permit under Section 87 preliminary research permit; Section 90 consent to destroy relics; or Consent under section 90 of the *National Parks and Wildlife Act 1974*.
Water Management Act 2000	Water use approval, water management work approval or activity approval under section 89; Water management work approval under section 90; or Activity approval under section 91 of the *Water Management Act 2000*.
Threatened Species Conservation Act 1995	Licence to harm or pick threatened species, populations or ecological communities or habitat; Actions that are essential for carrying out an approved project provide the same defence to actions relating to harm to native fauna (and threatened species) as a development consent under Part 4, or environmental assessment under Part 5, of this Act provide.

Approvals and Legislation which must be applied consistently under Part 3A

If the proposed development is granted project approval under Part 3A of the EP&A Act, the approvals listed in **Table 4.3**, which will be required, must not be refused by the relevant approval authority and must be substantially consistent with the terms of the Project approval.

Table 4.3 – Consistently Applicable (Approvals and Legislation)

Act	Approval	Authority
Mine Subsidence Compensation Act 1961 (Section 15)	Development within Mine Subsidence District	Mine Subsidence Board (MSB)
Mining Act 1992	Mining Lease	NSW Department of Primary Industries (Mineral Resources) DPI
Protection of the Environment Operations Act 1999	Environmental Protection Licence under Chapter 3 for any of the purposes referred to in section 43 of that Act	Department of Environment and Climate Change (DECC)
Roads Act 1993 section 138	Permit to Impact on a Public Road	Cessnock City Council (Local Roads)

4.2.2 Mining Act 1992

The *Mining Act 1992* as administered by DPI on behalf of the Minister for Mineral Resources and, amongst other legislative instruments, places controls on methods of exploration and mining, the disposal of mining waste, land rehabilitation and environmental management activities. The principal means of regulation is the requirement for nearly all exploration and mining to be conducted under a title, such as an exploration licence or a mining lease. It also addresses the environmental responsibilities of explorers and miners, royalties and compensation.

A Mining Lease granted under the *Mining Act 1992* entitles the leaseholder to mine coal from a deposit. Austar currently holds a number of mining leases as indicated in **Figure 2.3** and listed in **Appendix 3**. A new mining lease will be required for the section of the proposed Stage 3 mining area that is located to the east of CML2.

4.2.3 Coal Mine Health and Safety Act 2002

The commencement of *the Coal Mine Health and Safety Act 2002* (CMHS Act) and Coal Mine Health and Safety Regulation 2006 (CMHS Regulation) repeals the *Coal Mines Regulation Act 1982*. The development of the CMHS Act and CMHS Regulation provides closer alignment with the *Occupational Health and Safety Act 2000* and Occupational Health and Safety Regulation 2001.

The principal aim of the *Coal Mine Health and Safety Act 2002* is to secure the objectives of the *Occupational Health and Safety Act 2000* in relation to coal operations. It does this by imposing certain specific safety requirements on coal mines.

No additional requirements are applicable to the establishment of the Project.

4.2.4 Mine Subsidence Compensation Act 1961

Under the *Mine Subsidence Compensation Act 1961*, the approval of the Mine Subsidence Board (MSB) is required for the erection or alteration of improvements within a mine subsidence district. The proposed Stage 3 mining area is currently not a Declared Mine Subsidence District and approval under Section 15 of the *Mine Subsidence Compensation Act 1961* does not currently apply to the proposed development. Clause 47 of the *Cessnock Local Environment Plan 1989* (LEP) which specifies conditions of development within mine subsidence districts is also not applicable. The area, however, is scheduled for review and possible proclamation.

In NSW, if a home or other improvement is damaged as a result of subsidence following the extraction of coal, the owner's rights are protected by the Mine Subsidence Compensation Act. Buildings built outside of and prior to the proclamation of a Mine Subsidence District are automatically covered for compensation. However, homes and other structures built in contravention of, or without, the Board's approval in a Mine Subsidence District, are not eligible for compensation in the event of damage due to mine subsidence.

4.2.5 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (PoEO Act) is administered by DECC. The Act establishes the procedures for issuing licences for environmental protection including waste, air, water and noise pollution control. The owner or occupier of a premise that is engaged in scheduled activities is required to hold an Environment Protection Licence (EPL) and comply at all times with the conditions of that licence.

Austar currently holds EPL 416 for its operations. The EPL was granted 7 May 2002, includes aspects of air, water, applications to land and noise pollution and is reviewed annually (refer to **Section 2.3.3**). The proposed development will require either issue of a new EPL or a variation to the existing EPL as underground coal mining is a scheduled activity listed in Schedule 1 of the PoEO Act.

4.2.6 Water Management Act 2000

The *Water Management Act 2000* (WMA) provides for the sustainable and integrated management of the State's water and is administered by the NSW Department of Water and Energy (DWE). The WMA governs the issue of new water licences, the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced.

Under the WMA, water access licences entitle a licence holder to a share of the water in a listed water source that can be sustainably extracted.

As there are currently no Water Sharing Plans that apply to the site, and the Stage 3 Project is a major project to which Part 3A of the EP&A Act applies, no approvals or licences are required under the WMA.

4.2.7 Water Act 1912

The *Water Act 1912* is administered by the DWE and governs the issue of new water licences and the trade of water licences and allocations in areas where Water Sharing Plans under the WMA have not commenced. The licence is tied to the land as the licence covers both the right to take a specific volume of water as well as the works to be constructed. Most *Water Act 1912* licences for commercial purposes also have to be renewed every five years. A permit under Part 5 of the Water Act 1912 is required where groundwater is intercepted by mine workings. Austar currently holds a Part 5 permit under the *Water Act 1912*. The permit applies to all of CML2. The Part 5 permit will need to be amended following approval for Stage 3 to include that area outside of CML2.

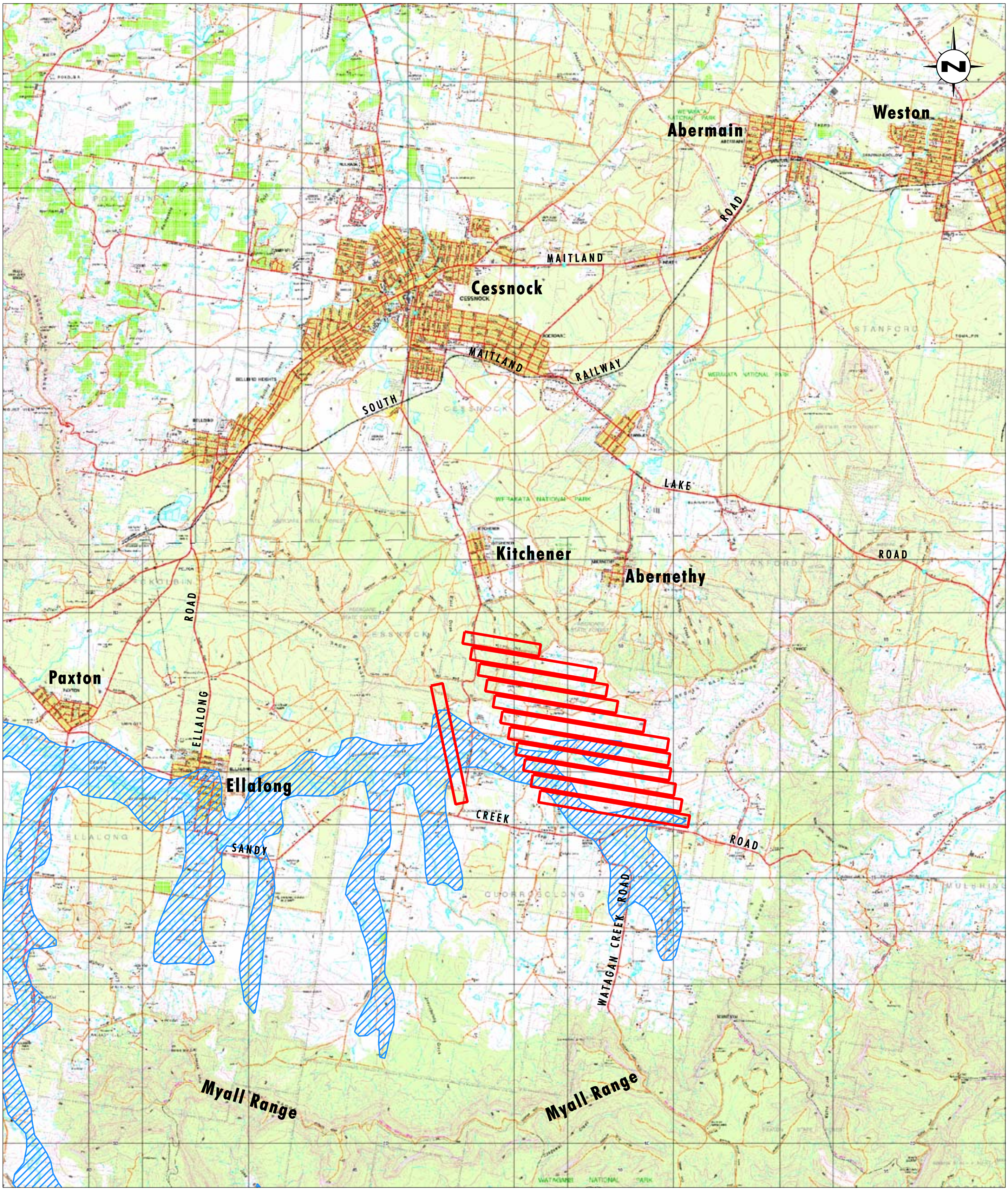
There are no registered groundwater extraction bores within the proposed Stage 3 mining area (refer to **Figure 3.1**).

Under Section 113A of the *Water Act 1912*, there is currently an embargo on any further applications for sub-surface water licences within the *Wollombi Brook Alluvium Water Shortage Zone GWMA 041* (refer to **Figure 4.1**). This zone of shallow alluvium is limited to Cony and Sandy Creek channels within the proposed Stage 3 mining area. The Department of Natural Resources, NSW Provisional River Data Groundwater Vulnerability Mapping indicates that the Wollombi Brook Catchment is classified as having very high to high groundwater vulnerability along its creek banks and a moderately high rating elsewhere. As indicated in the City Wide Settlement Strategy, these creekline areas are vulnerable to groundwater contamination (Cessnock City Council, 2004).

The Groundwater Monitoring Program for Austar will be expanded to include Stage 3 as discussed in **Section 6.3**.

4.2.8 Environmentally Hazardous Chemicals Act 1985

DECC is granted power under the *Environmentally Hazardous Chemicals Act 1985* (EHC Act) to assess and control certain chemicals by making a Chemical Control Order (CCO).



Source: Topo Maps: LPI NSW, Longwall Layout: Austar Coal Mine

0 1.0 2.0 4km
1:100 000

Legend

- Conceptual Layout for Stage 3 Longwalls Panels
- Wollombi Brook Alluvium GWMA 041

FIGURE 4.1

Wollombi Brook Alluvium GWMA 041

No chemicals or chemical wastes listed under the EHC Act will be required or produced as a result of the Project. Approval will not therefore be required under this Act.

4.2.9 Roads Act 1993

The *Roads Act 1993* in the proposed development area is administered by the RTA, Cessnock City Council or the Department of Lands. The RTA has jurisdiction over major roads, Cessnock City Council over minor roads and the Department of Lands over road reserves or Crown roads. Under Section 138, Part 9, Division 3 of the Act, a person must not (otherwise than with the consent of the appropriate roads authority):

- erect a structure or carry out a work in, or over a public road, or
- dig up or disturb the surface of a public road, or
- remove or interfere with a structure, work or tree on a public road, or
- pump water into a public road from any land adjoining the road, or
- connect a road (whether public or private) to a classified road,

The proposed development will require the construction of a new intersection on Quorrobolong Road and may result in subsidence of roads, road reserves and Crown road reserves.

Subsidence remediation works may be necessary along sections of Quorrobolong Road and approval for these works will be required from Cessnock City Council under s138 of the *Roads Act 1993*. The location of subsidence affectation areas is shown in **Figure 4.2**.

Further detail of the subsidence impact on Quorrobolong Road is provided in **Section 6.9**.

4.2.10 Crown Lands Act 1999

Crown land is land that is owned and managed by State Government and includes:

- Crown lands held under lease, licence or permit;
- community managed reserves;
- lands retained in public ownership for environmental purposes;
- lands within the Crown public roads network; and
- other unallocated lands.

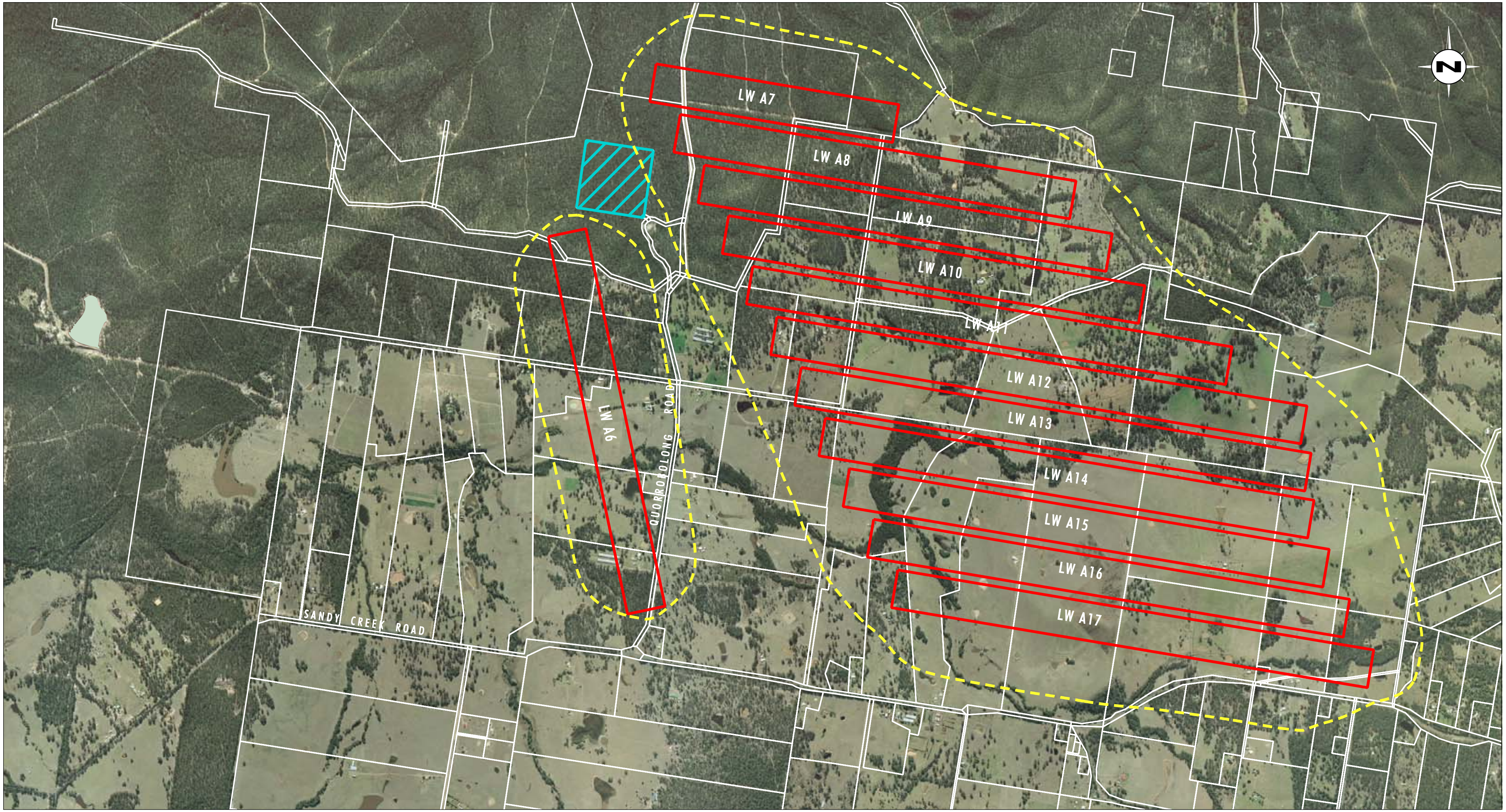
Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by the *Crown Lands Act 1999* or the *Crown Lands (Continued Tenures) Act 1989*.

The northern portion of the proposed Stage 3 mine plan extends underneath the Werakata State Conservation Area and Crown land. The approval of the Department of Lands may be required for any works within Crown road reserves.

4.2.11 National Park Estate (Lower Hunter Region Reservations) Bill 2006

The proposed new Surface Infrastructure Site is bordered by the Werakata State Conservation Area under the National Park Estate (Lower Hunter Region Reservations) Bill 2006 (NPE Bill*).* The NPE Bill, which is administered by the Department of Environment and Climate Change (DECC), facilitates the transfer of certain State forest and Crown lands to the National Park Estate.

Umwelt
Environmental Consultants



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW,
Aerial Photography: AAM Hatch 2006

0 0.5 1 1.5km
1:32 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site

FIGURE 4.2

Predicted Area of Subsidence - Stage 3

File Name (A4): R10_V1/2274_357.dgn

Werakata State Conservation Area was previously listed as Aberdare State Forest and is outlined in Schedule 1 of the NPE Bill, which lists transfers that have been made from State Forests Reserved as National Park or State Conservation Area. Werakata State Conservation Area is described as:

> 5 Werakata State Conservation Area
>
> An area of about 2,257 hectares, being so much of Aberdare State Forest No 981 as comprises the land designated as 1105-01 on the diagram catalogued Misc R00323 (Edition 1) in the Department of Environment and Conservation, subject to any variations or exceptions noted on that diagram.

As a State Conservation Area, the land is reserved to protect and conserve significant or representative ecosystems, landforms, natural phenomena or places of cultural significance, while providing opportunities for sustainable visitation, enjoyment, use of buildings and research. The principal difference between the management, objectives and principles of national parks and state conservation areas is that mineral and petroleum exploration and mining may be permitted in state conservation areas.

To allow time to complete detailed planning of the Surface Infrastructure Site, a request has been made by Austar to the Minister for the DECC for the granting of an inholding access agreement between Austar and DECC.

4.3 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) deal with issues significant to the state of NSW. They are made by the Minister for Planning and may be exhibited in draft for public comment before gazetted as a legal document.

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

The State Environmental Planning Policy (SEPP) (Mining, Petroleum Production and Extractive Industries) 2007 applies to the proposed Stage 3 development. This SEPP consolidates and updates many existing planning provisions related to mining, petroleum and production and extractive industries as well as introducing new provisions to ensure that potential environmental and social impacts are adequately addressed during the assessment and determination of development proposals. The SEPP is aimed at improving the relationship between the *Mining Act 1992* and the EP&A Act in the assessment and approval of mines.

Introduction of the SEPP revoked the provisions that allowed mines to expand without the need for a transparent assessment of their impacts or consent under the EP&A Act once a mining lease had been granted. It is intended that these and other initiatives will lead to improved environmental performance and increased community participation throughout the development assessment and approval process. The SEPP aims to provide for:

- the proper management and development of mining, petroleum production and extractive material resources;
- to facilitate the orderly use and development of areas where the resources are located; and
- to establish appropriate planning controls to encourage sustainable management of these resources.

The Major Projects SEPP prevails over the Mining SEPP to the extent of any inconsistency. Any mining that is a major project can only be carried out with project approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Mining SEPP does not apply to major projects approved under Part 3A of the EP&A Act.

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

The State Environmental Planning Policy (SEPP) No. 33 (Hazardous and Offensive Development) provides definitions for 'hazardous industry', 'hazardous storage establishment', 'offensive industry' and 'offensive storage establishment'. The definitions apply to all planning instruments, existing and future. Revised definitions enable decisions to approve or refuse a development to be based on the merit of the proposal.

The Project is not considered hazardous or offensive. A detailed hazard assessment is therefore not required.

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

The State Environmental Planning Policy (SEPP) No. 44 (Koala Habitat Protection) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline by:

(a) requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

(b) encouraging the identification of areas of core koala habitat, and

(c) encouraging the inclusion of areas of core koala habitat in environment protection zones.

While Cessnock Local Government Area (LGA) is listed in Schedule 1 of the SEPP, no core or peripheral koala habitat has been identified within the Project area (refer to **Section 5.7**). The provisions of SEPP 44 do not apply and a koala plan of management is not required for the Project.

4.3.4 State Environmental Planning Policy No 55 (SEPP) (Remediation of Land)

State Environmental Planning Policy (SEPP) No. 55 (Remediation of Land) aims to provide a Statewide planning approach to the remediation of contaminated land.

Under the SEPP, a consent authority must not approve development on land unless the potential contamination issues have been considered. No potential issues of contamination from mining operations have been identified.

The Project will be designed to prevent contamination. The storage and handling of chemicals will be undertaken in accordance with Australian Standards and DECC guidelines.

A closure and decommissioning strategy, including a contaminated land management strategy will be developed for the decommissioning and closure of the Project in consultation with DPI and in accordance with the Austar MOP. This management strategy will incorporate the investigation, assessment and remediation of any contaminated land and will be included in the MOP if required and submitted to DPI for approval.

4.4 Regional Environmental and Development Plans

4.4.1 Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan 1989 (HREP) establishes regional policies to guide the preparation and application of local environmental plans and development control plans to control development and control activities in the region. The following objectives apply to the Project:

(a) to promote the balanced development of the region, the improvement of its urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and man made features and so as to meet the needs and aspirations of the community;

(b) to co-ordinate activities related to development in the region so there is optimum social and economic benefit to the community; and

(c) to continue a regional planning process that will serve as a framework for identifying priorities for further investigations to be carried out by the Department and other agencies.

The HREP also provides a number of specific objectives in relation to underground mining and the associated rehabilitation objectives, as follows:

Section 41 Policies for Control of Development

Clause 1 Consent Authorities, in considering proposals for mining or extraction (including dredging):

a) should consider the conservation value of the land concerned and apply conditions which are relevant to the appropriate post-mining or extraction land use;

b) should, in respect of extraction from river banks or channels, ensure that instability and erosion are avoided;

c) should consult with officers of the Department of Mineral Resources, and of the Department of Agriculture, to determine appropriate post-mining or extraction land uses;

d) should ensure the progressive rehabilitation of mined or extracted areas;

e) should minimize the likelihood and extent of a final void and the impact of any final void, or facilitate other appropriate options of the use of any final void;

f) should minimize any adverse effect of the proposed development on groundwater and surface water quality and flow characteristics;

g) should consider any likely impacts on air quality and the acoustical environment;

h) should be satisfied that any environmentally acceptable mode of transport is available; and

i) should have regard to any relevant Total Catchment Management strategies.

The proposed development and the approved MOP are consistent with the development control objectives in relation to mining.

The proposed development will include a biodiversity offset area as part of Austar's commitment to ecologically sustainable development.

4.4.2 Lower Hunter Regional Strategy 2006

The Lower Hunter Regional Strategy 2006 (LHRS) (DoP, 2006) is a land use planning document that outlines the provision of sufficient, appropriately placed housing and employment land to cater for the Region's predicted growth over the next 25 years. The strategy is based on population growth projections which forecast that there will be an additional 160,000 people in the Region by 2031. These strategic planning documents state that mining will remain a significant element of the economies of both the Lower Hunter and the State. THE LHRS also states that:

> 'where possible, loss of biodiversity will be offset by improvements elsewhere during the life of the Strategy, with existing biodiversity values maintained or improved.'

The proposal is consistent with the LHRS objectives in relation to mining and includes an offset area for the surface infrastructure facilities.

4.4.3 Lower Hunter Regional Conservation Plan 2006

The Lower Hunter Regional Conservation Plan 2006 (LHRCP) (DEC, 2006) sets out a 25-year program to direct and drive conservation efforts in the Lower Hunter Valley. It is a partner document to the DoP LHRS that sets out the full range of Government planning priorities, and identifies the proposed areas for growth. The primary objectives of the Regional Conservation Plan (RCP) are to complement the Government's Planning Strategy by:

- describing the conservation values of the Lower Hunter region analysing the current status of biodiversity within the region, and assessing the likely impacts of development identified in the Lower Hunter Regional Strategy (LHRS);
- assessing the biodiversity values of the region, at a landscape scale, and identifying strategic areas for biodiversity protection, enhancement or restoration;
- contributing to a practical framework that can secure, maintain and improve biodiversity values as the Hunter grows over the next 25 years; and
- guiding local level planning with respect to biodiversity, including the development of local biodiversity conservation strategies and the development of new Local Environmental Plans (LEP) that can merit biodiversity certification.

Mining is not listed as one of the Future Threats to Biodiversity in the Lower Hunter however, two elements and reserve establishment of the LHRCP apply to the management and operational considerations of the Project. They include (refer to **Figure 4.3**):

1. a large addition to Werakata National Park near Cessnock (2200 hectares) – the gazetted Werakata State Conservation Area (SCA), formerly part of the Aberdare State Forest – which will significantly expand the existing area of reserve and will conserve significant areas of endangered ecological communities (EECs) including Lower Hunter Spotted Gum, Ironbark and Forest Red Gum; and

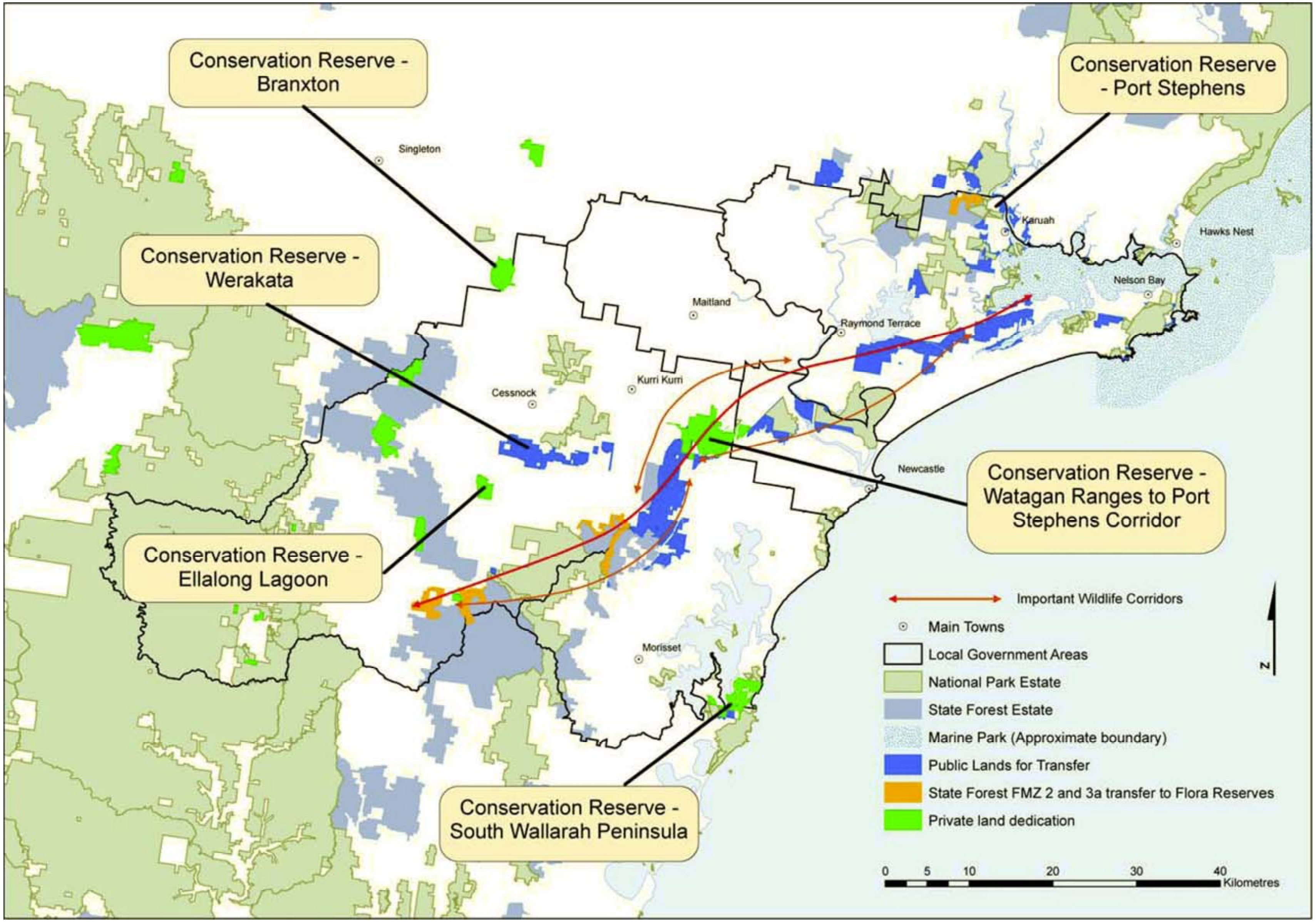


FIGURE 4.3

Reserves for Lower Hunter Region

Source: Department of Environment and Conservation NSW (2006)

File Name (A4): R10_V1/2274_355.dgn

2. establishment of the Ellalong Lagoon Conservation Area (430 hectares) to the east of Paxton, which contains important freshwater wetland communities, will protect further EECs including habitat for the green and golden bell frog.

The formal conservation management status of Ellalong Lagoon has also been considered in discussions of potential mine impacts on downstream water quality (refer to **Section 5.2**).

4.5 Local Environmental and Development Plans

4.5.1 Draft Cessnock Local Environment Plan 2008

The Draft Cessnock Local Environment Plan 2008 (LEP) has been prepared and released for comment. This LEP aims to supersede the current and operational Cessnock Local Environment Plan 1989 (LEP).

As previously outlined, this EA addresses in-force legislation and planning as part of the assessment process. The proposed development is consistent with the aims of the Draft LEP 2008, which are:

(a) to strengthen and protect a high quality, sustainable lifestyle for the Cessnock local government area's residents and visitors;

(b) to conserve and enhance, for current and future generations, the ecological integrity, environmental heritage and environmental significance of the Cessnock local government area;

(c) to encourage development for employment and housing purposes in appropriate locations having regard to proximity to appropriate infrastructure, to ensure efficient use of land and services, to provide walk-able urban environments and to reduce dependency on the use of private vehicles; and

(d) to provide opportunities for a range of new housing and housing choice in locations that have good access to public transport, community facilities and services, retail and commercial services and employment opportunities, including opportunities for the provision of adaptable and affordable housing.

4.5.2 Cessnock Local Environment Plan 1989

The Cessnock Local Environment Plan 1989 was last updated on 11 May 2007 in the form of a legislated update. This LEP is one of the current planning instruments applicable to proposed development in the Cessnock LGA. The Cessnock LEP 1989 has put forth 115 amendments. As specified on the LEP Zoning Map (refer to **Figure 4.4**), Stage 3 and integrated Austar land is zoned:

1. Zone No 1(a) Rural 'A' Zone;
2. Zone No 1 (f) Rural (Forestry) Zone; and

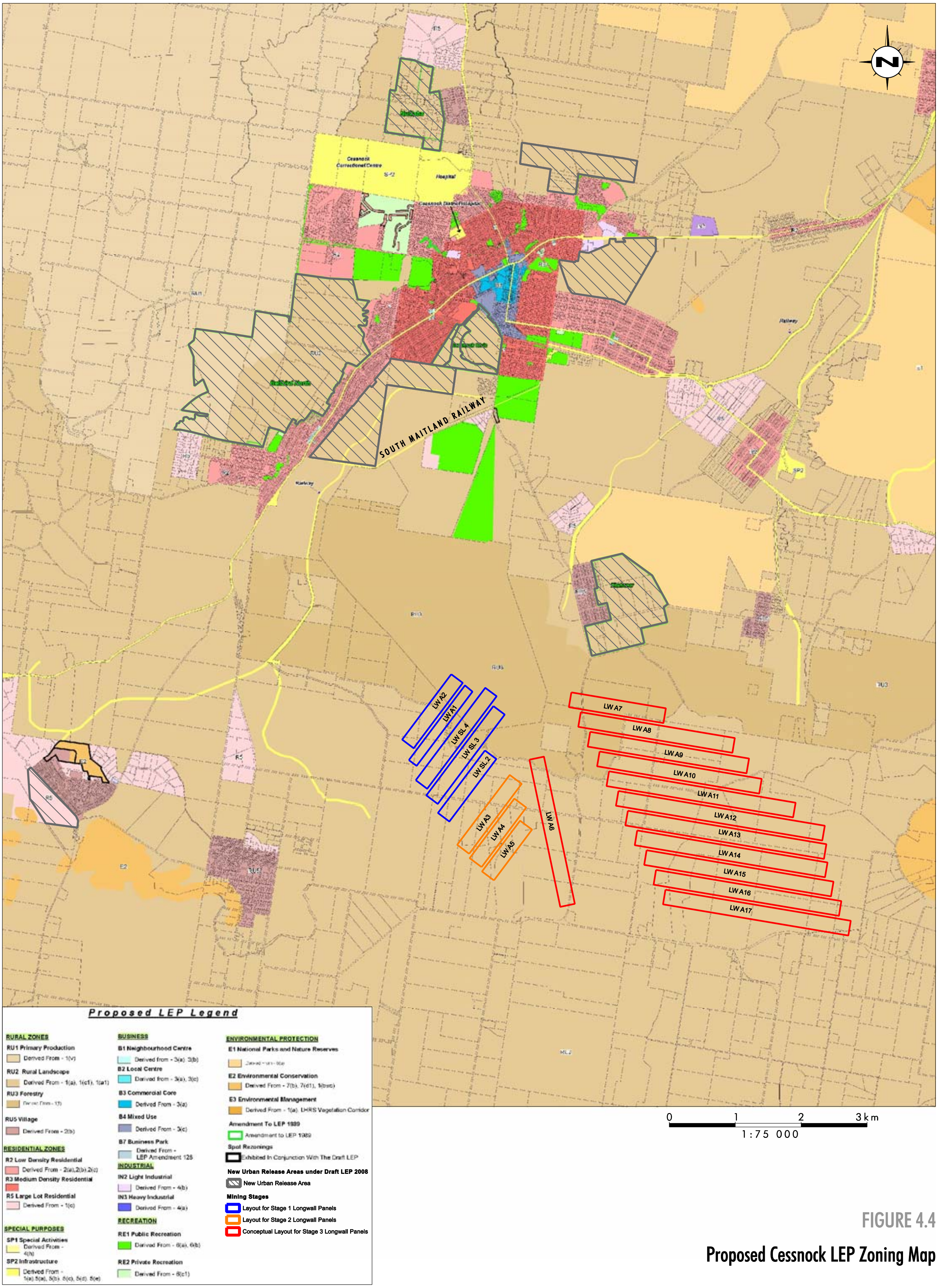


FIGURE 4.4

Proposed Cessnock LEP Zoning Map

Source: Cessnock City Council, 2007

File Name (A4): R10_V1/2274_348.dgn

The proposed Stage 3 operations are consistent with the zoning references and requirements in each of the stated zones. Mining and operations are permissible with development consent in each of these zones. The operations of the proposed Stage 3 development are consistent with the objectives of each of these zones as outlined below:

Zone No 1 (a) Rural "A" Zone

The stated objectives of this zone are:

(a) to enable the continuation of existing forms of agricultural land use and occupation;

(b) to ensure that potentially productive land is not withdrawn from production;

(c) to encourage new forms of agricultural land use;

(d) to enable other forms of development which are associated with rural activity and which require an isolated location, or which support tourism and recreation, and

(e) to ensure that the type and intensity of development is appropriate in relation to:

(i) the rural capability and suitability of the land;
(ii) the preservation of the agricultural, mineral and extractive production potential of the land;

(iii) the rural environment (including scenic resources); and

(iv) the costs of providing public services and amenities.

Zone No 1 (f) Rural (Forestry) Zone

The stated objective of this zone is to recognise and protect the renewable resources of State and private forests and their ancillary recreational functions.

4.5.3 Cessnock Development Control Plan 2006

The Cessnock Development Control Plan 2006 (DCP) complements the statutory provisions contained in the Cessnock LEP 1989 (LEP) by providing detailed guidelines for development within the Cessnock LGA. The current DCP replaces a number of existing Development Control Plans as required to comply with Section 74C of the *Environmental Planning and Assessment Act 1979*, as amended. The aims of the DCP are:

- to provide a detailed planning document that outlines requirements for development which meets community expectations and addresses the key environmental planning issues of the Local Government Area;
- to identify exempt and complying development provisions in accordance with sections 76 & 76A of the EP&A Act and Clause 10A in the Cessnock LEP 1989;
- to identify certain development as advertised development and to detail public notification requirements in accordance with Section 74C of the EP&A Act;
- to promote a more simplistic framework for dealing with Development Applications (DAs) consistent with the amended requirements of the EP&A Act;
- to encourage and assist effective community participation in the decision-making process;
- to provide a more accessible and understandable set of guidelines to the general public; and

- to apply common or consistent requirements and procedures in the assessment of all applications.

4.5.3.1 E1- Ellalong Lagoon Catchment Area

The DCP is specifically applicable to the proposed Stage 3 due to the Project's proximity to the Ellalong Lagoon Catchment Area (E1). The Area is identified as E1, as referenced in the DCP 2006, Part E – Specific Areas (refer to **Figure 4.5**). The Part E - Specific Areas was incorporated into the DCP in March 2007. The objectives of E1 include:

(a) to ensure that the water quality of Ellalong Lagoon, which is already under stress, does not deteriorate further;

(b) to guide subdivision of land to ensure that allotments created meet the objectives of this plan;

(c) to control the erection of dwellings and dual occupancy developments to ensure that they are appropriately sited to take account of on-site constraints;

(d) to reduce nutrient load entering Ellalong Lagoon by ensuring that effluent from residential and rural areas is adequately contained and treated where necessary;

(e) to reduce sediment transfer through adequate control over clearing of land and development works;

(f) to ensure that new developments are not adversely affected by flooding nor exacerbate existing flood levels; and

(g) to promote the use of land within Rural 1(a) zoning for agricultural purposes, whilst ensuring that a high standard of environmental management is incorporated into existing and future developments.

Of particular reference to Austar are the following components of E1:

Erosion Control

Clearing of Land

Those intending to remove trees or clear vegetation within the Ellalong Lagoon Catchment Area within the Rural 1 (a) or Rural Residential 1 (c) zones must consult Clause 20 of the Cessnock LEP 1989.

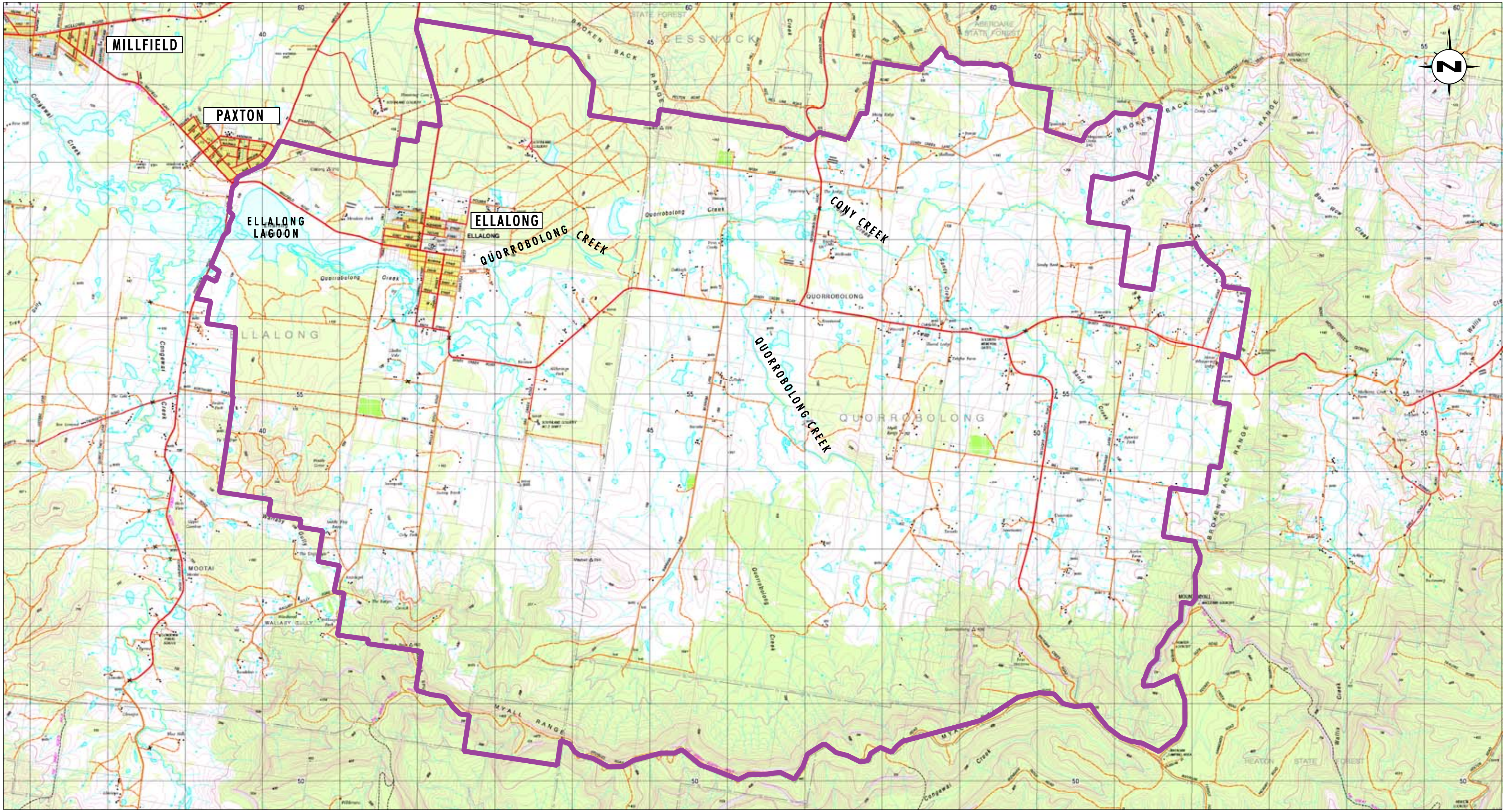
New Development

All development is to be undertaken in accordance with Council's engineering requirements for development for the catchment area, which incorporates erosion and sediment control measures, and specifies requirements for all new building and development works. Conditions of development consent may be imposed requiring specific erosion control works to be undertaken for particular developments, and construction of erosion control measures such as sediment basins.

The proposed development addresses the objectives of the relevant components of the DCP.

4.5.4 Cessnock City Wide Settlement Strategy 2004

The Cessnock City Wide Settlement Strategy 2004 (CWSS) (Cessnock, 2004) seeks to address the competing interests that Council must consider when determining the



Source: Topo Maps: LPI NSW

0 1 2 3km
1:70 000

Legend

Ellalong Lagoon Catchment Management Area

FIGURE 4.5

Ellalong Lagoon Catchment Management Area

appropriate land use or density for settlement opportunities and follows the principles of ecologically sustainable development. The CWSS indicates that the mining of coal has long been one of the driving forces behind the economies of many of the Lower Hunter LGAs, including Cessnock.

The Wollombi Brook Catchment details in the CWSS and mapping indicates that the Wollombi Brook Catchment is classified as having very high to high groundwater vulnerability along its creek banks and a moderately high rating elsewhere. These Wollombi creekline areas are vulnerable to groundwater contamination.

4.5.5 Cessnock Social and Community Plan

The Cessnock Social and Community Plan November 2004 to November 2009 (CSCP) (Cessnock, 2004) has been prepared by Cessnock City Council in partnership with a number of stakeholders within the community and community services centre. The CSCP identifies a range of needs within the Cessnock LGA community and proposes actions and strategies which aim to address the needs identified.

The CSCP states that despite the closure of most of the local mines, many residents travel to the Upper Hunter or Central Coast to retain employment in the coal mining industry.

As stated in **Section 5.8**, the Project will continue to employ ongoing 200 and up to 275 employees for the life of the mine. The proposed development will ensure long-term employment opportunities are available to the local community.

4.6 Southern Coalfield Inquiry

On 6 December 2006, the NSW Government appointed an independent panel to conduct an inquiry into underground mining in the Southern Coalfield. The Terms of Reference for the Inquiry were to:

1. Undertake a strategic review of the impacts of underground mining in the Southern Coalfield on significant natural features (i.e. rivers and significant streams, swamps and cliff lines), with particular emphasis on risks to water flows, water quality and aquatic ecosystems; and
2. Provide advice on best practice in regard to:
   a) assessment of subsidence impacts;
   b) avoiding and/or minimising adverse impacts on significant natural features; and
   c) management, monitoring and remediation of subsidence and subsidence-related impacts; and
3. Report on the social and economic significance to the region and the State of the coal resources in the Southern Coalfield.

In July 2008, the findings of the Southern Coalfield Inquiry (including a number of recommendations), were tabled in a report titled 'Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield Strategic Review' (NSW Department of Planning 2008).

As set out in the terms of reference, the Inquiry specifically focussed on the Southern Coalfield which has different geology and geomorphology to that of the proposed Stage 3 underground mining area and as a result the findings are not directly relevant to the proposed Stage 3 Project. As an example valley closure and upsidence impacts experienced in the Southern Coalfield are not evident to the same magnitude in the Hunter Valley.

Several of the recommendations reflect current practice in the Hunter Valley and have potential relevance to the proposed Stage 3 development. These include:

- Greater consideration of potential subsidence impacts on significant natural features and from geological anomalies;
- Environmental assessments for project applications lodged under Part 3A should consider the following in regard to subsidence effects, impacts and consequences:
  - the provision of a minimum of 2 years of baseline environmental data in assessment of impacts on significant natural features;
  - better distinction between subsidence effects, subsidence impacts and environmental consequences;
  - increased transparency, quantification and focus in describing anticipated subsidence impacts and consequences;
  - increased communication between subsidence engineers and specialists in ecology, hydrology, geomorphology, etc;
  - use of scientific peer review and/or expert opinion in the assessment subsidence impacts on significant natural features;
  - assessment of net benefits;
  - provision of environmental offsets to compensate for either predicted or non-predicted non-remediable impacts on significant natural features;
  - early and appropriate consultation with key government agencies and community stakeholders;
  - determination of the acceptability of impacts in a risk-based decision making framework which includes environmental, economic and social framework and includes consideration of sustainability issues.
- Coal mining companies should develop and implement:
  - approved contingency plans to manage unpredicted impacts on significant natural features; and
  - approved adaptive management strategies where geological disturbances or dissimilarities are recognised after approval but prior to extraction.
- The Part 3A approvals process should be used to set the envelope of acceptable subsidence impacts for underground coal mining projects. Subsidence Management Plans should be used to ensure that the risk of impacts remains within the envelope assessed and approved under Part 3A.

These requirements have been taken into consideration throughout this EA and are discussed further in **Section 9**.

5.0 Environmental Context and Risk Analysis

5.1 Regional and Historic Context of Proposed Development

As stated in **Section 1.1**, Austar is an underground coal mine located approximately 10 kilometres south of Cessnock (refer to **Figure 1.1**) in the Lower Hunter Valley of NSW.

The Central Lowlands of the Hunter Valley is the country of the Wonnarua people. The social interaction of small groups and the seasonal migration according to the seasonal availability of resources was characteristic of the Wonnarua people. The Wonnarua are recorded as having had social ceremonial and trade links from the coast to the western plains of NSW (Brayshaw 1986: 38-41).

European first settlement commenced in the area in the early 1800s and many of the current community are connected to this settlement. Pastoralists began settlement in the region in the 1820s and Wollombi became the first established centre in the area in the 1830s. The township of Cessnock began development in the 1850s and the area's first coal mine began in 1892, near Greta. Mining was the principal driving force behind the expanded settlement of the area and the development of village settlements such as Kitchener, Pelton and Bellbird.

The area covered by the project was historically developed for mining and agricultural purposes. Minor agricultural settlement and timber cutting occurred in the area as early as the 1820s and by the 1840s flour mills were processing locally produced wheat at Millfield, near Austar.

Underground coal mining commenced in the area surrounding Austar in the early twentieth century. Some of the local mines dating to this period include:

- Abermain Colliery 1903 – this was followed by subdivision for the village of Abermain in 1905;
- Bellbird Colliery 1911 – Bellbird village was declared in 1910, this lease continues as part of Austar;
- Aberdare South Colliery 1913 – the village of Aberdare had been laid out in 1906;
- Aberdare Central Colliery 1914 – adjacent to Kitchener;
- Pelton Colliery 1916 – this lease continues as part of Austar;
- Kalingo Colliery 1921 – this lease continues as part of Austar;
- Stanford Main No. 2 Colliery 1922;
- Ayrfield No. 1 1923;
- Ayrfield No. 2 1924; and
- Elrington 1925.

The communities established to support these mines comprise part of the Greta Coal Seam settlements. The villages of Ellalong, Millfield, Kitchener, Aberdare, Pelton, Quorrobolong, Paxton and Bellbird are proximate to the Austar Mine Complex and the Project. The populations of Heddon Greta, Stanford Merthyr, Pelaw Main, Weston, Abermain, Neath, Cessnock, and Bellbird are all located on or near the outcrop of the Greta Seam, with Kurri Kurri located at its north end.

The Lower Hunter Valley is dominated by valley floors which are fringed in the south-west and north-east by the ranges of both the Cessnock and Maitland LGA. The Valley is located within the Hunter-Central Rivers region (HCRCMA, 2006). The region covers approximately 430,000 hectares of which approximately 60% or 264,000 hectares is vegetated. The region supports one of the three largest river valley systems in eastern NSW and includes wetlands of international significance.

The Cessnock LGA also lies within the Hunter Subregion (SB02) of the Sydney Basin Bioregion according to the *Interim Biogeographic Regionalisation for Australia* (IBRA) (EA, 2000).

5.2 Risk Identification – Scoping and Consultation

5.2.1 Government Agency Consultation

During the preparation of this EA, relevant government agencies were consulted to assist in identifying matters to be addressed and potential issues of concern. A Planning Focus Meeting was held on 11 September 2007. Subsequent to this meeting Director-General's Requirements (DGRs) which encompass the issues raised by the relevant government agencies, were provided (see **Appendix 1**). In addition to the Planning Focus Meeting a series of meetings have been held with Cessnock City Council, Department of Planning, Department of Primary Industries, Department of Environment and Climate Change and Department of Water and Energy to discuss the project. The matters identified during these meetings along with those set out in the DGRs and relevant government publications have formed the basis for the preparation of this EA.

Table 5.1 sets out the key matters required to be addressed by the DGRs and identifies where in the EA these matters are discussed.

Table 5.1 – Director-General's Requirements

Requirement	Section of EA
General Requirements	
The Environmental Assessment must include:	
▪ an executive summary;	Executive Summary
▪ a detailed description of the existing operations within the project area that will be used for the project including: – all statutory approvals that apply to these operations; – a justification for the continued road transport of specialty coal products; – a rehabilitation and final land use strategy justifying the proposed final land use for the project area in accordance with relevant strategic land use objectives for the Cessnock area;	Section 2.0 and Appendix 3

Table 5.1 – Director-General's Requirements (cont)

Requirement	Section of EA
General Requirements (cont)	
▪ a detailed description of the project including: – the need for the project; – the alternatives considered; and – the various components and stages of the project, and how these will be integrated into the existing operations within the project area;	Sections 1.2 and 9.0
▪ consideration of any relevant statutory provisions, including whether the project is consistent with the objectives of the *Environmental Planning & Assessment Act 1979;*	Section 4.0
▪ a general overview of the environmental performance of the existing operations within the project area; a description of the environmental management and monitoring measures that currently apply to the existing operations; and a description of any measures proposed to improve the environmental performance of the existing facilities over time;	Sections 2.0, 8.13 and Appendix 3
▪ a general overview of the environmental impacts of the project, identifying the key issues for further assessment and taking into consideration the issues raised during consultation;	Sections 5.0, 6.0 and 7.0
▪ a detailed assessment of the key issues specified below, and any other significant issues identified in the general overview of environmental impacts of the project (see above) which includes: – a description of the existing environment; and – an assessment of the potential impacts of the project; and – a description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the impacts of the project (and how they would be integrated into the existing monitoring and management regime at the Austar Mining Complex);	Sections 2.0, 3.0, 4.0, 5.0, 6.0, 7.0 and 8.0
▪ a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures;	Section 8.0
▪ a conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and the benefits of the project; and	Section 9.0
▪ a signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading.	Appendix 2
Key Issues	
In relation to Stage 3 (i.e. the proposed mining of longwalls A6 to A17 and establishment of the new pit top facilities) the following key issues are to be addressed:	
▪ Subsidence – including impacts on surface and groundwater resources; flooding behaviour and flood prone land; sensitive natural features; cultural heritage sites; public access; and surface infrastructure including roads, utilities, buildings, water storage facilities and other structures. The assessment must also provide a comparison of subsidence and subsidence-related impacts associated with conventional longwall mining and Longwall Top Coal Caving;	Section 6.0
▪ Surface and Groundwater – including a detailed assessment of potential surface water and groundwater impacts; a detailed site water balance; and details of the proposed surface and groundwater monitoring program. As part of the mitigation measures for the project, a surface and groundwater management and contingency strategy must be included which details the measures proposed to protect environmental flows and the water supply to local landholders;	Sections 6.0, 7.0 and Appendices 13 and 14

Table 5.1 – Director-General's Requirements (cont)

Requirement	Section of EA
▪ Flora and Fauna – including any impacts on critical habitats, threatened species, populations and ecological communities;	Sections 5.5, 6.6 and 7.2
▪ Air Quality – including an assessment of air quality impacts at the proposed new pit top facility;	Section 7.8
▪ Greenhouse Gasses – a greenhouse gas assessment (including a quantitative analysis of greenhouse gas emissions associated with the combustion of product coal and a qualitative assessment of the impacts of these emissions on the environment);	Section 5.12
▪ Noise and Vibration – including construction and operational noise impacts at the new pit top facility;	Section 7.7
▪ Traffic and Transport – including construction and operational traffic associated with the new pit top facility;	Section 7.10
▪ Aboriginal and non–Aboriginal Heritage;	Sections 5.6, 5.7, 6.4, 6.5 and 7.3
▪ Visual Amenity; and	Section 7.9
▪ Social and Economic – particularly with regard to any increased demand for infrastructure and services in the region.	Sections 1.2.1 and 5.10
References	
The Environmental Assessment must take into account relevant State government technical and policy guidelines. While not exhaustive, guidelines which may be relevant to the project are included in the attached listed.	Section 10.0
Consultation	
During the preparation of the Environmental Assessment, you should consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised must be described in the Environmental Assessment. In particular you must consult with: ▪ Department of Environment & Climate Change; ▪ Department of Water & Energy; ▪ Department of Primary Industries; ▪ NSW Roads and Traffic Authority; ▪ NSW Mine Subsidence Board; and ▪ Cessnock City Council. The consultation process and the issues raised must be described in the Environmental Assessment.	Section 5.2

5.2.2 Stakeholder and Community Consultation

In addition to discussions with relevant government agencies, a detailed community and stakeholder consultation program has been undertaken as part of this project to identify further matters that the community seek to have addressed in the EA.

As part of consultation stakeholders from a number of Aboriginal groups registered their interest in the Project. A detailed assessment of the consultation process and outcome is provided in **Sections 6.4** and **7.3.1**.

The other major stakeholder group that was consulted comprised landholders in the area. Land use in the vicinity of the proposed development area is primarily forests associated with Werakata State Conservation Area which are managed by the NSW Department of

Environment and Climate Change (DECC) and privately-owned rural lands (with dispersed rural settings) and residential areas. The closest residence to the proposed Surface Infrastructure Site is approximately 600 metres to the south. The village of Kitchener is approximately one kilometre north of the site.

The Community Consultation Program has been integral to the EA, subsidence and operations management processes for the proposed development. Austar has been engaged in this consultation process on an ongoing basis since mining recommenced in 2005. Consultation has included discussions with landholders and meetings with a number of community groups throughout 2006 and 2007, including Cessnock LGA Landcare Group Inc, Quorrobolong Community Council, Cessnock Tidy Town Committee, Minewatch NSW Inc, Coalfield Heritage Group Inc, Kurri Kurri Chamber of Commerce and Industry Inc and Wollombi Valley Chamber of Commerce Inc.

Key objectives of the consultation process have included:

- distribute information and ensure that the community was informed by the distribution of information flyers, dedicated Project website, information brochures, production of newsletters, media releases, presentations, telephone contact, individual face-to-face meetings, and community group meetings;

- to gather information from the community in response to the information that was presented (of both the underground mining and the construction of the Surface Infrastructure Site). To facilitate this, the community was provided with feedback sheets; contact phone numbers; face-to-face interviews upon request and the opportunity to voice their opinions at community meetings and public information sessions; and

- presentations to and discussions with the Austar Community Consultative Committee to determine and address issues that may be raised by the community.

A detailed description of the consultation program is provided in **Appendix 4**. Through the stakeholder and community consultation program a range of community values were identified. These included:

- privacy, independence, security and friendly social context;
- scenic and acoustic amenity;
- rural lifestyle choices and property integrity;
- a productive rural environment;
- sustainability in practice;
- an affordable village lifestyle; and
- respect for intact or restored natural and cultural heritage.

During the consultation process, the community identified that it has a strong connection with both their heritage and environment, consequently seeing the need to retain:

- heritage character;
- landscape;

- privacy;
- a largely independent lifestyle;
- aesthetics;
- darkness of night time;
- quiet atmosphere;
- environmental values;
- a relaxed lifestyle;
- economic stability;
- safety of people and livestock;
- rural productivity; and
- the affordability of a village lifestyle.

In addition to these community values, a number of matters of concern in regard to the proposed development were identified. These included potential impacts from the proposed development in regard to:

- subsidence (see **Section 6.1**);
- air quality (see **Section 7.8**);
- noise (see **Section 7.7**);
- vibration (see **Section 7.7**);
- property values (see **Sections 5.10** and **6.1**);
- sustainability (see **Section 9**);
- potential declaration of a mine subsidence area (see **Section 4.2.4**); and
- road degradation (see **Section 6.1.9**).

Furthermore, the community expressed a strong desire to be kept well-informed about mining activities and want reliability and accessibility to all important information. They believe that keeping the actions of Austar transparent is an easy way to ensure that honesty and integrity is upheld.

The proposed development of the new Surface Infrastructure Site off Quorrobolong Road has the potential to impact on the village of Kitchener which is approximately one kilometre north of the site. EA project team members and company representatives attended a meeting at Kitchener and also conducted interviews with a few residents from Kitchener to establish what attributes of the village are valued and what concerns the residents may have in regard to the proposed development. Values and attributes identified included:

1. an affordable, small village lifestyle with large blocks (currently poorly serviced by shopping, public transport or medical services);

2. some Kitchener residents have lived in the village since the days of active mining in the district, or have inherited property from relatives who worked in the mines;

3. all employed residents work away from the village during the day;

4. the steep winding road to the south of the village may currently help to reduce speed; and

5. scenic and acoustic amenity, including an open parkland and darkness at night.

Potential impacts of the proposed development on the village of Kitchener are discussed in **Section 7**.

As identified above, these values and matters of concern which represent potential risks to the community have been considered and are incorporated into the environmental assessment process that has been undertaken.

5.3 Climate and Meteorology

The climate of the Lower Hunter Valley is described as warm temperate. The region is characterised by seasonal variations from hot wet summers to mild dry winters. The average temperature range is between minus 4.2 to 44.9 degrees Celsius and the highest mean 9 am windspeed is 13.9 kilometres per hour (BoM, 2008). Climate parameters for Cessnock (BoM Station 61242) for the period 1973 to 2000 are summarised in **Table 5.2**.

Table 5.2 – Climate Averages (Cessnock, 1973-2000)

Parameter	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Maximum Temperature (°C)	29.9	29.2	27.4	24.6	21.0	17.9	17.5	19.4	22.2	24.9	27.1	29.4
Average Minimum Temperature (°C)	17.5	17.4	15.5	11.8	8.9	6.0	4.5	5.0	7.7	10.8	13.4	15.9
Average Daily Evaporation (mm)	5.7	5.0	4.0	2.9	1.9	1.6	1.8	2.6	3.6	4.3	5.2	6.0
Average Rainfall (mm)	89.7	92.3	91.7	66.0	62.5	54.4	40.1	35.4	44.1	60.7	71.2	64.6
Average Temp. at 9am (°C)	23.0	22.1	21.2	18.3	14.3	10.9	9.9	11.9	15.9	19.2	20.2	22.5

Table 5.2 – Climate Averages (Cessnock, 1973-2000) (cont)

Parameter	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Relative Humidity at 9am (%)	69.6	74.5	73.7	73.7	80.2	80.2	78.2	70.4	62.2	59.4	64.0	63.8
Average Cloud Cover at 9am (oktas)	4.9	5.0	4.7	4.3	4.6	4.2	3.8	3.1	3.6	4.4	4.6	4.7
Average Temp. at 3pm (°C)	28.4	27.8	25.9	23.2	19.8	16.7	16.4	18.3	20.9	23.2	25.4	28.0
Average Relative Humidity at 3pm (%)	50.0	52.2	54.2	52.5	56.5	56.4	51.7	44.4	44.0	45.9	46.4	45.3
Average Cloud Cover at 3pm (oktas)	5.1	5.1	5.0	4.8	4.9	4.7	4.3	4.0	4.4	4.8	5.1	4.9

Rainfall in the region is summer dominant, often presenting as high intensity storms. The entire region receives an average of 750 to 950 millimetres of rain per annum. Cessnock receives approximately 750 millimetres of rain per year, which falls on 66 days of the year (BoM, 2007).

Analysis of historical daily rainfall data (Umwelt, 2008b) indicates that major storm events have occurred in the region in 1927, 1930, 1949, 1990 and 2007. Each of these storm events have typically resulted in overland flow flooding and backwater flooding within the Austar Mine Complex. In the 1990 storm event, for example, 311 millimetres fell in 48 hours at Mulbring and 296 millimetres fell at Congewai, the two closest stations near Quorrobolong at the time.

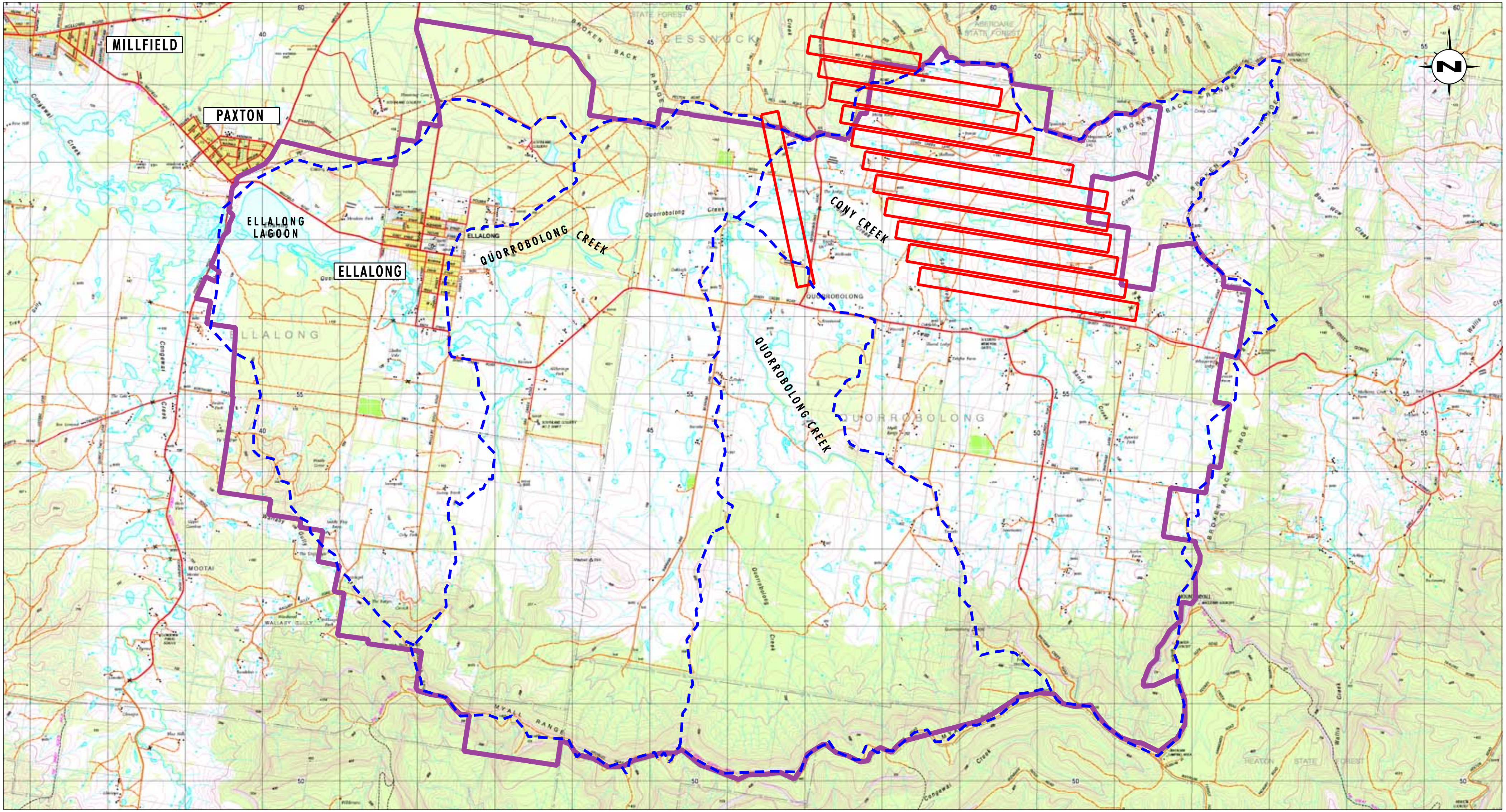
Since April 2007, Austar has operated a meteorological station at the Ellalong Drift and Pit Top that records rainfall at 10 minute intervals as well as wind speed and direction. Over the June 2007 long weekend (8 and 9 June) 255 millimetres of rainfall was recorded and was the equivalent of a 60 year Average Recurrence Interval (ARI) 36 hour event and 115 Average Recurrence Interval rainfall 24 hour event. To assist in providing certainty in regard to predicted outcomes, this event was used as part of the flooding assessment that was undertaken for the proposed Stage 3 mining which is discussed further in **Section 6.2**.

5.4 Landform Characteristics

5.4.1 Topography and Drainage

The morphology of the area surrounding Austar Mine Complex includes Broken Back Range (see **Figure 1.1**); the alluvial flats landforms of Black Creek, Bellbird Creek, Cony, Sandy Creek and Quorrobolong Creek systems and the intervening, undulating lands. Catchment boundaries in the vicinity of the proposed Stage 3 area are shown on **Figure 5.1**.

The majority of the proposed Stage 3 mining area is located immediately to the south of Broken Back Range which is a major landform extending from west of Pokolbin to Mulbring. Broken Back Range has a maximum elevation adjacent to the Stage 3 mining area of RL 236 metres. This unit is characterised by the steep slopes, narrow ridges and deep gullies. The majority of the Broken Back Range landform in the vicinity of the Austar Mine Complex is within the boundary of the Werakata State Conservation Area.



Source: Topo Maps: LPI NSW, Longwall Layout: Austar Coal Mine

0 1 2 3km
1:70 000

Legend

Conceptual Layout for Stage 3 Longwall Panels
Catchment Boundary
Ellalong Lagoon Catchment Management Area

FIGURE 5.1

Stage 3 Proposal: Catchment Boundaries

File Name (A4): R10_V1/2274_356.dgn

The majority of the proposed Stage 3 area drains to Congewai Creek catchment which is bounded by the Watagan Mountains in the south, Broken Back Range in the north and west and Black and Wallis/Swamp Creek catchments to the east. Water flows west out of the catchment via Quorrobolong Creek system which drains to Ellalong Lagoon from where it flows into Congewai Creek, Wollombi Brook and subsequently the Hunter River.

The Lagoon is situated immediately to the south of the townships of Ellalong and Paxton and will be conserved as the 530 hectare Ellalong Lagoon Conservation Area. A large area of endangered Hunter Lowland Red Gum Forest and small areas of River-flat Eucalypt Forest on coastal floodplain will be protected. The Lagoon itself supports a population of green and golden bell-frogs (CCC, 2004). Potential impacts on Ellalong Lagoon were raised as an issue during consultation and are taken into consideration as part of flooding and water management in **Section 6.2**.

The Ellalong Drift and Pit Top (see **Figure 2.2**) is also located on the upslope sections of an unnamed tributary that drains to Congewai Creek downstream of Paxton. The continuing activities at Ellalong Pit Top are addressed as part of the Austar Site Water Management Plan (see **Section 2.3.2.3**).

Pelton CHPP and associated emplacement and rail and coal loading infrastructure are located in the upslope sections of Bellbird Creek catchment which forms part of the Black Creek catchment. The continuing activities at Pelton CHPP and associated emplacement and rail and coal loading infrastructure are addressed as part of the Austar Site Water Management Plan (see **Section 2.3.2.3**).

The proposed Stage 3 mining area is located within Sandy Creek and Cony Creek catchments which form part of the Quorrobolong Creek system. Characteristics of Sandy Creek and Cony Creek systems are discussed further in **Section 5.4.2**.

The proposed new Surface Infrastructure Site off Quorrobolong Road is also located in the upslope sections of Black Creek. Black Creek is joined by Bellbird Creek in Cessnock and subsequently drains into the Hunter River. Characteristics of Black Creek systems are discussed further in **Section 5.4.3**.

5.4.2 Cony Creek and Sandy Creek Catchments

The proposed Stage 3 underground mining area is located on the south facing lower gentle slopes of the Broken Back Range and includes the Sandy Creek and Cony Creek drainage system and associated flats and footslopes. Most of the central and southern portions of the proposed Stage 3 Mining area is located under undulating hillslopes, which extend from the Broken Back Range to the alluvial landforms of the Cony and Sandy Creek systems.

The Cony and Sandy Creek system hillslopes have an average gradient of between 1 and 5%. The eastern slopes of the Broken Back Range and the southern crest near Sandy Creek Road have slopes extending up to 18%. The hillslopes are up to 500 metres wide, and elevation in this unit ranges between 130 and 200 mAHD.

Cony Creek and Sandy Creeks are characterised by numerous tributaries that have a combined length of approximately 46 kilometres above the proposed Stage 3 mining area. Within the proposed Stage 3 mining area there is approximately 23.6 kilometres of first order, 10.4 kilometres of second order, 5.2 kilometres of third order, 5.9 kilometres of fourth order streams and 1.3 kilometres of fifth order streams. Alluvial flats and floodplains occur along sections of third, fourth and fifth order streams. Flats of up to 500 metres extend from both creeks. Disturbance and erosion is evident in both systems.

Cony Creek flows from east (headwaters) to west above the proposed longwalls where it joins Quorrobolong Creek approximately 650 metres west of LWA6. The creek channel is typically approximately four metres wide, with steep banks up to two metres in height.

Sandy Creek originates to the south of the proposed Stage 3 mining area in the slopes of the Myall Range. This creek joins Cony Creek at the south-western edge of the Stage 3 mining area. The channel is approximately two to three metres wide with steep banks that are typically one to two metres high.

Potential impacts of the proposed Stage 3 underground mining on the Cony Creek and Sandy Creek systems are discussed in **Sections 6.1.15** and **6.2**.

5.4.3 Black Creek Catchment

The Black Creek Catchment is bounded to the south by Broken Back Range, Wallis/Swamp Creek Catchment to the east and the LGA boundary to the north. Black Creek flows in a northerly direction through Cessnock to Branxton before joining the Hunter River.

The Black Creek system is classified as being very highly saline and consequently unsuitable for irrigation, stock watering, potable supply and for the maintenance of aquatic ecosystems (ANZECC, 1992 in CCC, 2004). The presence of faecal contamination also renders Black Creek unsuitable for potable supply (NHMRC, 1987 in CCC, 2004) but acceptable for recreational and agricultural uses (ANZECC, 1992 in CCC, 2004). Overall the Black Creek catchment is generally regarded as a degraded catchment suffering from saline water ingress and subsequent adverse effects to the due to extraction for irrigation and stock watering (CCC, 2004).

Black Creek drains the proposed new Surface Infrastructure Site. There is evidence of high flows in the past, and there are often several small pools of standing water (Umwelt, 2008b).

Potential impacts from construction and operation of the proposed new Surface Infrastructure Site on Black Creek are discussed in **Sections 7.4** and **7.5**. Also outlined are the requisite soil and water controls that will be implemented in the Surface Infrastructure Site construction phase.

5.4.4 Regional Groundwater Resources

The regional groundwater resources in the area surrounding the Austar Mine Complex comprise:

1. Alluvial aquifers

   Quorrobolong Creek, Sandy Creek and Cony Creek each have alluvial sediment deposits. The groundwater in the alluvium is derived largely from infiltration of rainfall and runoff, although some is derived from lateral infiltration during high flows in the adjacent creeks. There is negligible utilisation of the alluvial groundwater in the area principally due to low yields and high salinity. There are no registered groundwater bores within the proposed Stage 3 mining area, however there are several bores in the surrounding area as shown on **Figure 5.2**.

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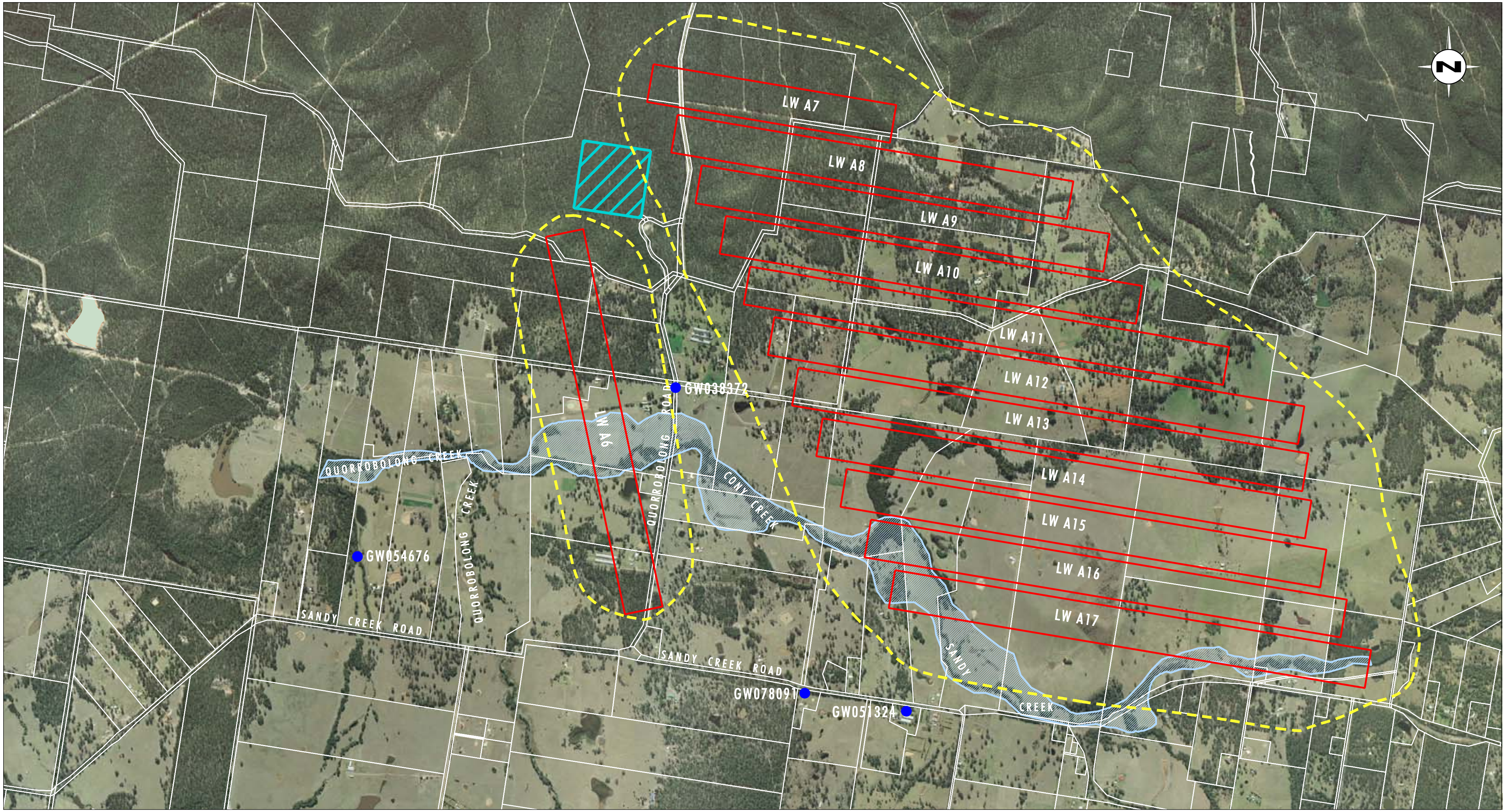


Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW,
Aerial Photography: AAM Hatch 2006, Alluvial: Connell Wagner

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Groundwater Bore Locations
- Alluvial Area

FIGURE 5.2

Extent of Alluvium

File Name (A4): R10_V1/2274_613.dgn

2. Fractured rock aquifers (including coal seam aquifers)

   The Permian strata overlying the coal measures in the Newcastle Coalfield generally have very low permeabilities (<10^{-8} m/s). There are occasional layers that have a slightly higher permeability and represent relative aquifers. Discontinuities in this water bearing strata are termed fractured rock aquifers. Flows are often small in these zones, and water quality is generally poor and suitable only for stock use. Fractured rock strata in the vicinity of Austar Mine Complex include the Branxton Formation and the Greta Coal Measures.

3. Abandoned coal mines

   The local groundwater regime in the vicinity of the Austar Mine Complex is heavily influenced by historic mine workings. Abandoned collieries adjacent to the Austar mine such as Pelton, Bellbird, Kalingo, Aberdare Central and Aberdare East (see **Figure 2.1**) are partially filled with groundwater that typically has very low pH, high conductivity and high iron and sulphate levels. These abandoned workings are filled by normal groundwater percolation through fractured rock and through infiltration via interconnected cracking in areas where shallow workings exist. Fine tailings from Pelton CHPP and mine water from the former Southland colliery are also discharged into Pelton and Bellbird collieries in accordance with the Austar Site Water Management Plan (Austar 2008).

   As stated, the quality of water contained in the abandoned mine workings is extremely poor. This is evidenced by the groundwater quality data obtained for water entering the mine through the coal barriers between the abandoned mines and the Austar workings.

A detailed assessment of the characteristics and potential impacts of the proposed Stage 3 underground mining on the groundwater resources is provided in **Section 6.3**.

Operation of the proposed new Surface Infrastructure Site has negligible potential to impact on groundwater resources. Soil and water management controls for the proposed new Surface Infrastructure Site are set out in **Section 7.5**.

5.4.5 Geology and Soils

Geology

Austar is located in the South Maitland Coalfield of the Maitland Group which forms part of the Newcastle Coalfields. The mid Permian Age Greta Coal Measures outcrop around the Lochinvar Anticline, which is the dominant structural feature in the Cessnock area. Austar Mine Complex is located on the nose of the Anticline. Coal in the Stage 3 area will be sourced from the Greta Seam at depths of approximately 440 to 750 metres below the surface (see **Figure 3.1**). The Seam is the main economic coal seam in the Greta Coal Measures (CW, 2007).

The Greta Seam is overlain by the Branxton Formation, which comprises a series of interbedded sandstone and siltstone layers up to 20 metres thick. The Pelton Seam, which is less than 0.5 metres thick, lies at the top of the Branxton Formation and forms the upper limit of the Greta Coal Measures (CW, 2007).

Four geological units are present in the area surrounding the proposed Stage 3 development (see **Figure 5.3**). The geological units include:

1. Branxton Formation

   The Formation overlies the Greta Coal Measures and extends to the ground surface. The Formation is prevalent across most of the proposed Stage 3 underground mining area with small exclusions including linear belts of Fenestella Shale in the north, undifferentiated alluvium along Cony Creek and Sandy Creeks and Muree Sandstone in the south. Maximum thickness in this region is of the order of 1300 metres, and comprises sandstone and conglomerate towards the base, with silty sandstone becoming more common towards the top. The rock is generally strong and massive, with few bedding plane partings. The thickness and strength of this formation is such that it can span significant distances when undermined and as a result it effectively acts as a beam above the mining goaf supporting the overlying strata. Characteristics of the Branxton Formation and its response to predicted subsidence impacts are discussed further in **Section 6.1**.

2. Muree Sandstone

   The Sandstone is Early Permian in age and occurs in a narrow band at the south of the proposed Stage 3 underground mining area. The band is no greater than 430 metres wide in this area and runs beneath the eastern portion of Sandy Creek Road. The sandstone is fine to coarse-grained and also comprises conglomerate and minor clay.

3. Fenestella Shale

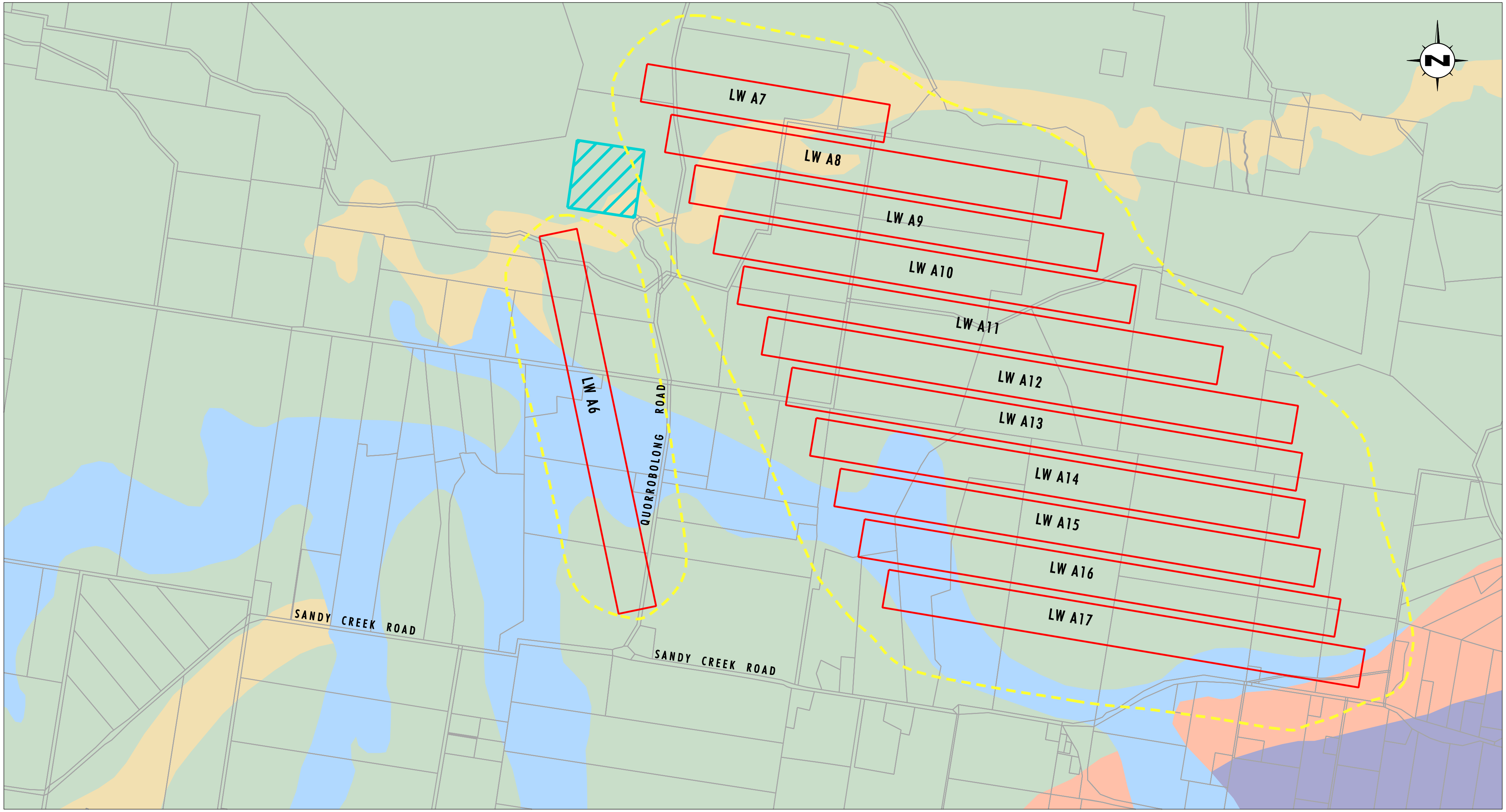
   Fenestella Shale consists of fine to coarse grained sandstone, conglomerate and clay and occurs in a narrow band, no greater than 380 metres wide in the northern part of the proposed Stage 3 underground mining area. The landscape above this band of Fenestella Shale is contained within the Werakata State Conservation Area, and consists of steep slopes with intermittent gullies.

4. Undifferentiated alluvium

   The undifferentiated alluvium is confined to the alignment of Sandy Creek and the alignment of the Cony Creek system to the west of its junction with Sandy Creek. The alluvium contains sand, silt, clay, gravel, residual and colluvial deposits, channel, levee, lacustrine, floodplain and swamp deposits. Tertiary terraces may also be present.

A detailed assessment of the potential impacts from underground mining on the geological and hydrogeological attributes of the area is discussed further in regard to:

- Subsidence and Land Use in **Section 6.1**;
- Groundwater in **Section 6.3**; and
- Aboriginal Archaeology in **Section 6.4**.



Source: Cadastre: LPI NSW, Geology: Mineral Resources 2003, Longwall Layout: Austar Coal Mine

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Branxton Formation (Conglomerate, sandstone, siltstone)
- Fenestella Shale (Conglomerate, sandstone, siltstone)
- Undifferentiated alluvial deposits; sand, silt, clay and gravel; some residual and colluvial deposits. Includes some channel, levee, lacustrine, floodplain and swamp deposits. May include some higher level Tertiary terraces
- Mulbring Siltstone (Siltstone, claystone, minor fine-grained sandstone)
- Muree Sandstone (Fine to coarse-grained sandstone, conglomerate, minor clay)

FIGURE 5.3

Geological Map

Soils

Three soil landscapes described below occur within the Project area as shown on **Figure 5.4**. The soil pH throughout the Project area varies from slightly acidic to alkaline.

1. Quarrabolong Soil Landscape

   The Quarrabolong Soil Landscape comprises a significant proportion of landscape above the proposed Stage 3 mining area. The Landscape defines the creek lines and associated landforms (flats, lower hillslopes) of the Quorrobolong Creek, Cony Creek and Sandy Creek systems. These soils have very low permeability and very high strength when dry (Charman and Murphy, 1991). The sandy nature of the upper horizons potentially leads to accelerated erosion if disturbed (HLA, 1995).

2. Aberdare Soil Landscape

   Aberdare Soil Landscape extends along the crests and hillslopes of the Project area to the south of the Werakata State Conservation Area. Alluvial soils (sand) are also found along drainage lines. Topsoil pH ranges between 5 and 6.5 (Kovac and Lawrie, 1991). The topsoil and subsoil can be moderately erodible.

3. Branxton Soil Landscape

   The Branxton Soil Landscape occurs only in the northern section of the Project area and within the Werakata State Conservation Area. The soils of this landscape include yellow podzolic, red podzolic, yellow soloth soils, alluvial sands and siliceous sands. Excluding alluvial soils, the topsoil of all units is moderately erodible. Topsoil pH ranges between 5.5 and 6.5. Acid topsoil problems are encountered throughout the area (Kovac and Lawrie 1991:109). The soils with the proposed Surface Infrastructure Site belong to the Branxton Soil Landscape.

A detailed assessment of the potential impact from the proposed Stage 3 underground mining on the soils of the area is discussed further in regard to:

- Subsidence and Land Use in **Section 6.1**;
- Drainage lines in **Section 6.2**; and
- Ecology in **Section 6.6**.

Assessment of the potential impact on soils of the area resulting from the construction and operations of the proposed new Surface Infrastructure Site is discussed in **Sections 7.4** and **7.5**.

5.4.6 Visual Attributes

The visual context of the area surrounding Austar Mine Complex is of predominantly forests and native vegetation interspersed with cleared pasture areas, roads, small villages (Ellalong, Paxton, Millfield and Kitchener), rural residences and the urban development of Cessnock and Bellbird to the north of Pelton CHPP. Several rural residences are located in elevated positions to the west of the Pelton CHPP.

Visually prominent features of the area include Ellalong Lagoon, Broken Back Ranges and Watagan Mountains. Werakata State Conservation Area is located to the north and east of the proposed Stage 3 underground mining area and surrounds the proposed new Surface

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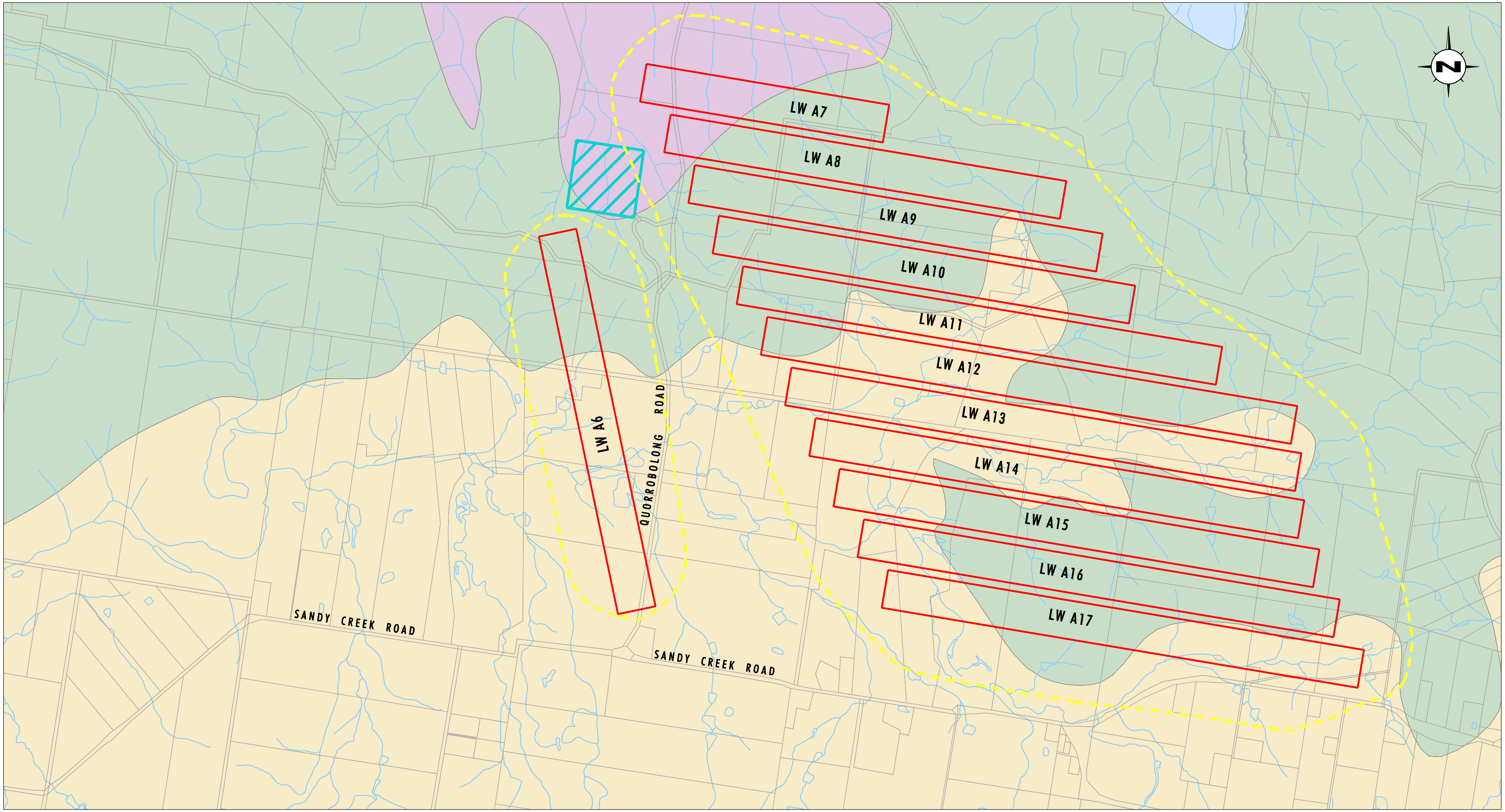


Source: Cadastre: LPI NSW, Soils: Department of Natural Resources 2005, Longwall Layouts: Austar Coal Mine

0 0.5 1 1.5km
1:32 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Quorrobolong Soil Landscape
- Aberdare Soil Landscape
- Neath Soil Landscape
- Branxton Soil Landscape
- Drainage Line

FIGURE 5.4

Soil Landscape Map

File Name (A4): R10_V1/2274_614.dgn

Infrastructure Site. The village of Kitchener is located approximately 1.5 kilometres north of the proposed new Surface Infrastructure Site. The Ellalong Drift and Pit Top facilities are located at the western edge of the Werakata State Conservation Area.

Farms and forested areas of Quorrobolong are situated above and to the south and north of the proposed Stage 3 underground mining area. The proposed Stage 3 underground mining is not expected to significantly change the surface appearance of the area and is predicted to have a negligible impact on the visual attributes of the surrounding area. Potential changes to the landform above the proposed Stage 3 mining area are minor as discussed further in **Section 6.1** and are not expected to change the visual character of the area.

The village of Kitchener is located north of the Surface Infrastructure Site and the village of Abernethy is located to the north-east. The closest residence to the proposed Surface Infrastructure Area is approximately 600 metres to the south and is well screened by intervening forest. A detailed visual assessment for the proposed new Surface Infrastructure Site is provided in **Section 7.9**.

5.5 Ecology

The Austar Mine Complex and surrounding area is within the Cessnock-Kurri vegetation area in the Lower Hunter Valley, as defined by Bell and Driscoll (2007). The Cessnock-Kurri area comprises part of the Hunter Subregion (SB02). The vegetation communities present encompass the structural range from simple sedgeland to subtropical rainforest, and include various forest communities with Spotted Gum (*Corymbia maculata*) being a dominant tree species.

The Subregion is of biogeographic and scientific significance as it supports a transition between the sub-tropical northern and less fertile southern ecological communities. Plant species that are characteristic of coasts, mountains, semi-arid areas and sandstone outcrops are evident (DEC, 2006). The major ecosystems of the Lower Hunter Valley include Wetlands, Dry forest and woodlands, Heath, Swamp forest and Moist forest/rainforest.

The native forests of the region have also experienced a long history of disturbance and management for timber. The Spotted Gum and Ironbark stands were specifically managed to provide pit props and other timber needs for the surrounding coal mines. This management technique has left forests in the area dominated by a young regrowth stand of even-aged trees (DECC, 2005).

The Cessnock-Kurri area supports nearly 800 native plant taxa across 37 vegetation communities. A total of 23 of these taxa are considered of significance. Seven endangered ecological communities (EECs), are listed in the NSW *Threatened Species Conservation Act 1995* (the TSC Act), and present within the area. A total of 10 of these taxa are currently listed on the EPBC Act or the TSC Act. Eight of these the taxa are considered to be nationally rare. Several newly discovered taxa also exist in the area.

Many of these species are well conserved in the reserves systems of The Werakata National Park and the Werakata State Conservation Area. Both reserves represent significant conservation measures for the species of the region. These areas are both managed by the Department of Environment and Climate Change (DECC).

The proposed development has potential to impact on the ecology of the landform above the proposed Stage 3 mining area and on the ecology of the proposed Surface Infrastructure

Site (see **Appendix 5**). Impacts on ecology outside of these areas are considered to be highly unlikely.

A detailed assessment of the ecology and potential impacts of the proposed Stage 3 underground mining area is provided in **Section 6.6**. Potential impacts on the ecology of the proposed Surface Infrastructure Site are discussed in **Section 7.2**. Biodiversity offset measures are detailed in **Section 7.2.4**.

5.6 Aboriginal Archaeology

A number of Aboriginal sites within the Cessnock and Wollombi region, including one ceremonial ground and two burial sites at Quorrobolong have been identified by primary sources and discussions with local residents (Needham, 1981). Cony Creek and Sandy Creek (and surrounding lower hillslopes and flats) were identified to be areas of archaeological potential by Aboriginal stakeholders and archaeologists during studies undertaken as part of this EA. Details of the Aboriginal Heritage Assessment that was undertaken as part of the proposed development is provided in **Appendix 6**.

A description of the identified Aboriginal Cultural Heritage of the proposed Stage 3 mining area and potential impacts from ongoing operations is provided in **Section 6.4**. Extensive stakeholder consultation has contributed to the identification of potential impacts and significance. Most sites identified were assessed to be of low to moderate scientific significance. An identified grinding groove was assessed to be of moderate scientific significance (refer to **Section 6.4**).

A comprehensive management strategy has been established for the proposed development. Austar and the Aboriginal stakeholders have agreed upon a grinding groove offset strategy of a monetary contribution of $100,000 to an Aboriginal project or program (refer to **Section 8.8**).

No archaeological sites or areas of cultural significance were identified within the proposed Surface Infrastructure Site.

5.7 Historic Archaeology

The coal mining industry has played an important role in the development of the Lower Hunter Valley, encouraging its settlement in the late eighteenth century (HO & DUAP, 1996). Before the development of the South Maitland Coalfields in the late 1880s, Cessnock was a farming area on the margins of the Hunter Valley. Settlers moved into the Cessnock area in the 1820s, and were involved in grazing sheep and cattle, growing wheat and maize and timber getting. Vineyards developed after the 1840s (HLA, 1995b).

With the development of mines at East Greta in 1892, exploitation of the South Maitland Coalfields began. The Greta Coal Seam measures were followed south and additional mines began to open. By 1906 mines were established in the Cessnock area and were linked to what later became the South Maitland Railway. Collieries to the south of Cessnock (in the vicinity of the Austar Mine Complex) were established in the early 1900s. Bellbird, Ellalong, Quorrobolong, Kitchener, Paxton, Kitchener and Kearsley communities were established adjacent to the mines to house workers.

As outlined in **Section 2.1**, Austar Coal Mine is an amalgamation of several historical mines. A chronology of the mining and related activities of the Greta Coal Seam at the Austar Mine

Complex site is presented in **Table 2.1**. Extensive land clearing activities were undertaken across the Cessnock LGA and the area surrounding Austar Mine Complex from the time of the early settlers in the first half of the nineteenth century.

The Cessnock LEP lists several items that are deemed Items of Environmental Heritage (Schedule 3) (CCC, 1989). In particular, Items in the vicinity of Austar Coal Mine include:

- Item 18 (All earthworks, structures and ancillary equipment along the South Maitland Railway, including a corridor of land 100 metres wide centred on the railway trackbed centreline);
- Item 20 (Pelaw Main Colliery Precinct);
- Item 21 (Abermain No. 1 Colliery Precinct);
- Item 22 (Hebburn No. 1 Colliery Precinct);
- Item 23 (Hebburn No. 2 Colliery Precinct); and
- Item 24 (Richmond Main Colliery Precinct).

None of these items will be adversely impacted by the proposed Stage 3 development. No items considered to be of local, heritage, archaeological research or State heritage significance will be impacted.

A Historic Heritage assessment of the land above the proposed Stage 3 underground mining area and of the proposed Surface Infrastructure Site has been undertaken and is provided in **Appendix 7**.

A summary description Historic Heritage items above the proposed Stage 3 mining area and an assessment of potential impact on these items is provided in **Section 6.5**. The assessment indicates that potential impacts are low or minimal.

The predicted impact of the construction of the Surface Infrastructure Site on Historic Heritage attributes is also expected to be low or minimal and is discussed further in **Appendix 7**.

5.8 Land Use and Tenure

The Cessnock City Wide Settlement Strategy (CWSS) identifies an interaction of urban, rural-residential, and rural-settlement with agriculture, mining, forestry, and extractive industries as the existing land uses of the LGA (CCC, 2004).

Areas to the north and west of the Project are being considered as part of new urban development strategies in the Lower Hunter Regional Strategy (LHRS) (DoP, 2006). Cessnock LGA is identified as a major growth centre in the LHRS and has a projected capacity of an additional 21,700 dwellings over the next 25 years. New projected urban areas include Bellbird North, Bellbird Heights, Millfield-Paxton (Sanctuary Village) and Kitchener (CCC, 2004).

Land use in the area surrounding the proposed Stage 3 development is primarily rural lands (with dispersed rural settings), residential and the forested areas of Werakata State Conservation Area. The land is this area includes the villages of Ellalong, Millfield, Kitchener, Quorrobolong, Aberdare, Abernethy, Pelton, Paxton and Bellbird. The dominant land uses within and adjacent to the Project area include grazing, poultry production, forestry and mining.

As specified on the Cessnock LEP Zoning Map (refer to **Figure 4.4**), the land surrounding the proposed development area is zoned:

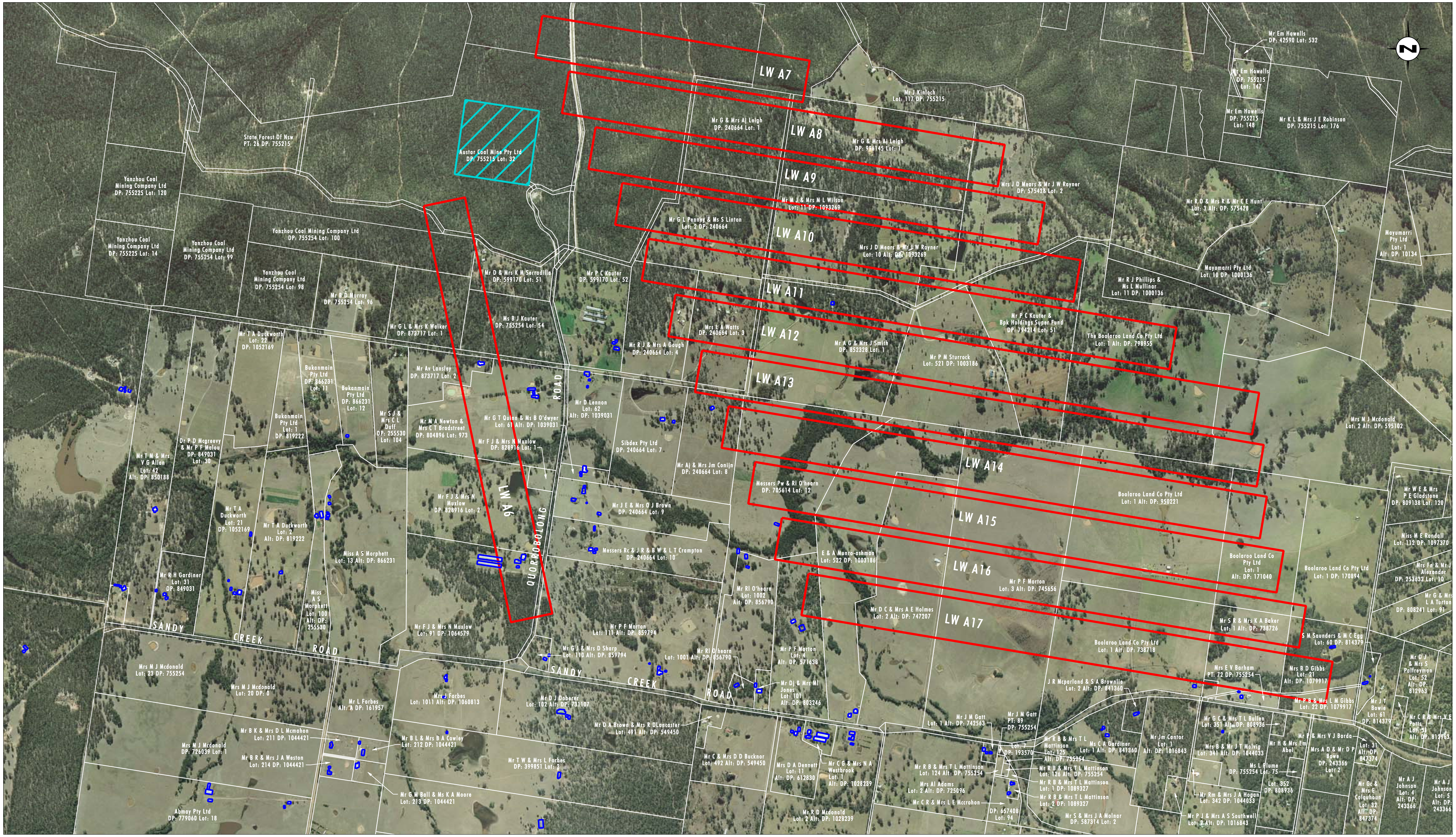
3. Zone No 1(a) Rural 'A' Zone; and
4. Zone No 1 (f) Rural (Forestry) Zone.

The northern portion of the mine plan extends underneath the Werakata State Conservation Area and sections of Crown land, as well as an area of Austar owned land. Austar owns the proposed Surface Infrastructure Site area. The remainder of the proposed Stage 3 mining area is located under private land as shown on **Figure 5.1**. Cadastral boundaries and the locations of dwellings are shown on **Figure 5.5**. Land use and landscape characteristics of the proposed Stage 3 area are summarised in **Table 5.3**.

Table 5.3 – Landscape and Land Use in the Vicinity of the Proposed Stage 3 Development (Quorrobolong Valley)

Project Land Areas	Project Area Features
North of Nash Lane/West of Quorrobolong Road	A series of blocks on partly forested steeper land, on the margins of the former Aberdare State Forest. Austar owns several of these blocks, closest to the Site. Two owners in this area are seeking to develop cabins for weekend tourism.
Between Nash Lane/Sandy Creek Road/West of Quorrobolong Road	Dominated by elongated allotments aligned north to south, with east west property boundaries aligned with the channel of Quorrobolong Creek. Gently sloping and have access to natural water supplies from pools along Quorrobolong Creek and its tributaries. Multiple large dams for cattle.
Between Coney Creek Lane/Sandy Creek Road/East of Quorrobolong Road	A series of relatively large/cleared properties (except along the creek lines and extensive creek flats). New spacious homes have been built (as a second residence). Small scale cattle grazing dominates. Some land rehabilitation/revegetation projects. Access to good water supplies in Sandy Creek or to large farm dams.
South of Sandy Creek Road/West of Quorrobolong Road junction	Allotments elongated and aligned east west. Access to tributaries of Quorrobolong Creek. Some properties overlie former underground mine workings, but none are located over the proposed conceptual Mine Plan.
South of Sandy Creek Road/East of Quorrobolong Road	Series of small allotments, some subdivided. Earlier rural character is being replaced by smaller scale; densely settled, rural residential development. Most blocks retain endemic vegetation. Not located above the conceptual Mine Plan.
North of Coney Creek Lane/East of Quorrobolong Road	Series of moderately large blocks on steeper, well vegetated country. Property owners in this area tend to be owner occupiers who do not depend on primary production from the property for their income.

As detailed in **Section 2.1**, Austar operates within a number of mining leases under 12 separate development consents which were issued by Cessnock City Council between 1974 and 2002 and by the NSW Minister for Urban Affairs and Planning in 1996 (DA 29/95). Underground mining is currently being undertaken within Consolidated Mining Lease 2 (CML2). The majority of the proposed Stage 3 mining area is within CML2 and beneath rural land holdings.



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.25 0.5 1.0km
1:20 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Surface Infrastructure Site
- Residential Dwelling
- Property Boundaries

FIGURE 5.5

Stage 3 Proposal Lot and DP Locations

File Name (A3): R10_V1/2274_603.dgn

A description and assessment of potential impact on the land use from the proposed development is provided in **Section 6** for underground mining and **Section 7** for the Surface Infrastructure Site.

5.9 Transport Characteristics

The current pattern of urban development, transport routes and industrial landscape was established in conjunction with the South Maitland Coalfield (CCC, 2006). Austar utilises road and railway transport networks for operations and product transport. The road and rail network infrastructure servicing the area is shown on **Figures 5.6** and **5.7** respectively. A detailed assessment of road and rail traffic has been undertaken for the project by GHD (2008) and is provided as **Appendix 8**.

5.9.1 Road Network

Pelton CHPP is located off Wollombi Road approximately 7 kilometres south of Cessnock. Approximately 20 of Austar's 200 employees work at the CHPP which operates 24 hours per day, 7 days per week. Austar transports up to 60,000 tonnes per year of specialty coal product from the CHPP via the local and regional road network to destinations in the surrounding area including the Port of Newcastle.

The existing Ellalong Drift and Pit Top are located off Middle Road at Paxton. The remaining approximately 180 of Austar's current employees either work at or access the existing underground mine at the Ellalong Drift and Pit Top. The Ellalong Drift and Pit Top also operates 24 hours per day, 7 days per week. All materials and heavy equipment are currently transported underground via the Ellalong Drift and all coal comes to the surface at this location. Middle Road connects with Wollombi Road approximately 2 kilometres north of the entrance to Ellalong Drift and Pit Top. Wollombi Road is a two-lane two way road connecting the town of Wollombi, approximately 25 kilometres south-west of Cessnock to Cessnock City centre. Wollombi Road becomes Maitland Road where the two roads intersect with Vincent Street in the City Centre (GHD, 2008). Access to the Ellalong Drift and Pit and the Pelton CHPP can also be gained from the east via Lake Road and Sandy Creek Road and from the south via Millfield Road.

The proposed new Surface Infrastructure Site off Quorrobolong Road will be the main access to the proposed Stage 3 mining area for materials and men during the life of the Project. Ellalong Drift and Pit Top will be maintained as the main access point for mining equipment and mine maintenance (GHD, 2008). Access to the proposed Surface Infrastructure Site from the north will be via Quorrobolong Road and Vincent Street to Cessnock from the south via Quorrobolong Road, Sandy Creek Road and Lake Road for those accessing the site from Paxton and Ellalong, Newcastle and Lake Macquarie.

Approximately 50% of existing employees live in the Cessnock LGA; 20% are from Lake Macquarie LGA and 15% are from Newcastle.

Longwall mining will occur under sections of Quorrobolong Road, Nash Lane, Cony Creek Road and Pelton Fire Trail and could potentially impact on the road surface, culverts and bridges along these road systems. An assessment of the potential subsidence impacts on these roads is detailed in **Section 6.1**.

In terms of road traffic, the proposed development will result in the majority of workers who currently travel to the Ellalong Drift and Pit Top off Middle Road travelling to the proposed new Surface Infrastructure Site off Quorrobolong Road. Employee numbers at the Pelton

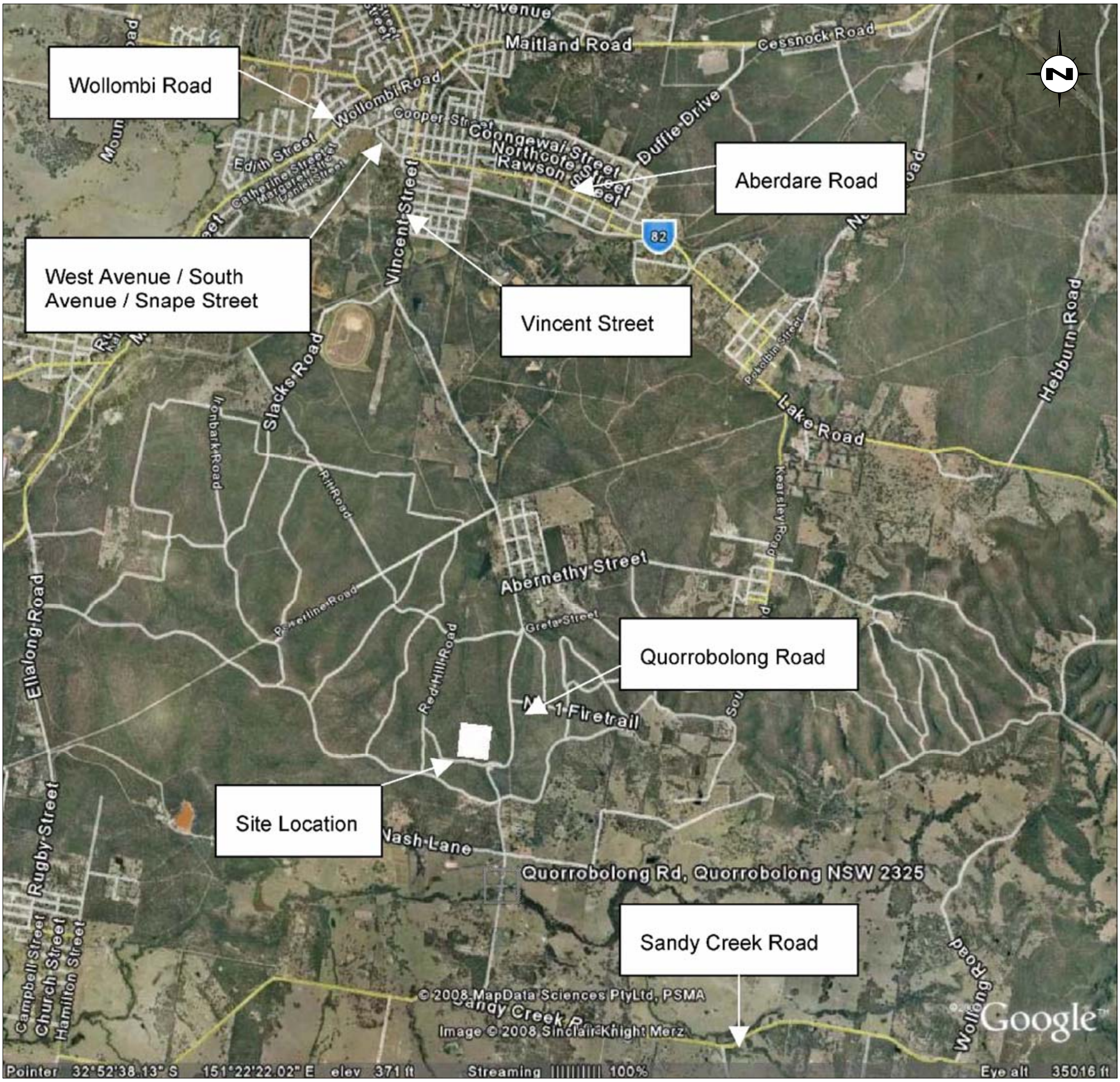
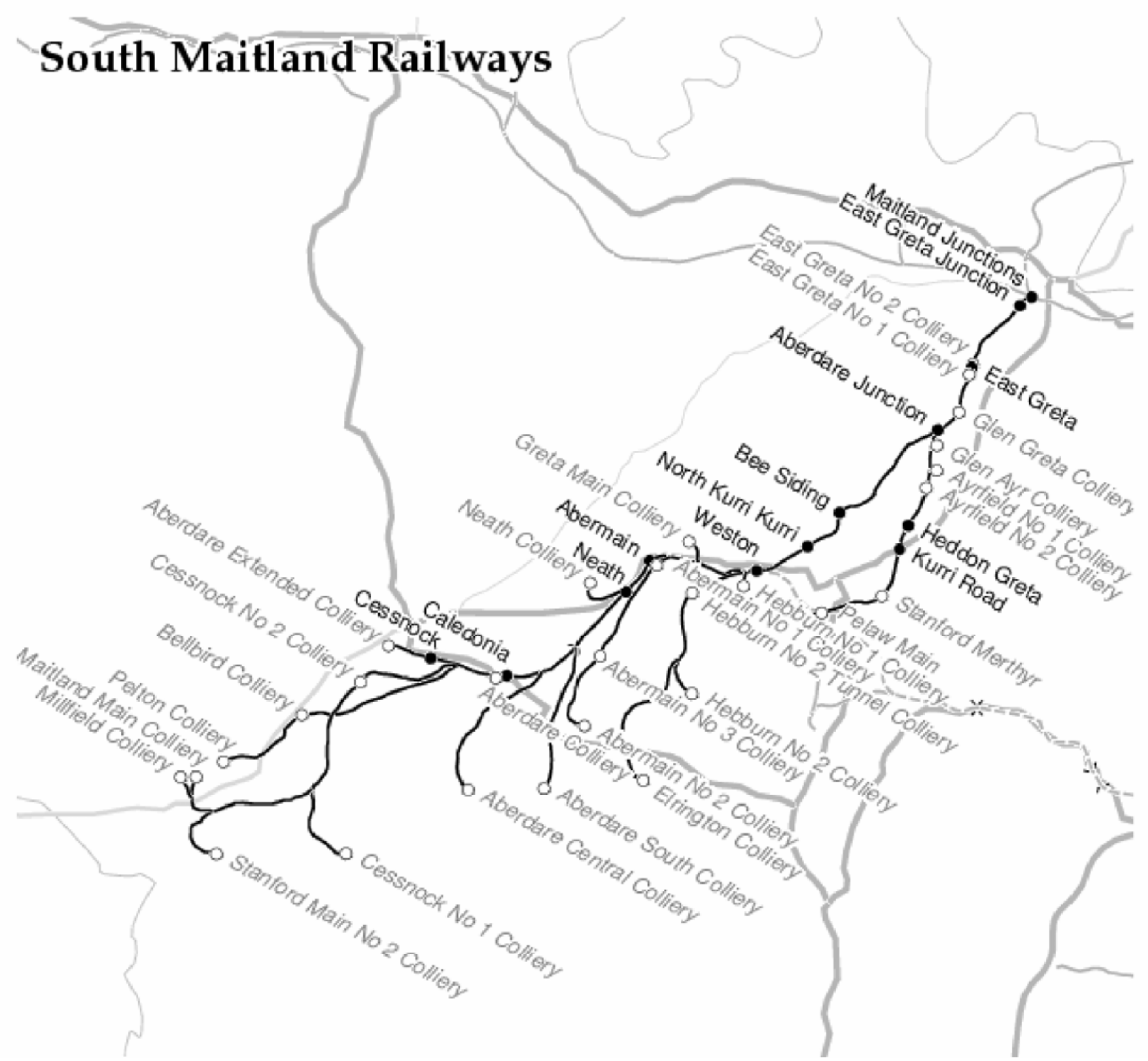


FIGURE 5.6

Road Network

Source: GHD - Report for Austar Coal Mine, Traffic Study. July 2008

File Name (A4): R10_V1/2274_604.dgn



Source: Rolfe Bozier, 2001

FIGURE 5.7

Plan Showing South Maitland Railway

CHPP are not expected to significantly change as a result of the proposed development and up to 60,000 tonnes per year of specialty coal product will continue to be transported to surrounding markets from the Pelton CHPP.

The major changes to traffic as a result of the proposed development will be that the majority of employees that currently travel to Ellalong Drift and Pit Top will travel to the proposed Surface Infrastructure Site. In addition, materials (other than large mining equipment) that are presently taken underground from Ellalong Drift, will be taken underground from the proposed Surface Infrastructure Site. As a result the proposed development will cause no significant change in regional traffic volumes with less traffic on Middle Road and Wollombi Road and on the western end of Sandy Creek Road and more traffic on Vincent Street and Quorrobolong Road. The volumes of traffic on Sandy Creek Road east of its intersection with Quorrobolong Road or on Lake Road are not expected to significantly change.

As discussed above, some local changes to road transport will result from the proposed establishment of the new Surface Infrastructure Site. To address this, a Traffic Impact Assessment has been undertaken by GHD (2008) (see **Appendix 8**). A description and impact assessment of key road intersection points and key road networks surrounding the Quorrobolong site from the Austar Mine Complex and the Project is provided in **Section 7.10**. Mitigation measures and management recommendations for safety, routes and potential sites of congestion are also provided.

5.9.2 Rail Network

The Austar Mine Complex utilises the Austar Rail Line to link with the South Maitland Railway and the Main Northern Rail Line. Austar currently transports approximately 98% of product coal from the Pelton CHPP to the Port of Newcastle by this network under commercial arrangement with South Maitland Railway and Pacific National. The freight distance is approximately 75 kilometres (one-way). Austar is the only mine left operating in the area that uses the South Maitland Railway (GHD, 2008).

The Austar rail Line (formerly Pelton Branch Line) was upgraded in 1988. This upgrade provided for the use of four SRA 48 Class diesel locomotives and 38 wagons with a capacity to haul 2200 tonnes of coal per trip (HLA, 1995).

The current coal chain logistical constraints at the Port of Newcastle which govern the amount of coal that Austar rails to the Port of Newcastle limit the number of trains required to six laden coal trips per day. These arrangements are expected to remain until beyond 2009 (GHD, 2008). After current restrictions at the Port of Newcastle are lifted, trains will operate up to the capacity of the rail system which is a maximum of eight laden coal trips in a 24 hour period.

There are four level rail crossings along the Austar Rail Line and South Maitland Railway between Bellbird and Weston. These locations include:

- Vincent Street, Kitchener (which is on Austar land);
- Cessnock Road, Kearsley;
- Neath Road, Neath; and
- Mitchell Avenue, Weston.

The crossings consist of a straight road alignment with Stop Sign control. The maximum speed limit for trains on the section of the South Maitland Railway line at each of the level crossings is 30 kilometres per hour (GHD, 2008).

A detailed assessment of the rail line was undertaken by GHD (2007). This report included a raft of recommendations for each level crossing. In accordance with the findings of this report, Austar is currently implementing improvements as part of its existing operations, to the Vincent Street Crossing at Kitchener which is under Austar's control. Austar is also discussing with South Maitland Railway the implementation of the recommendations for the remaining three level crossings.

The proposed development will not increase the capacity of the rail system with maximum product transport being maintained at 3 Mtpa. As a result the impacts of rail transport are not considered further as part of this EA.

5.10 Socio-Economic Considerations

5.10.1 Existing Social Profile

Mining within collieries that form part of the Austar Coal Mine has been a part of the land use and landscape context of the area for close to 100 years and formed a significant driver to early development of the area. Many families now living in the villages of the area have long standing direct associations with the mining industry.

The Cessnock LGA demography has been defined by Cessnock City Council (2008) according to Precincts as defined by the Australia Bureau of Statistics data in the Census for Housing and Population in 1991, 1996, 2001 and 2006. The proposed Stage 3 area is predominantly in the Rural East Precinct of Cessnock LGA and includes the margins of the Rural West Precinct.

Rural East Precinct includes Abernethy, Brunkerville, Elrington, Kitchener, Mount Vincent, Mulbring, Pelton and Quorrobolong. Rural West Precinct includes Ellalong, Paxton and Millfield and includes the Pelton CHPP and the Ellalong Drift and Pit Top site. The Rural West Precinct also extends into the remote and rugged parts of the LGA, south of Wollombi. Current Austar operations, the proposed Stage 3 underground mining area and the proposed Surface Infrastructure Site underlie the Rural East and Rural West precincts.

Key demographic components of both Precincts include:

- Cessnock LGA population in 2006 population was 46,019 which comprises 8.2% of the population of the Hunter Valley (Cessnock, 2008);

- villages that are adjacent to the Project area including Quorrobolong, Ellalong and Millfield, all recorded a growth rate of more than 10% between 1991 and 1996;

- in 2006, the greatest industry of employment in the Cessnock LGA was coal mining, which accounted for 6.6% of the workforce compared to the State average of 0.7% (Cessnock, 2008); and

- until the recently proposed Local Environment Plan (LEP) 2008 amendments, the majority of medium density development in the LGA has been characterised by ad hoc infill development in older residential areas.

Further details in regard to the social profile of the area are provided in **Appendix 9**.

The development of the proposed Surface Infrastructure Site and the utilisation of coal from the proposed Stage 3 mining area will not significantly change the social profile or workforce requirements of Austar Coal Mine with employment numbers at the mine currently being restricted by the volume of coal that Austar can export through the Port of Newcastle. In 1995 HLA envisaged that up to 375 people would be employed at the mine at full production. Austar Coal Mine currently employs approximately 200 people. If restriction on the Port of Newcastle were lifted, Austar Coal Mine would be able to provide employment for up to 275 people.

The proposed Stage 3 development will effectively result in employees that currently access the mine from the Ellalong Drift and Pit Top site, accessing the mine from the proposed new Surface Infrastructure Site off Quorrobolong Road. This change in access location will place no significant additional demands on regional social infrastructure or the social profile of the area. Continued resource extraction, continued value-adding at the Pelton CHPP, and continued transport and export of product coal are key contributing factors to the local and regional economy. Continued resource utilisation will ensure ongoing employment, continued use of local contractors and local employment services for the Project.

5.10.2 Socio-Economic Planning Framework

Cessnock City Council has established a number of socio-economic planning objectives and strategic plans for the area and the Lower Hunter Valley. The socio-economic framework of the proposed development has also been assessed against existing and projected Cessnock City Council LGA planning objectives in the Lower Hunter Valley. An assessment of the proposed development against specific and applicable planning documents is outlined as follows:

- The Cessnock City Council 2007-2010 Management Plan (Cessnock, 2007) outlines five goals and identifies specific strategic actions to implement this Plan. The Plan also outlines a management framework and budget for Council activities in relation to community, environmental, social and cultural requirements.

- The Local Government (General) Regulation 1999 requires all Councils in NSW to develop a social and community plan. The Cessnock Social and Community Plan November 2004 to November 2009 has been prepared in response to this requirement. The plan identifies community needs and proposes actions and strategies for implementation.

- The Social Planning and Community Development Access Policy date sets objectives for the implementation of the Cessnock Social and Community Plan November 2004 to November 2009. The proposed development is consistent with the objectives of the Plan.

5.10.3 Population Projections

Areas to the north and west of the proposed Stage 3 area are being considered as part of new urban development strategies in the Lower Hunter Regional Strategy (LHRS) (DoP, 2006). The Cessnock LGA is identified as a major growth centre in the LHRS and has a projected capacity of 21,700 additional dwellings over the next 25 years.

The locations of expansion areas will be defined through Cessnock local planning decisions with the Cessnock Social and Community Plan 2004, the Cessnock Strategic Plan and the

Cessnock Management Plan 2007 and Social Planning and Community Development Access Policy (CCC, 2004) guiding these decisions.

In addition to the LHRS, the City Wide Settlement Strategy (CWSS) (CCC, 2004) predicts greater demand than supply for residential and rural lifestyle lots around the proposed Stage 3 area. The CWSS predicts a growth rate of 1.2% per year throughout the LGA until 2011, which is an overall population increase of 6250.

A projected 900 residents will be located in the Congewai Creek Catchment, of which the proposed Stage 3 area is a part. The projected population increase would result in demand for an additional 360 dwellings around the proposed Stage 3 area in this period with the vast majority being in Rural 1(a) and Village 2(b) zoned areas.

The CWSS also identifies new urban areas at Bellbird North, Bellbird Heights, Millfield-Paxton (Sanctuary Village) and Kitchener. These areas will be developed between 2006 and 2061 (Cessnock, 2004).

5.10.4 Economic Assessment

Mining at the former collieries that make up the Austar Mine Complex has been a part of the social and economic fabric of the Cessnock area since 1916 when Pelton Colliery first commenced operations. When Austar purchased the Austar Mine Complex in 2005, the mine had been on care and maintenance since 2003 and as a result had made a negligible contribution to the local, regional and Australian economies over that period. In fact, if Austar hadn't purchased the mine and it had closed, it is estimated that the cost of decommissioning and rehabilitating the mine site would be in the order of $14 million, a liability that the State of NSW would have been responsible for.

Since purchasing the mine, Austar has recommenced mining and currently provides direct employment for approximately 200 people and now generates approximately $200 million in annual turnover. At full production of 3 Mt of product coal, annual turnover is expected to increase to approximately $400 million based on current day coal prices.

As part of recommencing mining operations, Austar has undertaken a number of environmental improvement programs in regard to reject emplacement and rehabilitation of disturbed areas, improvements to the water treatment and management system and noise emissions from the Pelton CHPP. As a result of these works, Austar is now a fully operational mine utilising existing infrastructure that has a current day replacement value of approximately $800 million. If the mine had not reopened, the ability to utilise and benefit from this existing infrastructure would not be realised and would have remained a significant liability.

By recommencing mining, Austar has returned mining operations to the Cessnock area and has turned a potentially significant State liability into a significant contributor to the local, regional and national economies.

The proposed Stage 3 Project provides considerable economic benefits on a local, regional, state and national level. Specific direct and indirect contributions include:

- continued employment of approximately 200 employees and contractors. When the mine reaches full production up to 275 people will be employed with many more indirect jobs created through flow-on effects;
- continued economic benefits from the production of approximately 3.0 Mtpa of premium export quality bituminous coal;

- continued payment of significant royalties to the New South Wales Government;
- significant export earnings for Australia; and
- significant economic benefits to the Cessnock LGA and Lower Hunter Valley through:
  - local employment;
  - purchase of goods and services;
  - local Austar expenditure; and
  - expenditure by employees.

In addition, the proposed establishment of the Surface Infrastructure Site off Quorrobolong Road has the potential to boost the economy of Kitchener which was established during the peak period of underground mining in the Cessnock Coalfields and is opposite the former site of the Aberdare Central Mine.

It is estimated that in 2007, Austar mine operations contributed approximately $160 million per year in direct expenditure in the region with this predicted to increase when the mine reaches a production level of 3 Mtpa of product coal based on current coal prices to approximately $300 million per year. Flow on effects of this expenditure due to project multipliers are expected to stimulate significant additional expenditure in the region through employment generation, associated household expenditure and value adding through the export of approximately $5.6 billion of high quality coal from Stage 3.

On a State level, continued operation of Austar Coal Mine as will be facilitated by approval for Stage 3 is likely to sustain Statewide employment opportunities at full production of up to 500 to 550 people. As a result, the contribution of ongoing Austar operations to the Cessnock, Regional and State economies is significant with negligible costs in terms of the need for additional community infrastructure and services to facilitate the proposed Stage 3 operations.

Austar is the last coal mine in the Cessnock LGA, an area established and once dominated by underground coal mining. The high quality coal that has been identified in the Stage 3 mining area is a valuable resource that has the potential to contribute to the wealth and planned growth of the community. The development strategies outlined in the Lower Hunter Regional Strategy indicate that Cessnock LGA will undergo major residential development over the next 25 to 30 years with an additional 21,700 additional dwellings planned.

Continued operations at Austar Coal Mine will make a significant ongoing contribution to the economic base and stability of the planned development in the area. This development is likely to result in some existing rural and rural residential areas such as those surrounding Austar Mine Complex, being transformed into a mixture of low density developments comprising residential, commercial and industrial activities. This growth has the potential to significantly change the social and economic structure of the area.

The proposed Stage 3 development has as a result of subsidence impacts, potential to have a socio-economic impact on residents and land holders above the proposed Stage 3 underground mining area. An assessment of potential subsidence impacts for properties above Stage 3 and possible impacts on property values is provided in **Section 6.1**.

An assessment of potential impact of operations on the amenity of local residents surrounding the proposed Surface Infrastructure Site operations is provided in **Sections 7** to **7.10**.

5.11 Greenhouse Gas and Energy

5.11.1 Project Context

The Project, as part of the Austar Mine Complex, will extend the use of LTCC technology for the ongoing development and utilisation of the identified Greta Coal Seam resource. Assessment work undertaken as part of the Ellalong Extension EIS (HLA 1995) identified a coal resource in the area of approximately 98 Mt with the proposed Stage 3 operations accessing approximately 45.3 Mt of this identified coal resource.

Considerable economies-of-scale in terms of reduction in net energy required per tonne of coal extracted will result from the use of LTCC with the longwall shearer required to cut a 3 metre thickness of coal with the remainder of the up to 7 metre thick coal seam falling onto the rear conveyor of the LTCC under the force of gravity. As a result, extraction of a 6.5 metre thick coal seam using LTCC requires approximately 50% of the coal to be extracted using the longwall shearer and the other 50% being extracted using gravity to deliver the coal onto the rear conveyor.

Analysis of Austar operations in Stage 1 indicate that operation of the rear conveyor uses approximately 5% of the total electrical power required to operate the LTCC equipment. As a result, in a 6.5 metre thick coal seam, LTCC enables approximately 64% more coal to be extracted compared to a conventional longwall mining operation for an additional 5% increase in energy usage making the LTCC method considerably more energy efficient than the conventional longwall mining operations that were previously used at the mine.

With less energy required per tonne of coal extracted compared to conventional longwall mining techniques, the LTCC method of coal extraction results in less GHG being produced in the generation of the energy required to extract coal. As a result, continued extraction of this coal resource using LTCC techniques will result in significant energy and greenhouse gas savings compared to if the resource was extracted using conventional longwall mining techniques.

In addition, it is proposed to handle and process the coal from Stage 3 using existing Austar Mine Complex infrastructure that has been gradually developed and expanded since the mine commenced in 1916. It is estimated that the current replacement value of the existing Austar Mine Complex infrastructure is approximately $800 million. As a result significant energy and resources would be required to establish this infrastructure to process and handle coal from Stage 3 if the Austar Mine Complex did not exist. As a result, significant energy and resource savings exist by using the Austar Mine Complex infrastructure compared to establishing a greenfield site to handle, process and transport coal. This also results in a significant GHG saving through the continued utilisation of existing infrastructure rather than the establishment of new infrastructure.

To explore greenhouse gas and energy aspects of the proposed development, a detailed Greenhouse Gas and Energy Assessment (GHGEA) has been undertaken by Umwelt. This report is provided in full in **Appendix 10**.

Coal produced at Austar is typically high volatile, low ash bituminous, high specific energy, high fluidity coal which can be utilised in a range of blends for the soft coking, semi coking and thermal markets. The typical emissions factor produced by this high quality bituminous coal (NSW electricity production) is 89.3 for all greenhouse gases.

5.11.2 Assessment Methodology

In accordance with the *National Greenhouse and Energy Reporting System* (NGERS) Department of Climate Change (2008) (DCCb, 2008) and the established methodology the *National Greenhouse and Energy Report (Measurement) Technical Guidelines 2008 v1.0* (NGERS:TG) (DCCc, 2008), all calculations have been made through the Department of Environment Water Heritage and the Arts (DEWHA) Emissions Calculator. The Calculator currently uses algorithms and formulae modelled in the NGERS:TG. Calculations are also in compliance with the United Nations Framework Convention on Climate Change (UNFCCC) reporting categories, as adopted and implemented by the Department of Climate Change.

All calculations are currently based on production of 3.6 Mtpa of ROM and include the following parameters as provided by Austar:

1	maximum demand is 9.07 MWh (or 9070 kWh)
2	average usage is 6.82 MWh (or 6820 kWh)
3	total weekly usage is 1.15 GW (or 1,150,000 kWh)
4	weekly production and wash of 69918 tonnes of resource
5	annual production over 46 weeks per year is 3.6 Mtpa ROM

In undertaking the GHGEA, Austar operations have been staged according to scheduled activities and timeframes and are based on maximum production (between 2012 and 2028).

The *National Greenhouse and Energy Reporting (Measurement): Technical Guidelines* (DCCc, 2008) (NGER: TG) defines three Scopes of emission categories for a project. Scope 1 and Scope 2 form the structure of this GHGEA and capture the operational and production elements of Austar. The emission categories are defined as follows:

Scope 1	covers *direct emissions* from the combustion of fuels (for example, diesel) and industrial processes within the boundary of the mining operation;
Scope 2	covers *indirect emissions* from the mining operation's consumption of purchased electricity that is produced by another organisation; and
Scope 3	includes *other indirect emissions* as a result of the mining operation's activities that are not from sources owned or controlled by the organisation or involve the offsite transportation (transport, combustion) of the product.

Scope 3 has been categorised, assessed and data provided according to both the impact on analysis of the Project GHGEA and potential mitigation measures that may be incorporated.

5.11.3 Fugitive Emissions

Scope 1 Fugitive Emissions

Scope 1 Fugitive Emissions are those that are produced from activities within the parameters of Austar Mine Complex and as a result of the current and projected operational activities. These emissions specifically arise from activities relating to coal, oil and gas.

Onsite Fuel Combustion Assessment

Onsite fuel combustion from the onsite transport of product and personnel (off-road) and onsite operations (industrial and mining) are included in the aggregate data set provided by Austar (Austar Diesel Total).

GHG emissions from mobile sources consist of gaseous products of engine fuel combustion (exhaust emissions) and gas leakage from vehicle (fugitive emissions). These essentially comprise:

- CO_2 emissions due to the oxidation of fuel carbon content during fuel combustion;
- CH_4, N_2O, NO_x, CO, SO_2 and non-methane volatile organic compounds (NMVOCs) emission resulting from incomplete fuel combustion;
- reactions between air and fuel constituents during fuel combustion;
- post-combustion reactions; and
- fugitive emissions of NMVOCs, due to fuel evaporation.

The GHGEA (see **Appendix 10**) is based on the time estimate for the Project to utilise identified coal resources (that is, between 2011 and 2025). For the 14-year period the total Onsite Fuel Emissions will be approximately **19,488t CO_2-e/kJ**. The mean yearly onsite emissions are calculated as **1,392 t CO_2-e/kJ**.

Fugitive Emissions from Underground Mining Assessment

Fugitive emissions from underground mines involves the release of CH_4 and CO_2 during the mining process due to the fracturing of coal seams, overburden and underburden strata. Emissions also arise from post mining activities such as the stockpiling of coal from the release of residual gases within the coal not released during the mining process (DCCc, 2008: 142).

Austar is classified as a Class B Mine ('non-gassy') according to the *Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006: Energy (Fugitive Fuel Emissions)* (DCCa, 2006). Class B Mines have an assumed coal seam CH_4 content of 0.02%.

Fugitive emissions from underground mining are presented as an estimated yearly mean, due to the potential projected variation in production. The production of 3.6 Mtpa ROM is the maximum expected. The yearly mean fugitive emissions is **28,800 t CO_2-e/3.6Mtpa ROM** (see **Appendix 10**).

5.11.3.1 Scope 3 Fugitive Emissions

Scope 3 fugitive emissions relating to the Project are those that occur outside of the parameters of the Austar Mine Complex. The World Business Council for Sustainable Development and the World Resources Institute *Greenhouse Gas Protocol 2004* (WRI, 2004) considers the reporting of Scope 3 emissions to be optional principally due to the complexity of these calculations and the potential for double-counting of emissions.

The GHG Protocol specifically acknowledges the importance of the avoidance of double-counting of GHG emissions. On an international scale, double-counting needs to be avoided when compiling national inventories under the Kyoto Protocol. Scope 3 emissions assessments are currently largely speculative and are therefore limited.

As a result, the GHGEA includes an outline of Scope 3 fugitive emissions for context, global perspective and general estimation only. These emissions are produced by third party organisations outside the parameters of the Project and the Austar Mine Complex.

Offsite Fuel Combustion

Austar transports up to 60,000 tonnes per year of coal product and coal fines by road to markets that are not feasible to service using rail. This includes small coal loading facilities at the Port of Newcastle that service ships that are not loaded by Port Waratah Coal Services, and some specialist end users that require special sized coal that needs to be transported by road to protect the sizing integrity.

The use of the Austar Railway and South Maitland Railway to transport coal is also considered a Scope 3 emission and is presented in this GHGEA for information and consideration only. The calculation is based on gross tonnes per kilometre (GTK) (see **Appendix 10**).

Offsite and Offshore Coal Consumption

Based on 3.0 Mtpa of product coal, the annual mean greenhouse emissions produced from the offsite and offshore combustion of coal produced by Austar is estimated to be approximately 7170 kt CO_2-e or **7.2 Mt CO_2-e** (NGERS Online Calculator, DCC) and is based on NSW Emission Factor (EF) only.

The GHG released from the offshore combustion of this 3.0 Mtpa of Austar product coal (estimated above) would **potentially contribute only 0.00062%** of the annual global GHG emissions from the consumption of coal. *The 2005 World Carbon Dioxide Emissions from the Consumption of (all) Coal, Most Recent Annual Estimates, 1980-2006* (EIAc, 2007) was 11,357.19 Mt CO_2-e.

5.11.4 Stationery Source Emissions – Scope 2 Consumption of Electricity

Stationery source (*indirect*) emissions are those that are physically produced by another organisation, most particularly in the form of electricity. Austar has an established modelling and calculation methodology to assess, measure and predict electricity consumption. The methodology and EF used to estimate annual emissions of GHG from stationery sources within the energy sector covers fuels including: coal, coke, brown coal briquettes, coke oven gas, petroleum products, natural gas, and town gas.

Over the life of the proposed development (between 2011 and 2025), the approximate Stationary Source Emissions will be approximately **914,718** kg $C0_2$-e/kWh or **914.718 t $C0_2$-e/kWh.** The annual mean consumption of electricity is estimated at 61,177,000 kWh. The annual mean Stationary Source Emissions are projected to be approximately **65,337 kg $C0_2$-e/kWh** or **65.337 t $C0_2$-e/kWh.**

5.11.5 Qualitative Assessment of Emissions

As there are no accepted methods for undertaking an assessment of the end use of product coal and the impact that these emissions may have on the global climate, a comparative analysis of project-related emissions to global emissions has been undertaken. Ignoring the significant consideration of double-counting of Scope 3 emissions, it is possible to assume that the Project may contribute to up **0.00062% of global emissions** from the combustion of coal.

It must be noted that the coal produced by the Project will be meeting market demand and that should the Project not proceed, this demand will be met from other sources. These sources may have poorer quality coal and may result in increased GHG emissions per unit of energy generated.

Given the small contribution that the Project may make to global GHG emission, it is reasonable to conclude that there will be no measurable environmental effects resulting from GHGs from the Project. It is, however, recognised that GHG emissions are affected by the cumulative effect of many contributions.

The NGER:TG details the respective energy content factor (GJ/t). As an approximate comparison, black coal for electricity (NSW) has an energy content of 27.0 GJ/t (includes anthracite, bituminous and sub-bituminous) compared with only 10.2 GJ/t for lignite (brown coal). Coal from Austar Coal Mine has an energy content of 28.0 GJ/t. The less coal carbon content and energy content factor, the greater quantity that has to be burned to produce the same amount of energy generated by bituminous coal. Hence, the greater the quantity of product that needs to be burned; the more GHG emissions are produced. It is therefore far more energy and GHG emission efficient to combust bituminous coal compared to lesser quality coal.

5.11.6 Greenhouse Gas Mitigation and Management

Continued operations will ensure maximum resource extraction for minimal additional energy consumption and hence GHG emissions.

Austar will assess and consider implementation of, where feasible, GHG and energy management and mitigation initiatives during the Project.

Austar GHG mitigation measures are focussed on energy management, energy efficiency and the potential reduction in Automotive Diesel Oil (ADO) consumption.

Some of the opportunities for improving energy efficiency and reducing GHG emissions from the Stage 3 Project are:

- energy efficiency in plant and equipment procurement, consideration be given to the life cycle costs advantages obtained by using energy efficient components;
- the opportunity to install additional sub-metering for offices, workshops and winders;
- operational initiatives such as turning off idling plant equipment;
- control and temperature settings for air conditioning units in offices and switchrooms;
- automatic control of external and internal lighting;
- potential energy efficiency opportunities in water pumping and dust suppression systems (for example, variable speed drive pumps);
- review changes in power consumption with installation of new equipment and install power factor correction equipment to suit; and
- review workshop and bathhouse lighting and office and high bay lighting.

More broadly, major emission reductions from coal mining and coal will also come from increasingly energy-efficient mining operations, reduced travel distance, improved coal preparation and improved water treatment and management that are being implemented as part of continuous improvement programs at Austar Coal Mine.

5.11.7 Potential Cumulative Impacts

The proposed Stage 3 underground mining area is sufficiently distant from existing underground mining operations in Stage 1 and Stage 2 to not result in any potential cumulative impacts in terms of subsidence. Subsidence as a result of proposed Stage 2 underground mining will cause changes to the surface landform and as a result cause changes to flooding characteristics of the area. These changes to the landform have been taken into consideration in developing flood models for Stage 3 and assessing potential flooding impacts of Stage 3 as discussed in **Section 6.2** and **Appendix 13**.

Groundwater inflows to Stage 3 are also potentially affected by previous and proposed mining operations. These potential cumulative impacts have been taken into consideration as part of the groundwater assessment undertaken for Stage 3 as discussed in **Section 6.3** and **Appendix 14**.

The proposed Surface Infrastructure Site is distant from Pelton CHPP and Ellalong Drift and Pit facilities and as a result there is negligible potential for cumulative impacts in terms of noise, air quality, water quality or visual amenity to occur. Socio-economic and potential traffic impacts are discussed in **Sections 5.10** and **7.10** respectively.

6.0 Stage 3 Mining Impacts and Management

During the consultation process as outlined in **Section 5.2** and **Appendix 4**, potential subsidence impacts on landform, land use, ecology, houses and buildings, surface and groundwater, roads and service infrastructure were raised as potential risks associated with the proposed development. To address these issues, a range of detailed assessments investigating the potential impacts from subsidence have been undertaken. The results of these assessments and analysis of the potential environmental aspects, impacts, monitoring, and management measures from the proposed Stage 3 underground mining operations are summarised in **Sections 6.1** to **6.6**.

6.1 Subsidence

6.1.1 Subsidence Prediction Methodology

Underground longwall (LW) mining involves the removal of coal from a series of panels (extraction areas) within a coal seam. As the coal in each longwall panel is removed, the roof behind the mine workings is allowed to collapse causing the overlying rock to fracture and settle. The settlement potentially progresses up through the overlying strata that may result in a degree of subsidence of the ground surface. Integral to this subsidence impact assessment, therefore, is the consideration and application of Longwall Top Coal Caving (LTCC) technology and the presence of the massive Branxton Formation within the proposed Stage 3 mining area.

The depth of cover to the Greta Coal Seam above the proposed Stage 3 longwalls varies between a minimum of 445 metres, at the north-western corner of proposed LWA7, to a maximum of 750 metres, above the middle of proposed LWA17 (refer to **Figure 3.1**). The seam floor at the proposed longwalls generally dips from the north-west to the south-east.

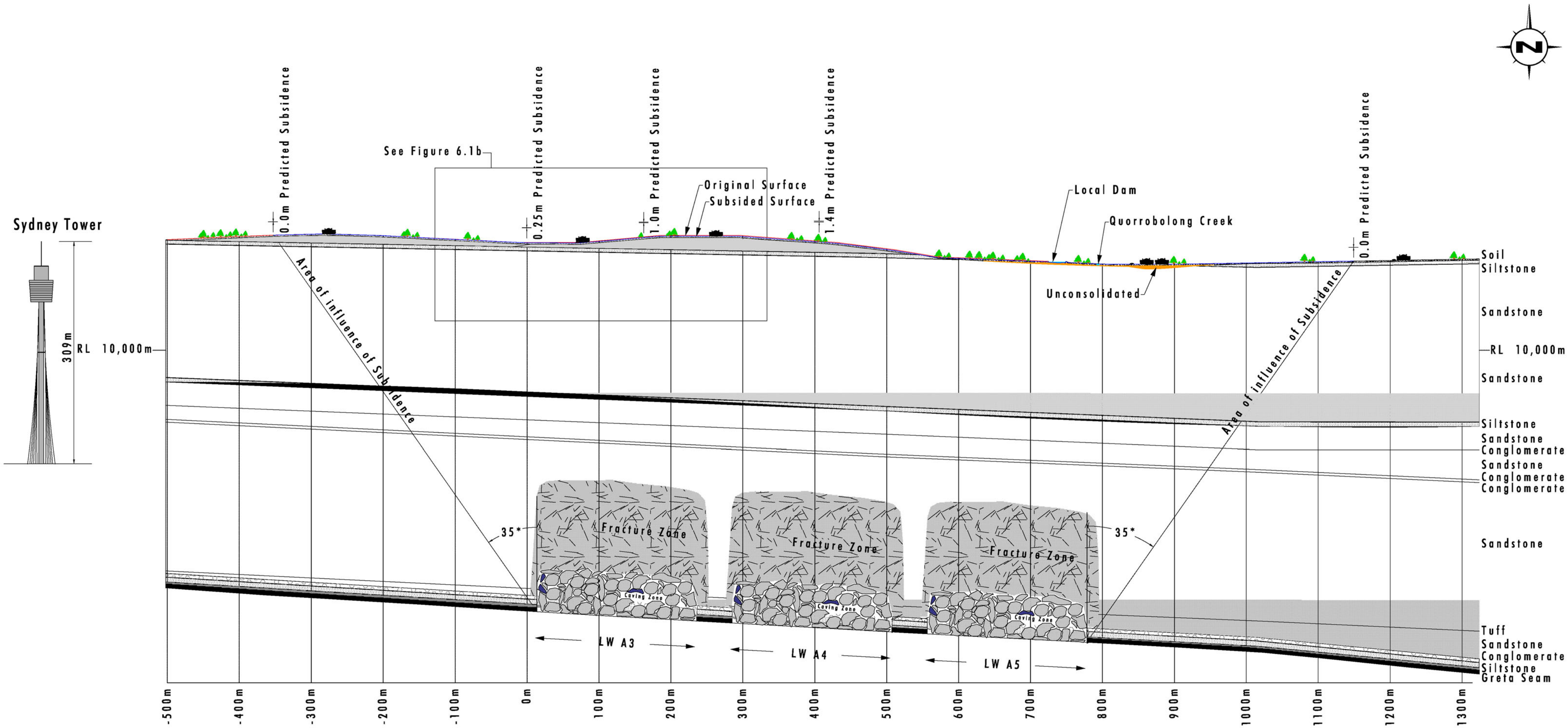
Thickness of the Greta Coal Seam at the proposed longwalls varies between a minimum of 4.0 metres, at the commencing (eastern) ends of proposed Longwalls A11 to A17 and a maximum of 7.0 metres, near the commencing (northern) end of proposed LWA6. A cross-section through the proposed longwalls is illustrated in **Figure 6.1**.

Mine Subsidence Engineering Consultants Pty Limited (MSEC) were commissioned by Austar to prepare subsidence predictions based on the conceptual mine plan for Stage 3 and undertake impact assessments in regard to natural and built features in the area of potential impact. The detailed Subsidence Impact Assessment prepared by MSEC for this EA is provided in **Appendix 11**. The Subsidence Impact Assessment area is indicated in **Figure 4.2.**

An empirical approach to predicting systematic and non-systematic subsidence has generally been adopted in the coalfields of New South Wales and has been applied to the Project. This methodology has expanded in recent years by the development of the Incremental Profile Method ('the IPM'). The calibrated IPM has been used by MSEC to assess the subsidence parameters for the Project.

Subsidence predictions have been presented at two levels, those being:

- **Maximum Predicted Subsidence** which is the maximum subsidence that is predicted to occur based on the calibrated IPM model MSEC developed for the site; and



Anticipated Subsided Landform Stage 2 Area

0 100 200 400m
1:8000

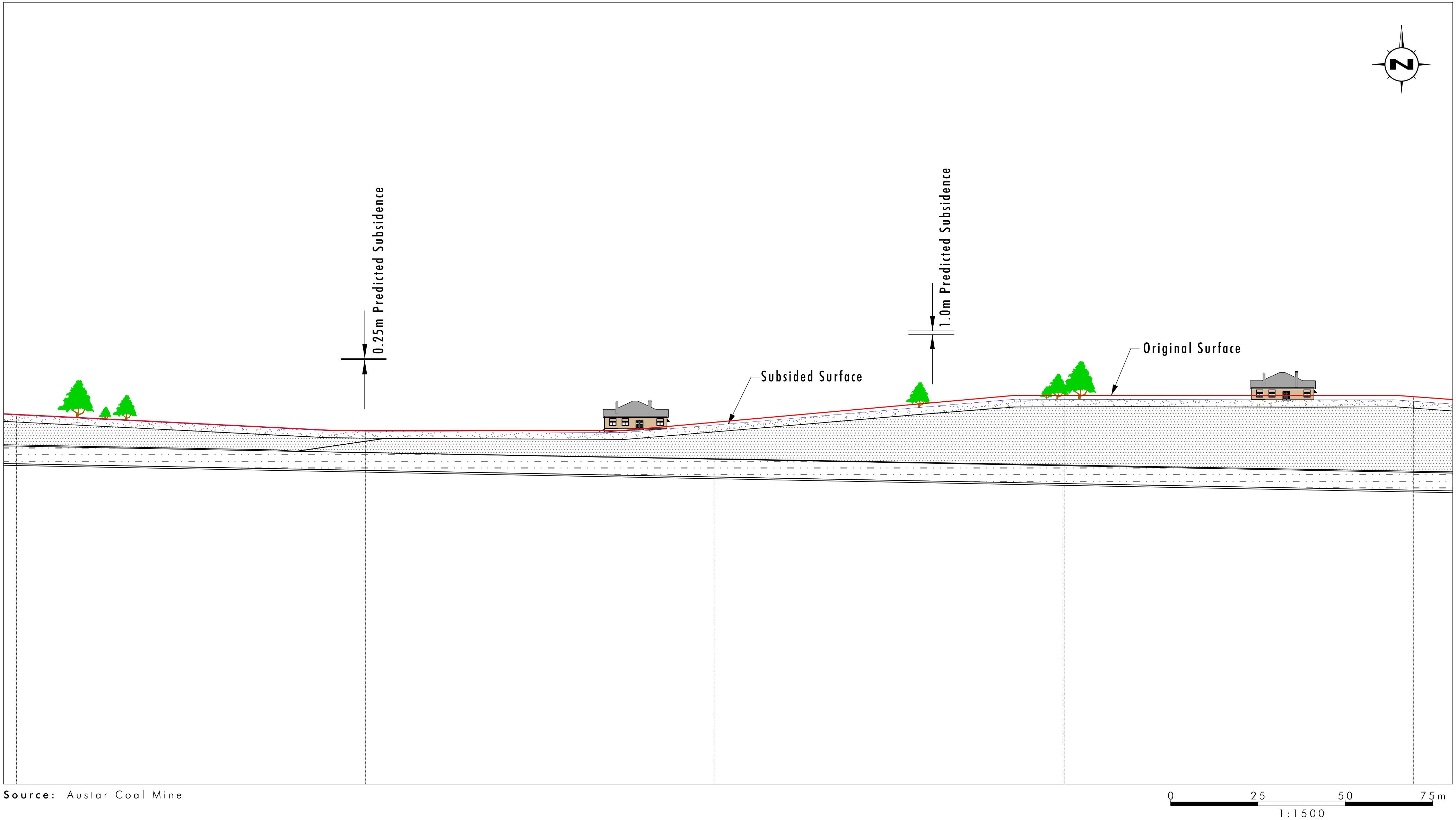
FIGURE 6.1a

Typical Cross Section - Stage 2

Source: Austar Coal Mine

File Name (A4): R10_V1/2274_644.dgn

Umwelt
Environmental Consultants



Source: Austar Coal Mine

FIGURE 6.1b

Typical Cross Section - Stage 2 Inset

File Name (A4): R10_V1/2274_645.dgn

- **Upperbound Subsidence** which has been derived assuming that subsidence is equivalent to 65% of extracted seam thickness. The Upper Bound subsidence prediction was generated for proposed Stage 3 underground mining for formal risk assessment purposes and is substantially greater than the Maximum Predicted Subsidence indicated by the calibrated IPM model developed by MSEC.

A peer review of MSEC's subsidence predictions has been undertaken by Seedsman Geotechnics Pty Ltd (2008) and is provided in **Appendix 12**. Subsidence predictions by Seedsman Geotechnics Pty Ltd for the proposed Stage 3 area indicated that subsidence would be less than the Maximum Predicted Subsidence generated by MSEC for all areas where the depth of cover was less than approximately 610 metres. As shown on **Figure 3.1**, the depth of cover does not exceed 610 metres until Longwall A11. Seedsman Geotechnics (2008) concluded that:

> 'In summary, it is assessed that the MSEC prediction for systematic subsidence (i.e. Maximum Predicted Subsidence) represents a suitable base case for the maximum vertical subsidence for the Part 3A process with the understanding that small scale undulations between panels (predicted by MSEC to be in the order of 100 mm amplitude) are likely to develop. A worst case of say 120% of the MSEC prediction (Maximum Predicted Subsidence) should be used for a formal risk assessment. The MSEC upper bound is considered to be needlessly conservative.'

In regard to the Upperbound Predictions, MSEC (2008b) note:

> 'The Upperbound Predictions provided for Austar Stage 3 Longwalls A6 to A17 are conservatively based on the maximum achievable subsidence observed anywhere in the Coalfields of New South Wales, for single-seam mining conditions, which includes the full range of mining geometries and geology. Based on all the observed monitoring data for longwall mining in the Coalfields of New South Wales Coalfields, the maximum achievable subsidence for single-seam mining conditions is 65% of the extracted seam thickness.
>
> At Austar, the main sequence overlying the Greta Coal Measures is the Branxton Formation, which is a thick and largely massive sequence and, where it is free geological structures, is expected to span the extracted goafs of the proposed longwalls. In this case, the maximum achievable subsidence would be governed by pillar squashing alone and, therefore, the maximum achievable subsidence for the proposed longwalls would be expected to be closer to 50% of the extracted seam thickness (i.e.: 3.3 metre pillar / 7.0 metre extraction height) rather than the 65% that has been adopted for the Upperbound Predictions.'

Subsidence generally refers to the range of ground movements which result from mining operations. A typical subsidence profile is illustrated in **Figure 6.1**. Ground movements are described by the following parameters:

- subsidence refers to the vertical and horizontal displacement of the ground;
- tilt is the change in the slope of the ground as a result of differential subsidence;
- curvature refers to the rate of change of tilt; and
- strain is the change in horizontal distance between two points on the ground. Tensile strains occur when the distance between two points increases and compressive strains occur when the distance between two points decreases.

Normal ground movements resulting from the extraction of pillars or longwalls are referred to as systematic subsidence movements. The movements may be incremental or cumulative.

Non-systematic subsidence movements include far-field horizontal movements; irregular subsidence movements and valley related movements (refer to **Section 6.1.3**).

6.1.2 Subsidence Predictions and Assessment

A subsidence profile may be projected once the parameters including maximum subsidence value; location of the inflection point; average goaf edge subsidence; and limit of subsidence have been determined. The limit of subsidence is determined from the depth of cover and the angle of draw.

The predicted maximum tensile strain, compressive strain and tilt can be determined from the maximum subsidence and depth of cover. Profiles can be predicted in both the transverse and longitudinal directions, thus allowing the subsidence, tilts, systematic curvatures. and systematic strains to be predicted at any point on the surface above a series of longwalls.

The predicted systematic subsidence parameters for the proposed underground mining of longwall panels LWA6 to LWA17 were made using a calibrated IPM. The model was calibrated using measured subsidence data from the Branxton Formation from previous mining at the Ellalong mine and monitoring results from Longwalls A1 and A2 from Stage 1 of the Austar mine where coal has been extracted using LTCC equipment.

The overall IPM empirical methodology is based on a large database of observed monitoring data from previously extracted longwalls within the Southern, Newcastle, Hunter and Western Coalfields of New South Wales. This database includes observed subsidence profiles based on extraction heights varying from less than 2 metres up to 5 metres. The IPM is slightly conservative and based upon predicting the incremental subsidence profile for each longwall in a series of longwalls. The respective incremental profiles are then added to show the cumulative subsidence profile at any stage in the development of a series of longwalls. This method also allows for variations in tilt, curvature and strain to be determined across a series of longwalls.

The extraction heights for proposed LWA6 to LWA17 which range from 4 to 7 metres are greater than those in the empirical database of the IPM. They are also greater than those at the previously extracted longwalls at the Austar Mine. However, at the location of maximum predicted total subsidence, the seam thickness is 6.0 metres. LTCC equipment will mine the bottom 3 metres of the seam and recover about 85% of the top coal. The equivalent extracted seam thickness as a result is approximately 5.55 metres which is approximately 10% thicker than the upper limit of seam thickness in the database used to develop IPM.

Subsidence impact assessment involves using the subsidence predictions to forecast the level of impact on natural and man-made surface features within the project area and beyond. A detailed review of natural features and items of surface infrastructure potentially impacted by the project has been completed and detailed subsidence predictions and impact assessment provided for these items (refer to **Appendix 11**).

Section 6.1.3 provides a description of the potential physical impacts of subsidence on the land and surface features. Further details of the impact of subsidence on particular environmental aspects are provided in the following sections:

- surface drainage systems – **Section 6.2**;
- groundwater resources – **Section 6.3**;
- Aboriginal heritage sites – **Section 6.4**;

- historic heritage sites – **Section 6.5**; and
- flora and fauna – **Section 6.6**.

6.1.3 Physical Context for Subsidence Impact Assessment

A number of structures and natural features were identified in the vicinity of the proposed longwalls during the Subsidence Impact Assessment. Creeks, drainage lines, steep slopes, roads, electrical services, telecommunication services, dams, water bores, archaeological sites, survey control marks and building structures were identified as occurring above or proximate to LWA6 to LWA17. The locations of these structures and features are detailed in **Appendix 11**.

Proposed LWA6 (see **Figure 4.2**) is a single panel located in excess of 180 metres east of approved Stage 2 (LWA3 to LWA5). Proposed LWA7 to LWA17 are a series of panels located in excess of 680 metres east of proposed LWA6.

The Greta Coal Seam splits near the middle of proposed LWA10 to LWA17. West of the seam split, the longwall thickness varies from 5.3 metres to approximately 7.0 metres near the northern end of LWA6.

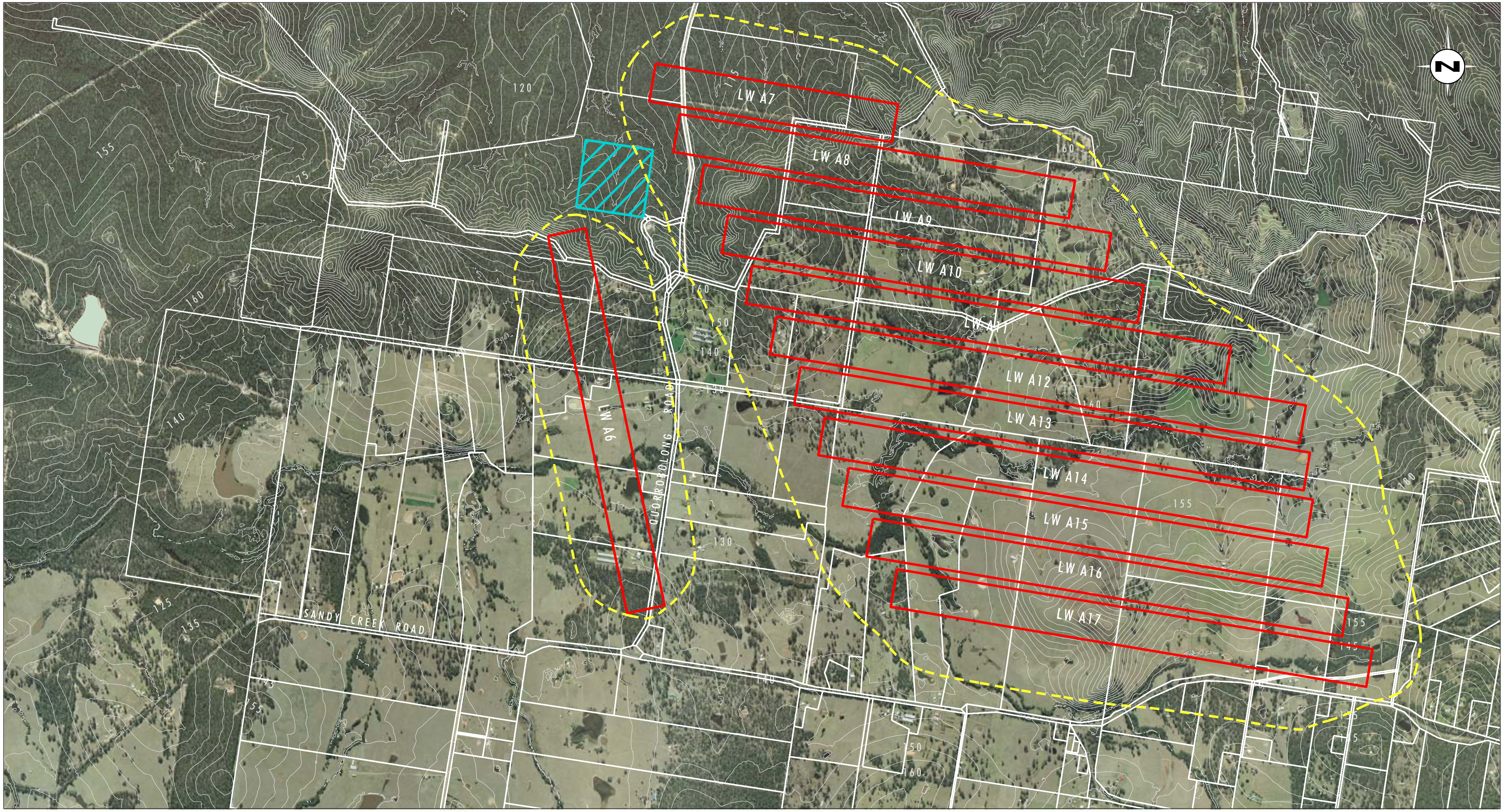
The substantial Branxton Formation which forms the geological strata above the Greta Coal Seam is very thick and strong and acts as a beam over the mined areas. As a result the majority of subsidence results from the compression of the chain pillars that are left between successive longwalls with the Branxton Formation effectively supporting the landform above the longwalls and transferring the resultant load to the chain pillars. The beam action of the Branxton Formation has considerable bearing on subsidence potential and surface subsidence impacts. The landform above mined areas following subsidence tends to subside reasonably uniformly creating a broad shallow subsidence bowl that will extend from the north (LWA7) to the south (LWA17) of the proposed mining area.

6.1.4 Maximum Predicted Systematic Subsidence Parameters

The predicted systematic subsidence contours, after the extraction of the proposed longwalls, is shown **Figure 6.2**. A summary of the maximum predicted cumulative systematic subsidence parameters is provided in **Table 6.1**.

Table 6.1 – Maximum Predicted Cumulative Systematic Subsidence Parameters

Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tilt (mm/m)	Maximum Predicted Cumulative Tensile Strain (mm/m)	Maximum Predicted Cumulative Compressive Strain (mm/m)
After LWA6	260	1.1	0.1	0.4
After LWA7	465	2.4	0.4	0.7
After LWA8	1370	5.8	0.7	1.7
After LWA9	1655	6.2	0.7	1.8
After LWA10	1775	6.6	0.8	1.8
After LWA11	1870	6.7	0.8	1.8



Source: AAM Hatch Aerial Photography (August 2006), LPI NSW, Austar Coal Mine

0 0.5 1 1.5km
1:32 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site

FIGURE 6.2

Maximum Predicted Subsidence Landform

Note: Contour Interval 5m

File Name (A4): R10_V1/2274_615.dgn

Table 6.1 – Maximum Predicted Cumulative Systematic Subsidence Parameters (cont)

Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Tilt (mm/m)	Maximum Predicted Cumulative Tensile Strain (mm/m)	Maximum Predicted Cumulative Compressive Strain (mm/m)
After LWA12	1915	6.7	0.8	1.8
After LWA13	1920	6.7	0.8	1.8
After LWA14	1920	6.7	0.8	1.8
After LWA15	1920	6.7	0.8	1.8
After LWA16	1920	6.7	0.8	1.8
After LWA17	1925	6.7	0.8	1.8

As can be seen from **Table 6.1** for the proposed Stage 3 mining area:

- **Maximum predicted** subsidence ranges from approximately 260 mm for LWA7 to approximately 1925 mm for LWA17.
- **Maximum predicted** tilt ranges from approximately 1.1 mm/m for LWA7 to approximately 6.7 mm/m for LWA17.
- **Maximum predicted** tensile strain ranges from approximately 0.1 mm/m for LWA7 to approximately 0.8 mm/m for LWA17.
- **Maximum predicted** compressive strain ranges from approximately 0.4 mm/m for LWA7 to approximately 1.8 mm/m for LWA17.

6.1.5 Maximum Upperbound Systematic Subsidence Parameters

The Upper Bound systematic subsidence parameters are described in **Section 6.1.1.1**. Maximum Upper Bound cumulative systematic subsidence parameters are summarised in **Table 6.2**.

Table 6.2 – Maximum Upperbound Cumulative Systematic Subsidence Parameters

Longwall	Maximum Upperbound Cumulative Subsidence (mm)	Maximum Upperbound Cumulative Tilt (mm/m)	Maximum Upperbound Cumulative Tensile Strain (mm/m)	Maximum Upperbound Cumulative Compressive Strain (mm/m)
After LWA6	425	1.9	0.2	0.5
After LWA7	760	3.9	0.6	0.9
After LWA8	2190	9.2	1.1	2.7
After LWA9	2640	9.5	1.1	3.1
After LWA10	2825	10	1.1	3.0
After LWA11	2960	10	1.2	3.0
After LWA12	3025	10	1.2	3.0

Table 6.2 – Maximum Upperbound Cumulative Systematic Subsidence Parameters (cont)

Longwall	Maximum Upperbound Cumulative Subsidence (mm)	Maximum Upperbound Cumulative Tilt (mm/m)	Maximum Upperbound Cumulative Tensile Strain (mm/m)	Maximum Upperbound Cumulative Compressive Strain (mm/m)
After LWA13	3040	10	1.2	3.0
After LWA14	3040	10	1.2	3.0
After LWA15	3040	10	1.2	3.0
After LWA16	3040	10	1.2	3.0
After LWA17	3040	10	1.2	3.0

As can be seen from **Table 6.2** for the proposed Stage 3 mining area:

- **Maximum Upper Bound** subsidence ranges from approximately 425 mm for LWA7 to approximately 3040 mm for LWA17.
- **Maximum Upper Bound** tilt ranges from approximately 1.9 mm/m for LWA7 to approximately 10 mm/m for LWA17.
- **Maximum Upper Bound** tensile strain ranges from approximately 0.2 mm/m for LWA7 to approximately 1.2 mm/m for LWA17.
- **Maximum Upper Bound** compressive strain ranges from approximately 0.5 mm/m for LWA7 to approximately 3.0 mm/m for LWA17.

As stated in **Section 6.1.1**, Seedsman Geotechnics Pty Ltd considers that the MSEC upper bound is needlessly conservative and that a worst case scenario of 120% of MSEC's **Maximum Predicted Subsidence** (see **Table 6.1**) should be adopted.

On this basis, a worst case subsidence prediction for Longwalls LWA13 to LWA17 of 2304 mm should be adopted compared to the 3040 mm estimated using the MSEC **Maximum Upperbound** prediction indicating that the **Maximum Upperbound** prediction is very conservative. As a result **Maximum Upperbound** predictions of tilt, tensile strain and compressive strain are also expected to be very conservative.

6.1.6 Likely Height of the Fractured Zone above the Proposed Longwalls

The height of the collapsed zone, which forms immediately above extracted longwalls, is generally between 21 to 33 times the extracted seam thickness. The height of the collapsed zone for the proposed longwalls varies between 65 and 155 metres (depending on Seam height).

The upper limit of the fractured zone will be reached when the strata above the collapsed zone are sufficiently strong to span the goaf area without significant bending or shear strains being developed. MSEC (see **Appendix 11**) estimates that the upper limit of the fracture zone will be between 225 metres and 265 metres. The depth of cover above the proposed longwalls ranges from approximately 450 metres to 700 metres. It is unlikely, therefore, that the fractured zone would extend up to the surface.

6.1.7 Projected Impacts on Houses

There are 32 houses (see **Figure 5.5**) located within the Subsidence Impact Assessment area, of which 29 are single-storey houses with lengths less than 30 metres (Structure Type H1), and three are single-storey houses with lengths greater than 30 metres (Structure Type H2) (MSEC, 2008). There are 10 houses which are located directly above the extracted longwalls and 22 houses which are located outside the extracted longwalls but inside a 26½ degree angle of draw line from the extracted longwalls. No other significant residential features were identified within the subsidence assessment area.

Predictions of systematic subsidence, tilt, curvature and strain were made at the centroid and at the vertices of each house, as well as eight equally spaced points placed radially around the centroid and vertices at a distance of 20 metres. In the case of a rectangular shaped structure, predictions were made at a minimum of 45 points within and around the structure. To be conservative, an additional strain of 0.2 mm/m was added to the magnitude of the predicted strains, when the predicted subsidence is greater than 20 mm, to account for the scatter in observed strain profiles.

The Upper Bound systematic subsidence parameters at the houses have been determined by scaling up the predicted systematic subsidence parameters, such that a maximum total subsidence of 65% of effective extracted seam height is achieved above the proposed longwalls. Based on the predictions (see **Appendix 11**):

- no houses are predicted to experience a tilt greater than 7 mm/m. It is unlikely that the maximum predicted or Upper Bound tilts at a house would be of sufficient magnitude to result in any significant impacts on the stability and serviceability impacts of these structures;

- only 15% of the houses located directly above or immediately adjacent to the proposed longwalls would experience a very slight or slight impact, and each house has a probability of less than 1% of experiencing an impact that would be considered moderate or greater as a result of anomalous non-systematic movement;

- no houses are assessed to experience a predicted systematic strain greater than 1.5 mm/m. One house is assessed to experience an Upper Bound tilt greater than 7 mm/m, at the completion of the proposed longwalls. No houses are assessed to experience an Upper Bound tilt greater than 10 mm/m; and

- one house is assessed to experience an Upper Bound systematic strain greater than 2 mm/m. Anomalous, non-systematic movements could possibly contribute to strains greater than 2 mm/m.

6.1.8 Projected Impacts on Swimming Pools

There are 11 privately owned swimming pools (Structure Type P) which have been identified within the subsidence impact assessment area (see **Appendix 11**). Predictions of systematic subsidence, tilt and strain have been made at the centroid and at the corners of each pool, as well as eight equally spaced points placed radially around the centroid and corners at a distance of 20 metres. The maximum predicted and maximum Upper Bound systematic tilts at the pools are 5.0 mm/m (0.5%) and 7.0 mm/m (0.7%), respectively, or changes in grade of 1 in 200 and 1 in 145, respectively; and

As a result, the maximum predicted and maximum Upper Bound changes in gradient at the pools are less than 1% and are unlikely, therefore, to result in any significant impacts on the serviceability of the pools.

6.1.9 Projected Impacts on Roads

Sandy Creek Road, Quorrobolong Road, Coney Creek Lane and Nash Lane, Pelton Fire Trail and Big Hill Road are each located across the subsidence impact assessment area.

- the maximum Upper Bound systematic tilt at the roads, at any time during or after the extraction of the proposed longwalls, is 8.1 mm/m (0.8%). This is a change in grade of 1 in 125. The maximum Upper Bound tilt is less than 1% and is unlikely, therefore, to result in any significant impacts on the serviceability or the drainage of water at the roads; and

- the maximum predicted systematic tensile and compressive strains at the roads, at any time during or after the extraction of the proposed longwalls, are 0.7 mm/m and 1.7 mm/m, respectively.

It would be expected, however, that any surface cracking that occurred at these roads, as a result of the extraction of the proposed longwalls, would be of a minor nature due to the relatively small magnitudes of predicted and Upper Bound systematic strains and due to the relatively high depths of cover (see **Appendix 11**). Quorrobolong Road has a bitumen seal within the assessment area and Coney Creek Lane and Big Hill Roads are unsealed roads.

6.1.10 Projected Impacts on Local Bridges

The bridges on Sandy Creek Road over Sandy Creek and Quorrobolong Creek Road over Cony Creek are both located within the subsidence impact assessment area. Both structures are not directly mined beneath and are located at minimum distances of 575 metres and 250 metres respectively from the proposed longwalls.

- the maximum Upper Bound systematic tilt at the bridges, at any time during or after the extraction of the proposed longwalls, is 0.5 mm/m (less than 0.1%), or a change in grade of 1 in 2000. The maximum Upper Bound tilt is less than 1% and is unlikely to result in any significant impacts on the serviceability of the bridges (see **Appendix 11**); and

- the systematic strains and curvatures at the bridges are very small and unlikely to result in any significant impacts on the structural integrity of the bridges (see **Appendix 11**). The maximum Upper Bound upsidence and closure movements at the bridges are 20 mm and 25 mm, respectively.

6.1.11 Projected Impacts on Local Drainage Culverts

There are several historical drainage culverts located across the mining area:

- the maximum Upper Bound systematic tilt, tensile strain and compressive strain within the mining subsidence assessment area resulting from the extraction of the proposed longwalls, are 10 mm/m, 1.2 mm/m and 3.1 mm/m, respectively. The drainage culverts are also relatively short, typically less than 4 metres in length; and

- it is unlikely that the predicted systematic strains would result in any significant impacts on the drainage culverts.

The maximum Upper Bound systematic tilt is equivalent to a change in grade of 1% and is unlikely, therefore, to impact the serviceability of the drainage culverts (see **Appendix 11**).

The drainage culverts are located along drainage lines and could experience some valley related upsidence and closure movements. The upsidence and closure movements are orientated perpendicular to the main axes of the culverts and are unlikely to result in any significant impacts. The potential magnitude of these impacts is likely to be further reduced by the fact that the Branxton Formation extends from the Greta Coal Seam to the weathered zone at the surface and is likely to be sufficiently strong to prevent upsidence and valley closure impacts manifesting on the surface.

6.1.12 Projected Impacts on Local Electrical Infrastructure

The electrical services comprise a number of branches of an 11 kV powerline which are located across the subsidence impact assessment area. The location of these services is provided in **Appendix 11**. The cables along the 11 kV powerline branches are not affected by ground strains, as they are supported by the poles above ground level.

- the maximum Upper Bound systematic tilt along the alignments of the powerline branches is 7.3 mm/m (0.7%), or a change in grade of 1 in 135 and 7.0 mm/m (0.7%), or a change in grade of 1 in 145 across the alignment at any time during or after the extraction; and

- it is unlikely that the maximum predicted or the maximum Upper Bound systematic tilts would result in any significant impacts on the powerlines. Based on a minimum bay length of 50 metres, the maximum Upper Bound horizontal movement at the tops of the poles would result in a change in bay length of less than 0.5%.

6.1.13 Projected Impacts on Local Optical Fibre Cable

The optical fibre cable within the subsidence impact assessment area (see **Appendix 11**) is directly buried and, therefore, will not be affected by the tilts resulting from the extraction of the proposed longwalls. The cable, however, is likely to experience slight ground strains resulting from the extraction of the proposed longwalls.

Maximum Upper Bound systematic tensile and compressive strains at the optical fibre cable, at any time during or after the extraction of the proposed longwalls, are 1.0 mm/m and 2.5 mm/m, respectively. MSEC (2008) (see **Appendix 11**) indicates that fibre optic cables can typically tolerate tensile strains of up to 4 mm/m without significant impact. MSEC (2008) recommends that the optic fibre cable is monitored during the extraction of longwalls using Optical Time Domain Reflector (OTDR) techniques or similar. MSEC (2008) concludes that:

> 'with the required preventative measures in place it is expected that the optic fibre cable can be maintained in a serviceable condition throughout the mining period.'

6.1.14 Projected Impacts on Local Copper Cables

The aerial cables within the Subsidence Impact Assessment area follow the alignment of Sandy Creek Road (see **Appendix 11**). The aerial copper telecommunication cables are not affected by ground strains, as they are supported by the poles above ground level. The cables can, however, be affected by the tilting of the poles, which affects the catenary profiles of the cables. MSEC (2008) predicts that:

- maximum Upper Bound systematic tilt at the aerial main copper telecommunication cables, at any time during or after the extraction of the proposed longwalls, will be 1.3 mm/m (0.1%), or a change in grade of 1 in 770; and

- maximum Upper Bound tilt will be less than 1% and is unlikely, therefore, to result in any significant impacts on the aerial main copper telecommunication cables along Sandy Creek Road.

6.1.15 Projected Natural Feature Impacts

The impact assessment conducted by MSEC (2008) (see **Appendix 11**) for each identified natural feature has been made for an Upper Bound case, which assumes that the maximum possible subsidence of 65% of effective extracted seam thickness is achieved. Predicted landforms resulting from maximum predicted and Upper Bound subsidence are shown on **Figures 6.2** and **6.3**.

6.1.15.1 Cony and Sandy Creeks

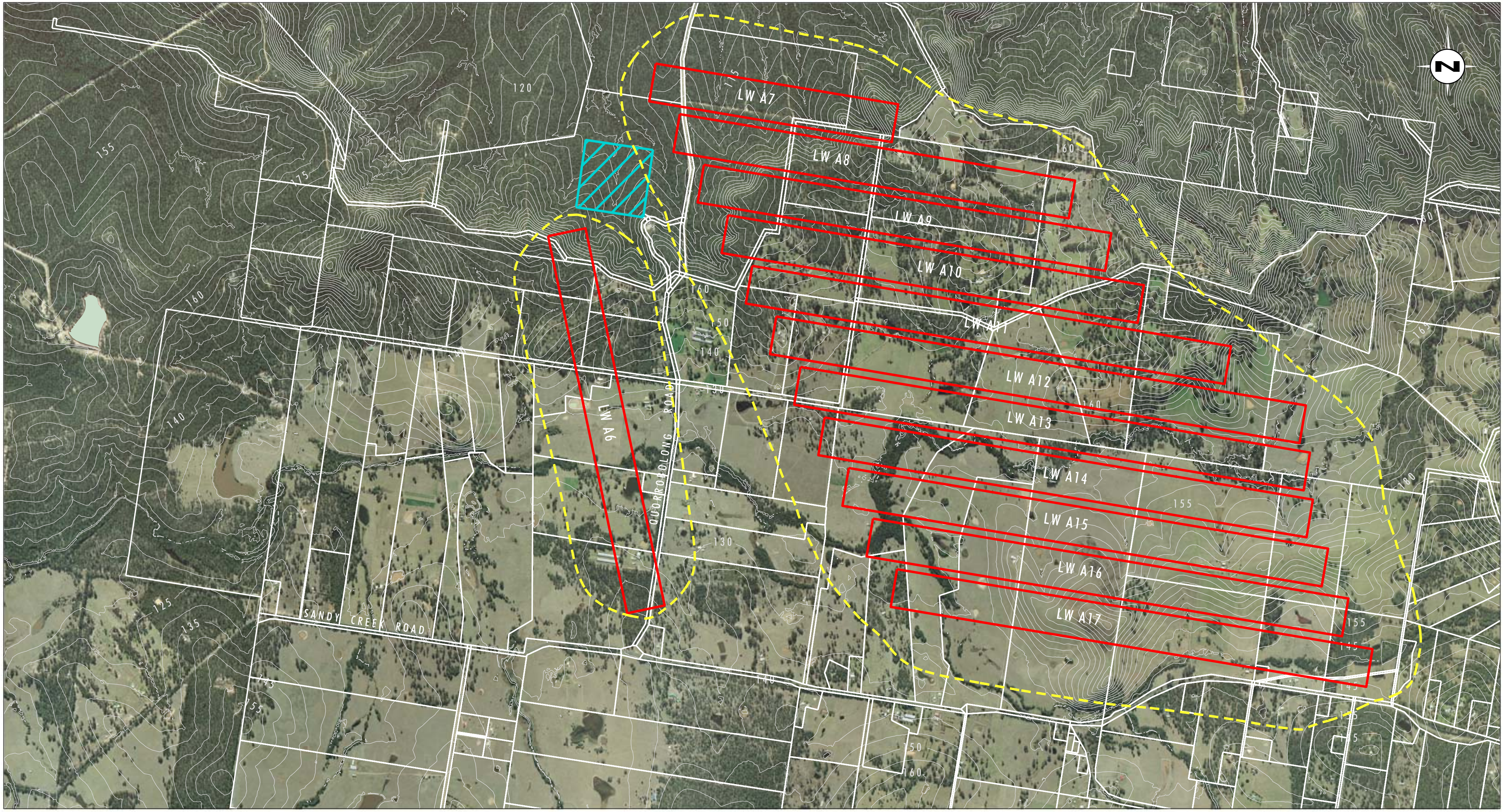
The impact assessments for Cony and Sandy Creeks should be read in conjunction with the findings from the flood modelling work discussed in **Section 6.2**. As discussed in **Section 6.2** a detailed flood model of the creeks has been prepared by Umwelt using the maximum predicted and the Upper Bound subsidence movements resulting from the extraction of the proposed longwalls, which were provided by MSEC (2008).

Maximum predicted cumulative subsidence along Cony Creek and Sandy Creek are summarised in **Table 6.3**.

Table 6.3 – Maximum Predicted Cumulative Subsidence, Upsidence and Closure along Cony and Sandy Creeks

Creek	Longwall	Maximum Predicted Cumulative Subsidence (mm)	Maximum Predicted Cumulative Upsidence (mm)	Maximum Predicted Cumulative Closure (mm)
Cony Creek	After LWA6	200	20	20
	After LWA12	200	45	65
	After LWA13	910	150	125
	After LWA14	1490	255	190
	After LWA15	1780	290	220
	After LWA16	1840	310	240
	After LWA17	1865	320	250
Sandy Creek	After LWA13	<20	<20	<20
	After LWA14	35	<20	<20
	After LWA15	300	<20	<20
	After LWA16	1190	40	25
	After LWA17	1410	65	25

As set out in **Table 6.3**, maximum predicted subsidence along Cony Creek ranges from 200 mm above LWA6 to 1865 mm above LWA17 while maximum predicted subsidence along Sandy Creek ranges from <20 mm above LWA13 to 1410 mm above LWA17. The increased likelihood of ponding and flooding along Cony Creek and Sandy Creek as a result of this predicted subsidence is discussed further in **Section 6.2**.



Source: AAM Hatch Aerial Photography (August 2006), LPI NSW, Austar Coal Mine

0 0.5 1 1.5km
1:32 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site

FIGURE 6.3

Upperbound Subsidence Landform

Note: Contour Interval

File Name (A4): R10_V1/2274_628.dgn

Table 6.4 – Maximum Upperbound Cumulative Subsidence, Upsidence and Closure along Cony and Sandy Creeks

Creek	Longwall	Maximum Upperbound Cumulative Subsidence (mm)	Maximum Upperbound Cumulative Upsidence (mm)	Maximum Upperbound Cumulative Closure (mm)
Cony Creek	After LWA6	320	30	25
	After LWA12	320	45	65
	After LWA13	1330	155	125
	After LWA14	2140	260	195
	After LWA15	2590	295	225
	After LWA16	2680	315	245
	After LWA17	2785	325	250
Sandy Creek	After LWA13	<20	<20	<20
	After LWA14	60	<20	<20
	After LWA15	440	<20	<20
	After LWA16	1675	40	25
	After LWA17	2040	65	25

As set out in **Table 6.4**, maximum Upper Bound subsidence along Cony Creek ranges from 320 mm above LWA6 to 2785 mm above LWA17 while maximum Upper Bound subsidence along Sandy Creek ranges from <20 mm above LWA13 to 2040 mm above LWA17. The increased likelihoods of ponding and flooding along Cony Creek and Sandy Creek as a result of this predicted subsidence is discussed further in **Section 6.2**.

As previously discussed, the Branxton Formation forms the upper section of the constrained zone. This formation is massive, relatively homogeneous and contains relatively thick beds. As a result upsidence and valley closure impacts are expected to be less than those listed in **Tables 6.3** and **6.4**.

At any time during or after the extraction of the proposed longwalls the maximum strains along Cony and Sandy Creeks are predicted to be subject to:

- maximum predicted systematic tensile strains are 0.5 mm/m and 0.6 mm/m, respectively, and the associated minimum radii of curvatures are 30 kilometres and 25 kilometres, respectively;
- maximum Upper Bound systematic tensile strains are 0.7 mm/m and 0.8 mm/m, respectively; and
- maximum predicted systematic compressive strains are 0.7 mm/m and 0.4 mm/m, respectively, and the associated minimum radii of curvatures are 21 kilometres and 38 kilometres, respectively; the maximum Upper Bound systematic compressive strains are 1.1 mm/m and 0.8 mm/m, respectively, and the associated minimum radii of curvatures are 14 kilometres and 19 kilometres, respectively.

6.1.15.2 Steep Slopes

Steep slopes are defined as areas of land having a natural gradient greater than 1 in 3 (a grade of 33%, or an angle to the horizontal greater than 18°). No cliffs or escarpment have been identified within the potential subsidence impact area. In regard to steep slopes

Subsidence Impact Assessment undertaken by MSEC (2008) (see **Appendix 11**) indicates that:

- maximum Upper Bound systematic tilt at the steep slopes along the Broken Back Range, at any time during or after the extraction of the proposed longwalls, is 9.8 mm/m (1.0%), or a change in grade of 1 in 100. The maximum Upper Bound systematic tilt at the steep slopes along the hill above LWA17, at any time during or after the extraction of the proposed longwalls, is 6.7 mm/m (0.7%), or a change in grade of 1 in 150; and

- maximum Upper Bound systematic tensile and compressive strains at the steep slopes along the Broken Back Range, at any time during or after the extraction of the proposed longwalls, are 1.0 mm/m and 3.0 mm/m, respectively, and the associated minimum radii of curvatures are 15 kilometres and 5.0 kilometres, respectively.

MSEC (2008) concludes that if the maximum Upper Bound systematic tilt anywhere above the proposed longwalls of 10 mm/m were to occur at the steep slopes, it would still be unlikely to result in any significant impact, as the change in surface gradient of only 1.0%, or 1 in 100, is still very small when compared to the natural gradients of the steep slopes. Further, any surface cracking would be expected to be minor and could be remediated by infilling with soil or other suitable materials, or by locally regrading and recompacting the surface if required.

6.1.16 Subsidence Effects on Land Use and Agricultural Productivity

6.1.16.1 Local Rural Building Structures

A total of 80 rural building structures (Structure Type R) have been identified within the Subsidence Impact Assessment area (MSEC (2008)). These buildings include generally lightweight farm sheds, garages and other non-residential structures. Any impacts are expected to be easily repaired using normal building maintenance techniques. Predictions of systematic subsidence are identical to the methods used to assess Houses (refer to **Section 6.2.3.2**). Assessment undertaken by MSEC (2008) indicates that:

- no rural building structures are likely to experience a predicted tilt greater than 7 mm/m or a predicted systematic strain greater than 1.5 mm/m. It is recognised that some rural building structures could experience strains greater than 1.5 mm/m due to anomalous non-systematic movements. Tilts less than 10 mm/m generally do not result in any significant impacts on rural building structures; and

- any impacts on the rural building structures that occur as a result of the extraction of the proposed longwalls are expected to be easily remediated using well established building techniques.

MSEC (2008) concludes that it is unlikely that there would be a significant impact on rural building structures resulting from the extraction of the proposed longwalls.

6.1.16.2 Tanks

There are a number of larger tanks (Structure Type T) that have been identified within the subsidence impact assessment area, which include water and fuel storage tanks. There are also a number of smaller rainwater and fuel storage tanks associated with the residences on each rural property. Predictions of subsidence, tilt and strain have been made at the centroid of each identified tank at a minimum of 45 points within and around the tanks. Assessment undertaken by MSEC (2008) indicates that:

- Maximum predicted systematic tilt at the identified tanks, after the completion of any of the proposed longwalls, is 4.0 mm/m (0.4%), or a change in grade of 1 in 250. The maximum predicted systematic tensile and compressive strains at the identified tanks are 0.8 mm/m and 1.3 mm/m, respectively, and the associated minimum radii of curvatures 19 kilometres and 12 kilometres, respectively.

- Any impacts are expected to be of a minor nature, including leaking pipe joints, and could be easily repaired. With these remedial measures in place, it would be unlikely that there would be any significant impacts on the pipelines associated with the tanks.

6.1.16.3 Fences

There are a number of fences which are constructed in a variety of ways, generally using either timber or metal materials. Any impacts on the fences which occur as the result of mining are likely to be of a minor nature and relatively easy to rectify by re-tensioning the fencing wire, straightening the fence posts, and if necessary, replacing some sections of fencing. Assessment undertaken by MSEC (2008) indicates that:

- maximum Upper Bound systematic tilt within the mining area is 10 mm/m (1.0%), or a change in gradient of 1 in 100, which occurs above proposed LWA7 after the extraction of proposed LWA8;

- maximum Upper Bound systematic tensile and compressive strains within the mining area are 1.2 mm/m and 3.0 mm/m, respectively. The maximum Upper Bound systematic tensile strain occurs above proposed LWA7 and the maximum Upper Bound systematic compressive strain occurs above the chain pillar between proposed LWA7 and LWA8; and

- maximum Upper Bound systematic strains are less than 5 mm/m and are unlikely, therefore, to have a significant impact on the fences.

6.1.16.4 Farm Dams

There are 134 farms dams identified within the subsidence assessment area (see **Appendix 11**). Predictions have been made at the centroid and around the perimeters of each farm dam. Such dams are typically constructed of cohesive soils with reasonably high clay content and capable of withstanding tensile strains of up to 3 mm/m without impact because of their inherent elasticity. The dams may also be subjected to minimal valley related upsidence. Assessment undertaken by MSEC (2008) indicates that:

- Maximum predicted systematic tilt at the farm dams, at any time during or after the extraction of the proposed longwalls, is 6.1 mm/m (0.6%) or a change in grade of in 1 in 165.

MSEC (2008) concludes that it is unlikely that the maximum predicted and maximum Upper Bound systematic strains would result in any significant impact on the farm dams. With any remediation measures in place, it is unlikely that any significant impact on the farm dams would occur resulting from the extraction of the proposed longwalls.

6.1.16.5 Wells and Bores

There is one registered groundwater bore which is adjacent to LWA6 and at the edge of the subsidence impact assessment area, being Ref. GW038372 (see **Appendix 11**). The bore is unlikely to be subjected to any significant systematic subsidence movements, however:

- the groundwater bores in the vicinity may be affected by far-field horizontal movements, which can occur up to 2 or 3 kilometres from the proposed longwalls; and
- differential horizontal movements at different strata horizons could reduce the capacities of these groundwater bores, or increase the ingress of water into the bores at different strata horizons. There are no known bores yielding water that are used by the property holders within the proposed Stage 3 mining area.

MSEC (2008) concludes that the assessed impact on groundwater bores within the study area is not significant. Potential impacts on groundwater resources in the area are discussed further in **Section 6.3**.

6.1.17 Subsidence Monitoring, Management and Contingency Measures

The monitoring, management and mitigation of subsidence is an integral component of the current Austar Mining Operations Plan 2008-2015 (MOP) and the Austar Subsidence Management Plan (SMP).

Austar has communicated with surrounding communities and stakeholders regarding the subsidence impact assessment, potential subsidence impacts, monitoring and management considerations and will continue this communication throughout the development of Subsidence Management Plans and Property Subsidence Management Plans prior to mining taking place.

The following subsidence monitoring procedures will be implemented as part of the Project, and will be further refined in consultation as mining progresses:

- subsidence monitoring lines to be located as determined as part of the SMP process;
- visual assessment of all natural features and items of surface infrastructure before, during and following mining to detect subsidence impacts such as surface cracking, irregularities in the subsidence profile, erosion, damage to structures, changes in drainage patterns or loss of water from drainage structures;
- assessment of all building structures by a structural engineer before and after mining; and
- verification and revision of subsidence predictions as mining progresses.

There will be ongoing refinement and calibration of the subsidence predictive model throughout the project life as a result of subsidence monitoring and comparison with predictions. As the coal resource is extracted, refinement and verification of the model will be incorporated into the SMP for each set of longwalls, providing a more accurate basis for the assessment and management of subsidence impacts as the project progresses. Contingency measures such as revisions to the mine plan and extraction height will be explored if subsidence monitoring indicates that subsidence impacts are greater than predicted.

Significant subsidence impacts on the land surface from the proposed Stage 3 underground mining are not predicted. However, in the event that subsidence impacts are greater than those predicted, a variety of contingency measures and rehabilitation techniques are available to repair or avoid further the impacts of subsidence. Remediation techniques will vary depending on the extent of surface cracking or landform changes. These techniques will aim to minimise the impact on the surface whilst achieving an acceptable level of rehabilitation from a land user safety, mine safety and environmental perspectives.

In areas where smaller scale cracking is predicted to occur, remediation activities may include one, or a combination of the following methods:

- infilling of cracks with soil to seal cracks visible at the surface;
- tilling the ground surface using small agricultural equipment to blend fill material and restore the soil profile; and/or
- where necessary, using small machinery, such as a small excavator, bobcat or grader, to restore the surface profile.

Where subsidence remediation is required within sensitive areas such as adjacent to Aboriginal sites or significant ecological areas, hand methods can be used to repair any cracking and restore the soil profile.

Austar is committed to effective and timely rehabilitation of surface cracking should it occur, whilst minimising impact on the natural environment, cultural values and land use. The ground surface across the project area will be visually inspected during and following longwall extraction so that significant cracking or irregularities in the subsidence profile can be identified and remediated where required.

A summary of Subsidence Management and Remediation Measures is provided in **Table 6.5**.

Table 6.5 - Summary of Subsidence Management and Remediation Measures

Feature/Location	Typical Management and Remediation Options
Roads, Culverts and Bridges	• Tensile cracking or compressive rippling of the road surfaces remediated using normal road maintenance techniques. Roads will be visually monitored during mining. • Management strategies are developed, in consultation with Cessnock City Council
Powerlines (11kV)	• Management strategy developed in consultation with Energy Australia • Visually inspected during mining.
Optical Fibre Cable	• Monitored using optical fibre sensing techniques, such as Optical Time Domain Reflector (OTDR) monitoring. • Establish management strategies, in consultation with Telstra
Telecommunication Cables	• No significant impact predicted. • Management strategies will be developed in consultation with Telstra.

Table 6.5 - Summary of Subsidence Management and Remediation Measures (cont)

Feature/Location	Typical Management and Remediation Options
Building Structures	• Managed with the implementation of suitable management strategies. Each dwelling and rural building structure above the proposed longwalls will be inspected prior to being mined beneath, to assess the existing condition and whether any preventive measures may be required. • Rural building structures are visually monitored during mining.
Tanks	• Suitable management strategies. • Tanks will be visually monitored during mining.
Farm dams	• No significant impact predicted. • All water retaining structures visually monitored during mining. • Repair leaking dams if/as required.
Cony, Sandy, Quorrobolong Creeks and other drainage lines	• No significant predicted impact. • Any significant tensile cracking will be remediated by infilling with alluvials or other suitable material or by locally regarding and recompacting surface.
Houses	• PSMPs developed for houses directly above proposed mining. Inspected prior to mining. • Houses visually monitored during mining.
Steep slopes	• Earthworks, soil remediation and revegetation as required.
Fences	• Repair impacted fences if required.
Bores	• Repair or replace impacted bores if required.

As part of ongoing subsidence management Property Subsidence Management Plan (PSMP) will be developed for each landholder whose property is potentially subject to subsidence of great than 20 millimetres. A comprehensive consultation program with landholders will be undertaken and current property-specific baseline data will be compiled prior to mining and provided to landholders in the form of a PSMP. PSMPs will be prepared and discussed with relevant landholders as requested.

6.1.18 Land Use and Property Values

There are approximately 36 privately-owned land parcels in approximately 24 separate land ownerships directly above the proposed Stage 3 underground mining area. There are an additional approximately 22 properties located between the perimeter of the proposed Stage 3 underground mining area and the predicted 20 mm subsidence contour. As described in **Section 5.8**, land use within this area includes grazing land, chicken sheds, rural residential and hobby farms, forest plantations and vineyards.

The assessment of potential impacts from subsidence on the land surface, natural features and surface infrastructure as set out in **Sections 6.1.1** to **6.1.16** combined with the implementation of contingency and management measures as set out in **Section 6.17**, indicate that the proposed development will not have a significant adverse impact on land use above the proposed Stage 3 underground mining area. In addition, mining is not expected to have a negative impact on the visual attributes, ecology or amenity of the area or streamflow or usable groundwater resources in the area.

Subsidence Management Plans and Property Subsidence Management Plans that will detail monitoring and management measures to be implemented on a property by property basis will be prepared in consultation with relevant authorities and land holders prior to longwall extraction.

Based on the low level of predicted surface impact and the management controls that are proposed, it is not envisaged that land values of the properties above Stage 3 will be adversely affected by the proposed underground mining.

Continued economic growth coupled with predicted growth in urban and rural residential development in the area, are likely to continue result in increased demand for property in the area.

6.2 Surface Water and Drainage

6.2.1 Surface Drainage and Flood Modelling

As discussed in **Section 5.4**, the proposed Stage 3 mining area is predominantly located within the Cony Creek and Sandy Creek catchments which forms part of the Quorrobolong Creek, Congewai Creek and Wollombi Brook drainage systems. The proximity of the proposed Stage 3 mining area to Cony Creek and Sandy Creek catchments is shown on **Figure 5.1**. A small section of the northern part of the proposed Stage 3 mining area underlies an upslope section of Black Creek catchment (see **Figure 5.1**).

To assess the potential impacts on flooding and drainage that may result from the proposed Stage 3 mining, a detailed flood and drainage assessment (Umwelt, 2008b) has been undertaken and is presented in **Appendix 13**. The assessment builds on work undertaken for the Stage 2 (Umwelt, 2007) which examines the potential impacts on the flooding and drainage regime of mining Longwalls A3 to A5. The Stage 2 flood assessment is detailed in *Flooding Assessment: Longwalls A3, A4 and A5* (Umwelt, 2007) and formed part of the Subsidence Management Plan (SMP) for Stage 2.

The methodology used to undertake the flood and drainage assessment is detailed in **Appendix 13** and includes the following components:

- review of available meteorological and flooding data;
- extension of the one dimensional and two dimensional hydrodynamic flood models used for Stage 2 to incorporate the proposed Stage 3 area using high resolution Aerial Laser Survey (ALS) data to define the landform and locations and nature of drainage lines;
- collection of site specific observed flood level information from the February 1990 and June 2007 flood events;
- review of the calibration of the two dimensional model by comparing flood observations during the 1990 and June 2007 storm events to the modelled 1990 storm event with pre Stage 2 mining landform;
- modelling of the 100 year ARI storm event with pre Stage 2 mining landform;
- sensitivity analysis to explore model sensitivity to a range of hydraulic roughness and rainfall infiltration to soil parameters;
- definition of base conditions for the assessment (i.e. pre Stage 2 mining and pre Stage 3 mining);

- investigation of potential impacts of the Stage 3 mining operations on flooding and drainage for 1 year and 100 year ARI flood events for a range of landform scenarios including:
  - pre-mining landform;
  - post Stage 2 mining landform;
  - post Stage 3 (maximum predicted subsidence);
  - post Stage 3 (maximum Upper Bound subsidence); and
- analysis of predicted changes to flood depths, velocities, flood durations and hazards in the Quorrobolong Valley.

6.2.2 Surface Flows and Flooding Impacts

For each of the landform scenarios modelled as discussed in **Section 6.2.1**, the maximum water depths, maximum water velocities and maximum flood hazards were determined. The analysis also included an assessment of potential changes to duration of flooding in key areas as a result of proposed underground mining activities.

The predicted impacts on flooding as a result of the upper bound subsidence for Longwalls A6 to A17 are discussed in **Sections 6.2.2.1** to **6.2.2.4**.

Figures 6.4 to **6.6** show the predicted maximum flood depths for the 100 year ARI flood events modelled. **Appendix 13** contains flood depth, flow velocity duration and flood hazard information for all scenarios modelled.

6.2.2.1 In Channel and out of Channel Flood Depths

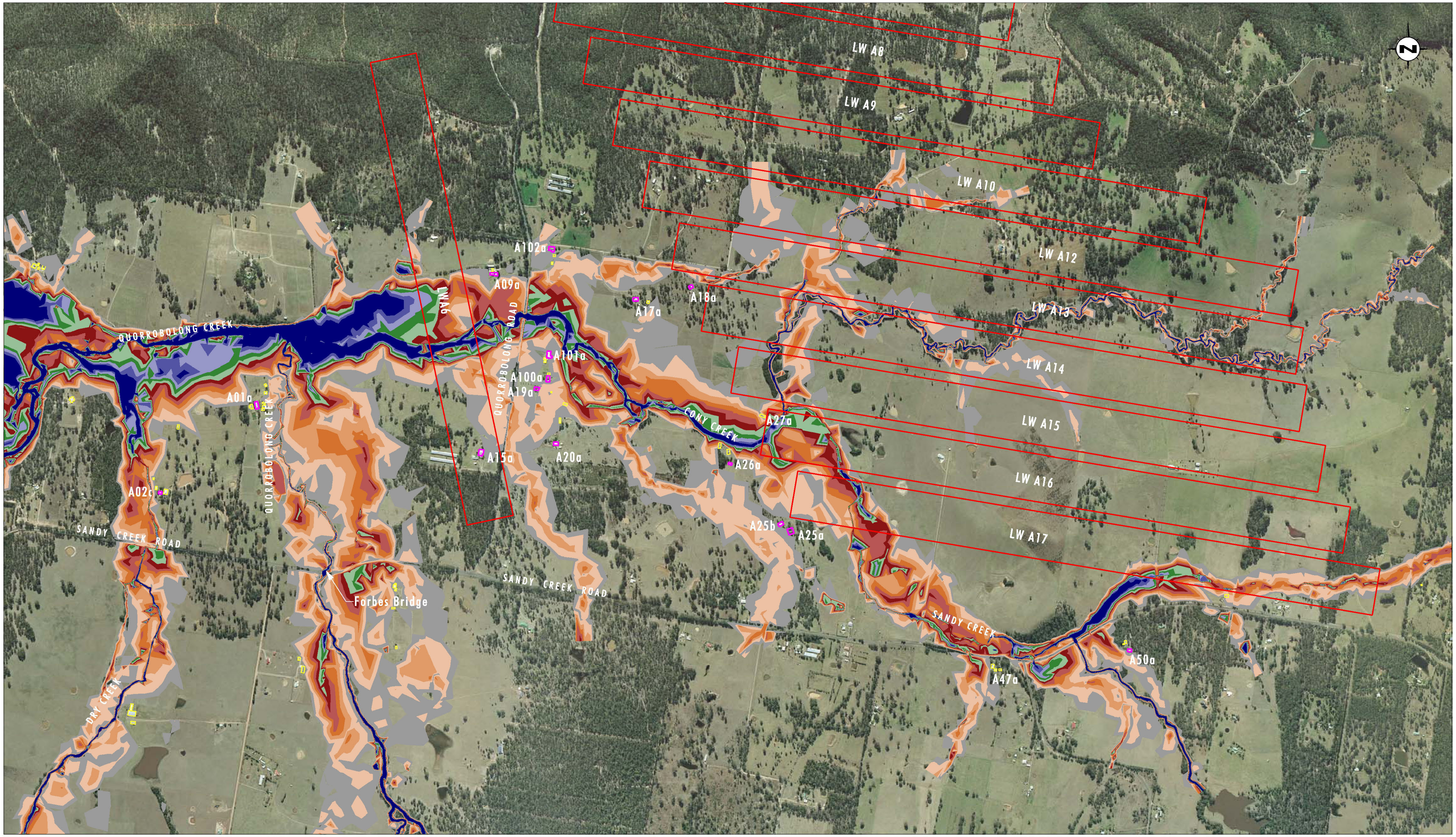
The modelling indicates that during the 100 year ARI storm event for pre Stage 3 mining conditions (i.e. with predicted subsidence for the Stage 2 Mining Area having occurred) the Stage 3 Mining Area may experience in channel flood depths of up to 950 mm. The modelled flood depths in this area with the upper bound subsidence landform are predicted to increase to a maximum of 1560 mm. This predicted increase is localised on Sandy Creek over the western section of Longwall A16 for approximately 300 metres upstream of the confluence of Sandy Creek and Cony Creek. Modelling indicates that flood depths may increase on average by approximately 90 mm over the floodplain area to be undermined by Longwall A6 and 40 mm over the floodplain area to be undermined by Longwalls A7 to A17 with the upper bound subsidence predictions.

In terms of out of channel flooding, modelling indicates during the 1 year ARI storm event for the pre Stage 3 mining landform flood depths are typically in the order of up to 300 mm. These levels are predicted to increase by up to 180 mm for the post-mining condition with the upper bound subsidence.

6.2.2.2 Flood Depths at Dwellings

The modelling results indicate that during the 100 year ARI storm event, longwall mining of Longwalls A6 to A17 will not increase flood depths at dwellings within the Quorrobolong Valley.

One dwelling, A102a (refer to **Figure 6.4**), in the Quorrobolong Valley has been identified where flooding is predicted to reach a depth of up to 70 mm at a dwelling. However, the floor level of this dwelling is estimated to be at least 400 mm above the ground level at this location. The Stage 3 flood assessment indicates that flood depths above ground level at



Source: Longwall Layout: Austar Coal Mine
Base Source: AAM Hatch, 2006
Note: Dwellings only shown for flood model extent

Legend

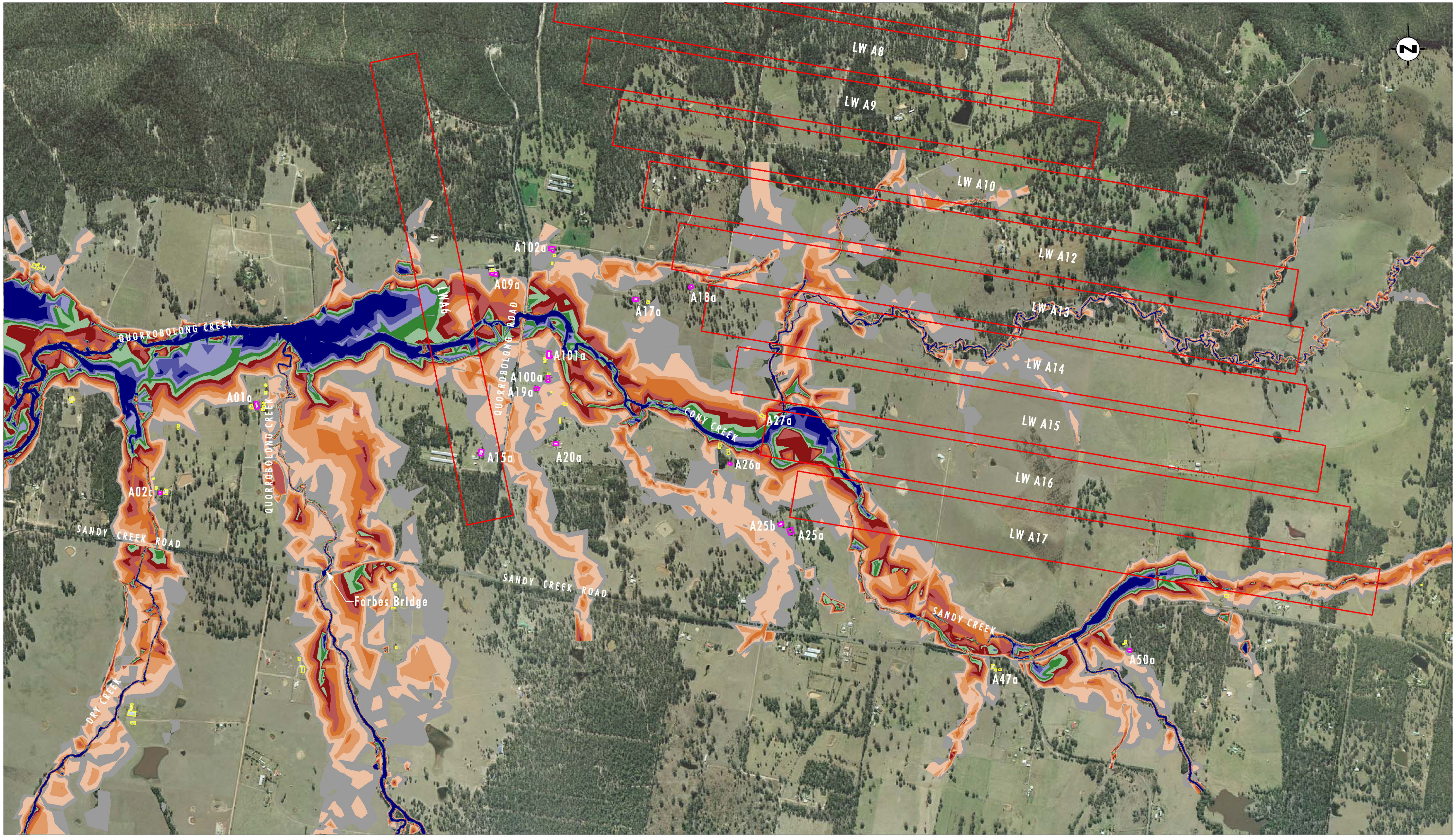
Conceptual Layout for Stage 3 Longwall Panels
Building
Dwelling
A01a Dwelling Reference Number

Water Depth (m)

Range [0.001 : 0.100]
Range [0.100 : 0.300]
Range [0.300 : 0.500]
Range [0.500 : 0.700]
Range [0.700 : 0.900]
Range [0.900 : 1.100]
Range [1.100 : 1.300]
Range [1.300 : 1.500]
Range [1.500 : 1.700]
Range [1.700 : 1.900]
Range [>1.900]

FIGURE 6.4

100 year ARI Storm: Maximum Water Depths for Pre Stage 3 Mining Landform



Source: Longwall Layout: Austar Coal Mine
Base Source: AAM Hatch, 2006
Note: Dwellings only shown for flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number

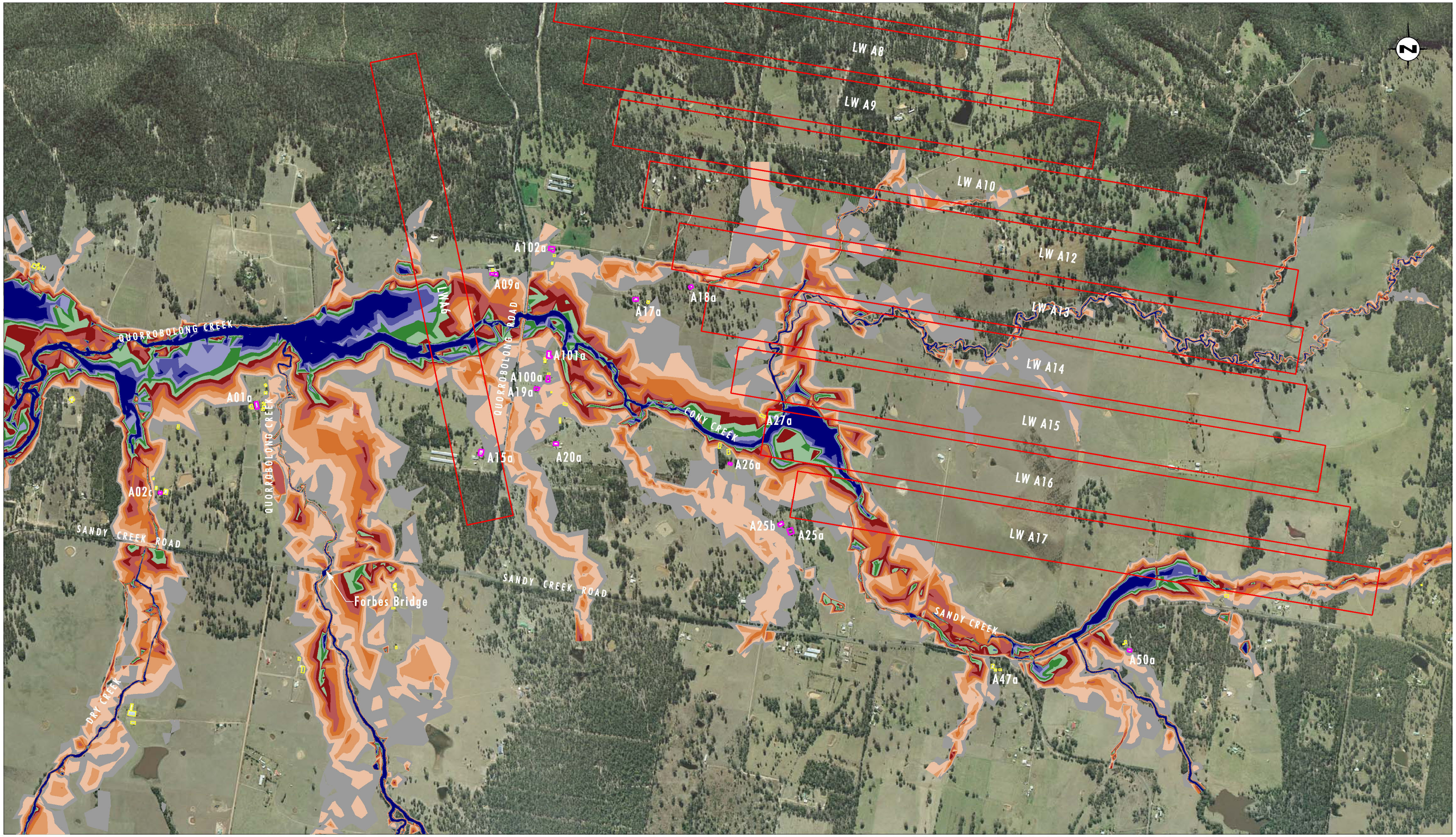
Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [>1.900]

FIGURE 6.5

100 year ARI Storm: Maximum Water Depths - Predicted Subsidence

Umwelt Environmental Consultants



Source: Longwall Layout: Austar Coal Mine
Base Source: AAM Hatch, 2006
Note: Dwellings only shown for flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number

Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [>1.900]

FIGURE 6.6

100 year ARI Storm: Maximum Water Depths - Upper Bound Subsidence

this dwelling will remain unchanged at approximately 70 mm for both the predicted subsidence and upper bound subsidence landforms.

6.2.2.3 Velocities

Flood modelling (see **Appendix 13**) indicates that maximum out of channel flow velocities for the 100 year ARI storm event for the maximum predicted subsidence case generally vary within +/- 0.1 m/s of the pre Stage 3 mining operations modelled maximum velocities. The modelled change for maximum in channel flows is in the order of +/- 0.3 m/s.

Flood modelling indicates that maximum out of channel flow velocities for the 100 year ARI storm event for the upper bound subsidence landform case generally vary within +/- 0.2 m/s of the pre Stage 3 mining operations modelled maximum velocities. This modelled change for maximum in channel flows is in the order of +/- 0.5 m/s.

Modelling indicates that maximum velocities in Cony Creek over proposed Longwall A6 would be in the order of 0.8 m/s to 1.1 m/s for pre Stage 3 mining conditions during a 100 year ARI storm event. These maximum velocities are predicted to decrease in the order of 0.2 m/s as a result of predicted upper bound subsidence.

The maximum velocities for the 1 year ARI storm event were found to decrease by approximately 0.1 m/s to 0.2 m/s.

The reach of Cony Creek immediately downstream of Quorrobolong Road Bridge is predicted to experience increases in maximum velocities of up to approximately 0.2 m/s to a maximum of approximately 1.6 m/s during the 100 year ARI storm event as a result of upper bound subsidence. Modelling indicates that approximately 200 metres of Cony Creek may be subject to this predicted increase in velocity.

In the reaches of Cony Creek to be undermined by Longwalls A14 and A15, maximum pre Stage 3 mining velocities are in the order of 0.8 m/s to 1.2 m/s. These maximum velocities are predicted to decrease by up to 0.2 m/s for the 100 year ARI storm event. Under these flow conditions the maximum velocities are expected to decrease by up to 0.6 m/s over the chain pillar on the western end of Longwall A16.

Modelling indicates that maximum velocities for the 1 year ARI storm event would range from 0.6 m/s to 1.2 m/s for the pre Stage 3 mining conditions and are predicted to decrease with the upper bound subsidence by up to 0.2 m/s over Longwalls A14 and Longwall A15 and 0.3 m/s over Longwall A16.

Along Sandy Creek in the area to be undermined by Longwalls A16 and A17, modelling indicates that the maximum pre Stage 3 mining velocities are predicted to be in the order of 0.8 m/s to 1.7 m/s for the 100 year ARI storm event. With the upper bound subsidence, modelling indicates that these maximum velocities are expected to increase by up to approximately 0.35 m/s for a short section over Longwall A17 and decrease by up to approximately 0.4 m/s over Longwall A16.

Modelling indicates that for the 1 year ARI storm event, maximum velocities at Points F and G (see **Appendix 13**) are predicted to increase in the order of 0.2 m/s over Longwall A17 and decrease in the order of 0.4 m/s over Longwall A16.

In the upper reaches of Sandy Creek to be undermined by the eastern section of Longwall A17, modelling indicates that the maximum pre Stage 3 mining velocities are currently in the order of 0.6 m/s to 1.1 m/s in the 100 year ARI storm event. These maximum velocities are predicted to increase by up to 0.2 m/s with the upper bound subsidence landform.

Modelling indicates that for the 1 year ARI storm event, maximum velocities are expected to increase from the pre Stage 3 mining levels of 0.2 m/s to 0.6 m/s by up to 0.2 m/s.

Analysis of the modelling results for Cony Creek and Sandy Creek indicate that maximum velocities will remain within non-scouring levels for both the 100 year and 1 year ARI storm events following the proposed Stage 3 mining operations and as a result no significant changes due to velocity induced scouring or erosion are predicted.

6.2.2.4 Flood Hazards

In order to assess the potential flood hazards associated with underground mining in the Stage 3 Mining Area, the flood hazard categories outlined in Appendix G of the *Floodplain Development Manual* (2005) were utilised. The four flood hazard categories, in order of increasing hazard, are:

- unclassified;
- vehicles unstable;
- wading unsafe (and vehicles unstable); and
- damage to light structures.

The flood hazard categories along dwelling access roads associated with flooding during the 100 year ARI storm event for the maximum predicted subsidence and upper bound subsidence cases with the proposed Stage 3 mining operations are listed in **Table 6.6** (for dwelling locations refer to **Figure 6.4**).

Table 6.6 – Flood Hazard Categories for Dwelling Access Routes[1]

Dwelling Access Route	Modelling Scenario		
	Pre Stage 3 Mining Landform	**With Maximum Predicted Subsidence**	**With Upper Bound Subsidence**
A17a	Unclassified	Unclassified	Unclassified
A18a	Wading Unsafe	Wading Unsafe	Wading Unsafe
A19a	Unclassified	Unclassified	Unclassified
A20a	Vehicles Unstable	Vehicles Unstable	Vehicles Unstable
A26a	Unclassified	Unclassified	Unclassified
A27a	Unclassified	Unclassified	Unclassified
A29a	Wading Unsafe	Wading Unsafe	Wading Unsafe
A33a	Unclassified	Unclassified	Unclassified
A65a	Wading Unsafe	Wading Unsafe	Wading Unsafe
A83a	Wading Unsafe	Wading Unsafe	Wading Unsafe
A100a	Vehicles Unstable	Vehicles Unstable	Vehicles Unstable
A101a	Vehicles Unstable	Vehicles Unstable	Vehicles Unstable
A102a	Unclassified	Unclassified	Unclassified

Note[1]: Only dwellings with access routes within the flood extent are listed

The results presented in **Table 6.6** indicate that the flood hazard categories are not predicted to increase for any of the dwelling access routes within the modelled floodplain.

6.2.2.5 Duration of Flooding and Overbank Ponding

The modelling indicates no discernible change in flow rates or hydrograph shape at Ellalong Bridge for the 100 year ARI storm event (**Appendix 13**). The modelling also indicates a potential decrease after mining in peak flow rates during the 1 year ARI storm event at the model outlet (see **Appendix 13**).

The area at the confluence of Sandy Creek and Cony Creek is proposed to be undermined during Stage 3 mining operations by Longwall A16. The maximum predicted subsidence in this area ranges between 1000 mm and 2000 mm. Modelling indicates that during the 100 year ARI storm event there will be no increase the duration of peak flows for either the maximum predicted subsidence or upper bound subsidence cases at this location.

Analysis of the 100 year ARI storm event modelling results in the area near the confluence of Sandy Creek and Cony Creek (see **Appendix 13**) indicates that inundation of the overbank areas to the south of the confluence will occur for approximately 27 hours for the pre Stage 3 mining landform with this increasing to approximately 35 hours due to maximum predicted subsidence and 39 hours due to upper bound subsidence. This increase in the duration of inundation is not expected to be of sufficient duration to adversely impact on grasses or riparian vegetation in the area.

Similarly analysis of the modelling results for the 1 year ARI storm event indicates that overbank ponding occurs for a period of approximately 19 hours for the pre Stage 3 mining landform. The analysis of the modelling results indicates that this may increase to the order of 28 hours for the maximum predicted subsidence case and 33 hours for the upper bound subsidence case.

Although the analysis indicates potential increases in flooding durations immediately upstream of the junction of Cony Creek and Sandy Creek, the predicted increases in flooding durations with the Stage 3 mining operations for the 1 year and 100 year ARI storm events are considered to be relatively small compared to the storm durations and not likely to significantly impact on grasses or riparian vegetation in the area.

6.2.3 Impacts on Stream Flow and Channel Stability

Analysis as set out in **Appendix 13** indicates that proposed mining of Stage 3 will not have a significant impact on the flow regime of the Sandy Creek and Quorrobolong Creek systems with only minor changes predicted in runoff regimes and peak discharges.

The high resolution ALS data that has been used to develop the digital terrain model for the Stage 3 area has been used along with subsidence predictions provided by MSEC (2008) (see **Appendix 11**) and the two dimensional hydrodynamic flood model to explore potential changes to channels and overland flow paths as a result of subsidence. This analysis indicates that the potential for changes to overland flowpaths to occur is greatest near the edges of longwalls and chain pillar regions with this potential being minor and localised for both the maximum predicted subsidence and upper bound subsidence cases. Analysis indicates that no changes to channel alignment are predicted as a result of subsidence from Stage 3 mining.

Longsections showing the existing, maximum predicted and Upper Bound bed elevations of Cony Creek, Sandy Creek and Quorrobolong Creek are provided in **Appendix 13**.

The in-channel grades along Cony/Quorrobolong Creek typically are within the range of 0.0% to 0.8%, with an average in-channel grade of 0.4%. Following mining within the proposed Stage 3 area, the creek channel grades are predicted to be within the range of 0.1% and 0.8% as a result of both maximum predicted subsidence and upper bound subsidence.

Average in-channel grade is predicted to remain at approximately 0.4% indicating that no significant changes in overall stream power or erosive potential along these reaches is expected.

The in-channel grades along Sandy Creek typically are within the range of 0.1% to 0.6%, with an average in-channel grade of 0.3%. Following mining within the proposed Stage 3 area, the creek channel grades are predicted to be within the range of 0.0% and 0.8% as a result of maximum predicted subsidence and 0.0% to 0.9% as a result of upper bound subsidence. Average in-channel grade is predicted to remain at approximately 0.3% as a result of maximum predicted subsidence and 0.4% as a result of upper bound subsidence indicating that no significant changes in overall stream power or erosive potential expected in the Stage 3 area of Sandy Creek.

As the predicted changes in in-channel grade are small and are considered to lie within the natural variations in grade of the creeklines of the Quorrobolong Valley, it is considered that the Stage 3 mining operations will not significantly alter the flow capacity or stream velocities within the existing channels. It is also considered that there is minimal potential for channel realignment to occur as a result of the proposed Stage 3 mining operations.

The potential to increase erosion on the landform is also expected to the minimal due to the relatively small predicted changes in landform grades combined with the high level of groundcover limited amount of exposed soils that exist in the area.

6.2.4 Impacts on Surface Water Users

As discussed in **Section 6.2.3**, modelling indicates that the proposed Stage 3 mining is unlikely to have a significant impact on runoff or flow regimes within the Sandy Creek and Cony Creek systems and as a result flows within the creeks should remain relatively unchanged.

The potential for mining to result in stream capture within these creek systems is also considered negligible predominantly due to the depth of cover and the strength and thickness of the underlying Branxton Formation. As set out in **Section 6.1**, the predicted upper limit of the vertically connected cracking above the goaf is 265 metres or less with the depth of cover between the Greta Coal Seam and the bed of Cony Creek and Sandy Creek being in excess of 500 metres. Vertical fracturing within the constrained zone is generally discontinuous and is unlikely, therefore, to result in increased hydraulic conductivity. As a result the potential for flows within the Cony Creek or Sandy Creek system to drain to the goaf resulting from the proposed Stage 3 mining is negligible.

This is supported by the fact that Quorrobolong Creek was previously undermined by LW1 to LW6 and LW SL1 at the Southland Colliery. In these locations the depth of cover varies between 310 and 370 metres. Following mining there was no reported loss of water from the creek and no reported surface cracking in the creek bed.

6.3 Groundwater

A detailed Groundwater Impact Assessment for Stages 2 and 3 of Austar Coal Mine was undertaken by Connell Wagner (October 2007) and is provided in **Appendix 14**. Key aspects of Connell Wagner (October 2007) relevant to the proposed Stage 3 development, are summarised in **Sections 6.3.1** to **6.3.5**.

6.3.1 Hydrogeological Context

There are three potential sources of groundwater that form an integral part of the local hydrogeological regime in this area:

- alluvial aquifers;
- fractured rock aquifers (including coal seam aquifers); and
- abandoned coal mines.

The distribution, characteristics and importance of these water sources are summarised in the following subsections.

Alluvial Aquifers

Quorrobolong Creek and its tributaries which flow in a general westerly direction across the Austar lease area comprise the alluvial aquifers in proximity to the proposed Stage 3 mining area. The tributaries that cross the Austar lease, including Sandy Creek and Cony Creek, are second to fifth order streams, and comprise a series of intermittent creeks, which only flow after consistent or heavy rainfall. These creeks have shallow alluvium-filled valleys ranging in width up to 400 metres and support shallow, low yielding groundwater resources that exhibit no major water bearing zones. Due to the very low vertical permeability of the underlying rock strata, there is very little vertical leakage of groundwater from the alluvium, and it is essentially isolated hydraulically from the rest of the hydrogeological regime. The extent of alluvium associated with this creek system and which covers only a small proportion of the extended lease area is shown on **Figure 5.2**.

Department of Water and Energy (DWE) database of water bores indicates that there are no registered bores within the local area that extract water from the alluvial deposits.

To provide greater understanding of the alluvial groundwater resource, Austar has established a monitoring bore in an existing borehole in the Stage 2 area (AQD 1073A) (see **Appendix 14**). The locations of known bores are shown on **Figure 5.2**. This bore is 7.7 metres deep and is located in the alluvial deposits in Cony Creek over Longwall A4. The bore log indicates that the alluvium is less than 3 metres thick in this area, and the groundwater table was at a depth of 2.7 metres below the ground surface when the bore was drilled. Subsequent measurements have indicated that the groundwater table rose to a level of 1.6 metres below the surface following heavy rains in June 2007.

The variable composition and excessive fines content in the alluvium indicate that its overall permeability is not likely to be high, and yields from any water bores would generally be expected to be low. The limited data available also suggests that the groundwater quality is normally fair, and generally suitable for stock use but not domestic consumption. Consequently, as an aquifer, the alluvium is of limited use as a groundwater resource.

The only groundwater dependent ecosystem known in the area that relies to some extent on the groundwater in the alluvium is the Swamp Oak Riparian Forest, areas above the proposed underground mining which is restricted to the creek channels. For this reason, potential impacts on the alluvial aquifer must be determined, as there may be a consequential impact on the dependant ecosystems.

Fractured Rock Aquifers

Permian strata overlying the coal measures in the Newcastle Coalfield generally have very low permeabilities (<10^{-8} m/s). Fractured rock aquifers generally comprise localised jointed or fractured zones, often adjacent to major faults.

Fractured rock aquifers have the potential for high flows, since they are confined aquifers and are at a relatively high pressure. Nevertheless, flows are often small in these zones, and water quality is generally poor and suitable only for stock use. Due to the very low vertical permeability of the Permian strata, there is very little leakage between any water-bearing zones or aquifers.

The occurrence of fractured rock aquifers overlying the proposed Stage 3 mining area comprise those associated with the Branxton Formation and those associated with Greta Coal Seam.

The Branxton Formation contains few if any major fractured rock aquifers due to its massive nature. A search of the DWE database of water bores indicates that there is only one bore within the Stage 2 area which intersected groundwater in the rock strata. This bore is 39.6 metres deep, and is located to the west of Longwall A3. The limited data from this bore (GW054676) indicates that the water bearing zone was located in a shale layer below the alluvium. The bore is low-yielding, and produces a flow of about 1 L/sec of poor quality water (EC = 12,000-16,000 µS/cm). The standing water level in this bore is currently about 1.3 metres below the surface following heavy rainfall, although the groundwater table is normally more than 2 metres deep. The bore is not utilised for agricultural purposes, but is used as a background monitoring bore for the DWE.

A seven metre deep bore, which intersects the soil profile, is located adjacent to the registered bore GW054676. The groundwater in this bore has an Electrical Conductivity (EC) of 10,000 to 11,000 µS/cm, and the depth to the water table is normally more than 2 metres. However, heavy rainfall in June and August 2007 reduced the near-surface groundwater EC to about 1600 µS/cm, and raised the water table to within 0.15 metres of the surface.

There are an additional three registered bores within the near vicinity of the Stage 3 longwall panels that intersect the Branxton Formation strata. These bores range in depth from 9.1 to 55 metres and all three attempt to tap fractured zones in the upper Branxton Formation. All three bores are low yielding, with individual fractured zones producing 0.3 to 0.6 L/sec. The one bore in which salinity levels were measured had salinity estimate of 10,000 to 14,000 ppm. The poor groundwater quality in the Branxton Formation is due largely due to the fact that the rocks were formed in a marine environment.

Drilling indicates a potential water-bearing zone in the Branxton Formation at a depth of 70 to 100 metres below the surface in the vicinity of Stage 2 and Stage 3 mining areas.

Previous experience (see **Appendix 14**) in the Newcastle Coalfield has shown that the permeability of the strata in the Branxton Formation is normally very low. The sandstone is generally strong and massive with a silica and/or clay matrix. As a result, the interstitial permeability is negligible, and any measured permeability derives from fractures and joints.

Coal Measures

Like the Permian strata, the rocks in the Greta Coal Measures also have very low permeabilities (<10^{-8} m/s). The coal seams are normally the water-bearing zones in the coal measures due to the presence of cleats and fractures in the rock mass. Hitchcock (1995) concludes that the coal measures in the Newcastle Coalfield 'have a poor resource potential with low yielding aquifers of high salinity'.

Permeability of the Greta Seam decreases with depth. The importance of the seam as an aquifer is minimal, as it contains poor quality groundwater.

There are no known groundwater dependent ecosystems of any significance that rely on the groundwater from the Greta Seam.

Abandoned Mine Workings

As shown on **Figure 2.1** there are several abandoned collieries adjacent to the Austar mine which are partially filled with groundwater. In addition to normal groundwater percolation into these workings, they also receive water from several other sources. These main sources include the following:

- return of the brine component of the output from the Reverse Osmosis Plant into the underground workings;
- diversion of water from surface dams to underground workings during major storm events (governed by automatic control systems);
- tailings discharge from the CHPP into the underground workings;
- transfer of water from 2 east underground storage to the Bellbird Colliery workings; and
- inflow of rainfall/runoff from high intensity or prolonged rainfall events.

The quality of the water contained in the abandoned mine workings is extremely poor as shown in **Table 6.7.**

Table 6.7 – Minewater Quality of Abandoned Mines

Location	pH	Electrical Conductivity (µS/cm)	Fe (mg/L)
#2 Shaft Pump (Ellalong Goaf)	4.7	18,733	575
West Pelton Goaf	6.8	8,350	52
East Pelton Goaf	3.8	11,960	851
LW13 flank hole (adjacent to Kalingo workings)	3.8	15,382	507
13C/T A1 Panel flank hole (adjacent to Aberdare Central workings)	3.9	11,823	1700

Typically rainfall does not infiltrate into the abandoned mine workings except during high intensity or prolonged rainfall events. Rainfall also enters the abandoned mines through significant one-off events such as the major rainfall event in June 2007 when a large volume of water was diverted via a sinkhole in Black Creek into the Aberdare Central workings. This resulted in approximately a 50 metre rise in water level in Aberdare Central and also increased water levels in the adjoining abandoned mines.

6.3.2 Impacts on Groundwater Regimes

6.3.3 Alluvium

In regard to potential impacts on alluvium, Connell Wagner (2007) (**Appendix 14**) concluded:

> 'The likely overall impact of the proposed extraction on the alluvial aquifer is assessed to be minimal, since the fractured zone above the mine is not expected to reach the ground surface and hence vertical drainage should not occur. In addition, fracturing from valley bulging is not predicted. The impact will be limited to minimal changes in hydraulic gradient in the aquifer zones, which should have a negligible impact. In the current context, the risk of the loss of the resource is considered acceptable, due to its relatively minor importance in this area, and the very low probability of an adverse outcome.'

6.3.3.1 Branxton Formation

In regard to potential impacts on fractured rock aquifer associated with the Branxton Formation, Connell Wagner (2007) (**Appendix 14**) concluded:

> 'It is assessed that any water-bearing zones which occur within the fractured zone above the Greta Seam will most likely drain into the mine opening during extraction of the longwalls (no such zones are currently known). It is concluded that the impact of the proposed mining on the water-bearing zone at a depth of 70 to 100 metres will be negligible since it is located well above the zone of interconnected fracturing. In the current context, the risk of the loss of the resource is considered acceptable, since it contains poor quality groundwater, is low yielding, and has limited potential for future exploitation.'

6.3.4 Greta Seam and Abandoned Workings

In regard to potential impacts on fractured rock aquifer associated with the Greta Coal Seam alluvium, Connell Wagner (2007) (**Appendix 14**) concluded:

> 'Extraction of the Greta Seam will drain groundwater from the seam into the mine and lower the hydraulic head in the seam in the area to the south of the development. Since the incremental drawdown will be minimal, the groundwater quality is poor, the seam is very deep, and there are no known users of the resource, the impact is judged to be negligible.'

Water in the abandoned workings, forms a major, but low quality source of groundwater in the region. The hydraulic head in these collieries is significantly higher than the level of the existing Austar workings with this difference in hydraulic head being responsible for most of the groundwater inflow to the mine. The head in most of the workings is approximately 160 metres above the level of the adjacent longwall panel A2 in the Austar mine.

Austar actively collects inflow into its current workings from the adjoining abandoned mines to prevent underground flooding of the workings. This water is pumped to the surface where it is treated in a series of water treatment processes to remove iron and manganese and increase the pH. The water is then passed through a reverse osmosis plant before being utilised in coal preparation and processing. The balance of the treated water from the reverse osmosis plant is discharged under licence to Bellbird Creek and contributes to environmental flows in this creek.

As a result, operations at Austar mine contribute to maintaining water levels in the surrounding abandoned workings to levels below which the mine water would start to flow (via springs and seepages) into the surrounding creeklines. As set out in **Table 6.7**, the water quality in the abandoned workings is very low have low pH, high conductivity and high iron concentrations. Maintenance of groundwater levels in these workings at a level where discharges do not occur is an important environmental outcome.

The proposed continuation of mining in Stage 3 will ensure that the groundwater levels in the adjoining workings continue to be managed for the life of the mine. In addition, it is estimated that the proposed extraction of coal from Stage 3 will result in an additional underground void capacity that will be available for the storage of low quality mine water at the end of the life of the mine of approximately 20 GL.

6.3.5 Regional impact

In regard to potential impacts on the regional groundwater resources, Connell Wagner (2007) (see **Appendix 14**) concluded:

> 'The impact of the proposed future extraction at the Austar Coal Mine on the alluvial aquifer system on a catchment-wide basis should be negligible, while incremental impact on the regional hydrogeological regime in the overburden strata will also be negligible.'

6.3.6 Groundwater Monitoring and Contingency Measures

The groundwater monitoring program for Austar operations is based on the premise that the height of interconnected fracturing above the coal seam is not known with any certainty, but should not be high enough to intersect either the alluvial aquifer or the shallow water-bearing zone in the Branxton Formation, which is more than 300 metres above the seam. Due to the lack of any significant aquifers in the lower overburden, the height of fracturing is therefore considered to be unimportant and largely academic in this case. Consequently, multi-level piezometers, which have been used in other localities, are not necessary to monitor the height of fracturing, particularly given their high cost and demonstrated propensity to fail at an early stage in the monitoring process.

The strategy to be adopted (see **Appendix 14**) is to monitor the groundwater levels in both the alluvial aquifer and the shallow (70 metres to 100 metres below ground surface) water-bearing zone for any changes. Ongoing analysis of the data will be carried out to determine if the changes are due to longwall extraction. If the changes are determined to be mining-related, the verification review process will examine the cause and suggest possible contingency measures.

Connell Wagner (2007) (see **Appendix 14**) recommended that the monitoring program for Stage 3 form part of the Site Water Management Plan and include the following:

- Establish two shallow groundwater monitoring bores in the alluvial area (one over longwall A6 and one over longwall A16), and monitor the groundwater levels on a continuous basis to give an indication of the impact of longwall mining on the groundwater in the alluvium. EC readings should be taken in these bores every three months.

- Establish two groundwater monitoring bores to check for any drawdown in the near-surface water-bearing zone in the Branxton Formation in the vicinity of the Stage 3 extraction area. The groundwater level should be monitored continuously in these bores. EC readings should be taken in the bores every three months.

- Monitor daily rainfall in the vicinity of the site so that the timing of any groundwater level fluctuations can be compared with the occurrence of rainfall events.

- Review the results of the above monitoring at three monthly intervals and report results at the completion of each longwall panel.

The suggested locations of the proposed groundwater monitoring points are shown on **Figure 5.2**. The location of these bores is subject to landowner approval, and may also be altered to take advantage of proposed exploration bores.

Connell Wagner (2007) also recommended that the monitoring for Stage 3 will also include a verification program that involves a detailed review of all:

- data from groundwater monitoring bores;
- subsidence data;
- extensometer data;
- mine water balance data;
- shaft water level data; and
- surface water data.

The verification reviews for Stage 3 will include the following:

- assess the likely height of fracturing in the area under review (if possible);
- assess the condition of the aquifers in the area under review;
- determine the sources of groundwater inflow to the mine and their relative volumes;
- determine whether the assessed conditions differ in any way to the conditions predicted;
- determine whether the variant conditions indicate a potentially adverse outcome, or will have an adverse impact on the main aquifers;
- identify any necessary remedial measures that will mitigate the identified impact or prevent it from occurring (these measures will be drawn from methods that have proven successful in the past); and
- identify any necessary modifications to future operations or operational constraints that will assist in limiting future adverse impacts.

Connell Wagner (2007) recommended the verification reviews for Stage 3 be undertaken at the following times:

- at the completion of longwall A6;
- at the completion of longwall A11; and
- at the completion of longwall A17.

6.4 Aboriginal Cultural Heritage

A comprehensive Aboriginal Heritage Assessment of the Project was prepared by Umwelt (2008c) with input from Aboriginal stakeholders provided during survey and at meetings between September 2007 and January 2008 (see **Appendix 6**). It is recognised that places of Aboriginal cultural value can only be identified by Aboriginal stakeholders.

The subsidence impact assessment conducted by MSEC (refer to **Appendix 11**) identifies the areas of Aboriginal Cultural Heritage significance and the associated and projected impact from subsidence.

6.4.1 Aboriginal Stakeholder Involvement

Aboriginal stakeholders were engaged in all stages of the assessment process. Aboriginal Stakeholder Meetings were held at the Austar Mine Complex in September 2007, December 2007 and July 2008. Issues discussed at the meetings included:

- the Project (longwall mining and surface works);
- the archaeological survey strategy;
- the significance of sites recorded;
- the potential impact of the Project to sites; and
- how sites should be managed.

Aboriginal stakeholder views on management formed the basis of recommendations in this report. Aboriginal stakeholders who registered at the start of the project were also involved in the archaeological survey.

6.4.2 Survey Methodology

Survey was conducted over six days in September and October 2007. Surveys were conducted in properties where landholders gave access. The properties surveyed were Austar land, the Werakata State Conservation Area and five private properties. In these properties, all creek lines, flats and ridges were surveyed, and a sample of hillslopes were surveyed.

The aim of the assessment was to develop an understanding of the archaeological and cultural Aboriginal heritage values of the Project area, through consultation with Aboriginal stakeholders, background research and archaeological survey. All works were conducted in compliance with DECC Guidelines (1997) for archaeological survey and assessment, DECC (2004) *Interim Community Consultation Requirements for Applicants* (DECC 2004a) and DECC's draft Part 3A assessment guideline *Draft Guidelines (2004b).*

During the assessment process, Aboriginal stakeholders were provided with the opportunity to contribute to the survey strategy, to identify sites/places of cultural significance, to assess the impact of the proposal to sites/places of cultural significance, and to determine appropriate heritage management strategies. In the latter stages of the Project, three Aboriginal stakeholder meetings were held to discuss key Aboriginal heritage issues and determine their appropriate management. Aboriginal stakeholder input was a determining factor in the final heritage management outcomes, through determining appropriate impact mitigation works and the nature of the conservation offset strategy.

6.4.3 Survey Results

Survey found 17 archaeological sites that comprised nine isolated finds, seven artefact scatters and one grinding groove. Sites were identified at a low density throughout the landscape within the 76.4 hectares surveyed.

All sites were found in areas of erosion and existing disturbance, with six sites recorded along graded vehicle access. Artefacts were also recorded at a low density, with only 49 found in the survey area. Low site and artefact density indicates that, although Aboriginal use of the landscape was extensive, areas were not intensively used within the Project area.

The DECC Aboriginal Heritage Information Management System (AHIMS) sites recorded as part of the Project area are indicated in **Figure 6.7** and listed in **Table 6.8**.

Table 6.8 – Archaeological Sites Registered within the CML2 Lease

AHIMS #	Site Name	Site Type	AMGE	AMGN
37-6-0422	Quorrobolong	Artefact Scatter	345700	6357400
37-6-0114	Quorrobolong	Carved Tree	349567	6355577

Cony Creek and Sandy Creek (and surrounding lower hillslopes and flats) were also identified to be areas of archaeological potential by Aboriginal stakeholders and archaeologists.

Table 6.9 – Archaeological Sites Known to Occur within the CML2 Lease

AHIMS #	Site Name	Site Type	AMGE	AMGN
NA	EL-1	Isolated Find	340780	6359840
NA	BC1	Isolated Find	346867	6359255
NA	BC2	Isolated Find	346889	6359162

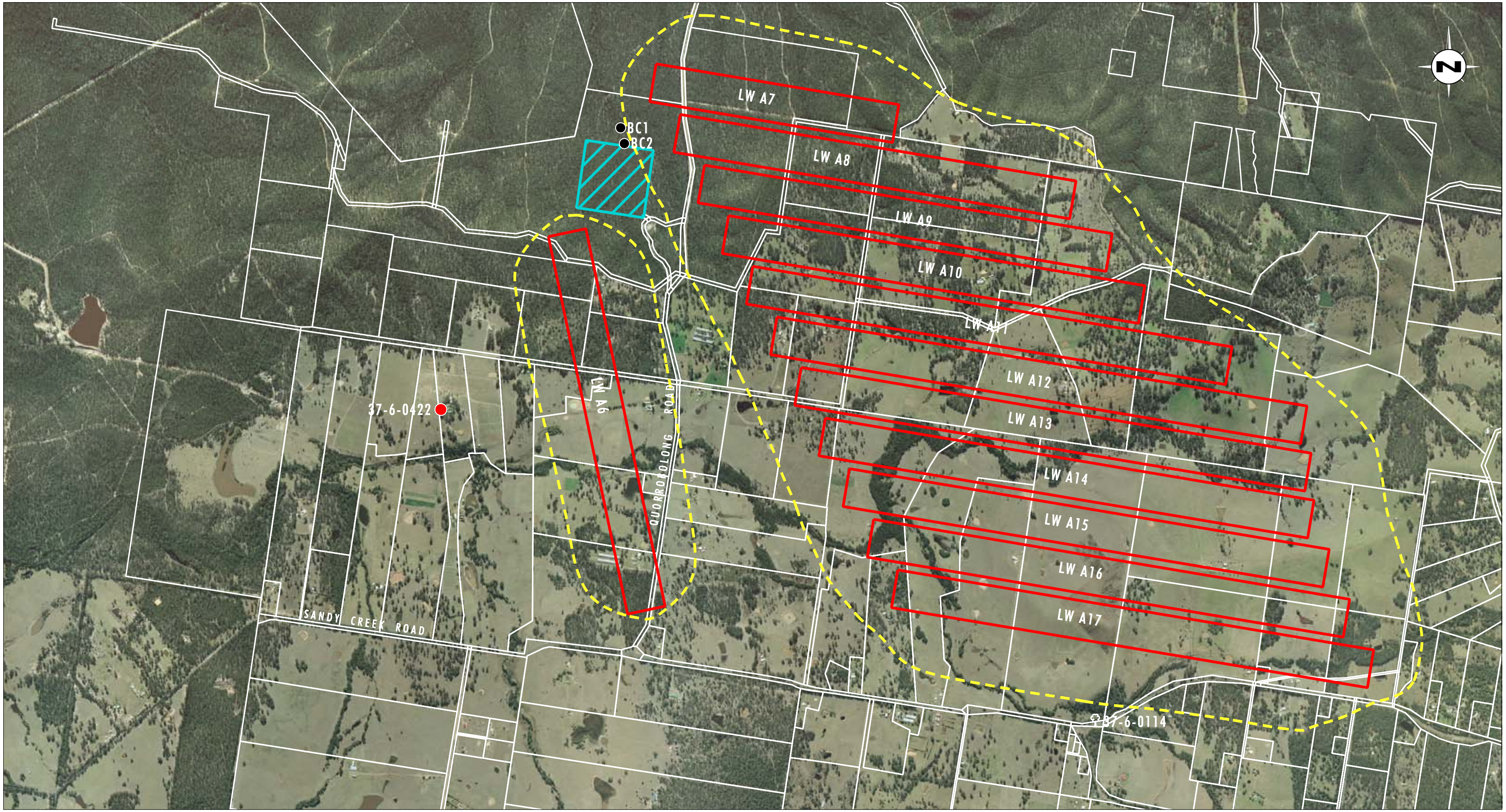
The potential for burial sites and ceremonial sites in the Quorrobolong Valley was also recognised, with a book about the Aboriginal history of the Cessnock area (Needham 1981) stating that these sites were in the valley. The potential for skeletal remains to survive in the area is low as the soil is acidic, and no potential ceremonial sites have been recorded in the Project area.

6.4.4 Grinding Groove

The survey identified one grinding groove, recorded at ACM6 (refer to **Figure 6.8**). Edge grinding of axes and other implements such as hatchets and adzes has been present in the archaeological record of northern Australia since the late Pleistocene; however, the antiquity of edge grinding in south-eastern Australia appears limited from the mid-Holocene to recent period (McBryde and Binns 1972: 65).

Based on this, the ACM6 grinding groove could date to anytime over the last 4000 years; however, as grinding grooves subject to waterborne sediments gradually wear away due to abrasion, it is hypothesised that the ACM6 groove is less than 1000 years old as it has not been subject to extensive erosion.

Umwelt
Environmental Consultants



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.5 1 1.5km
1:32 000

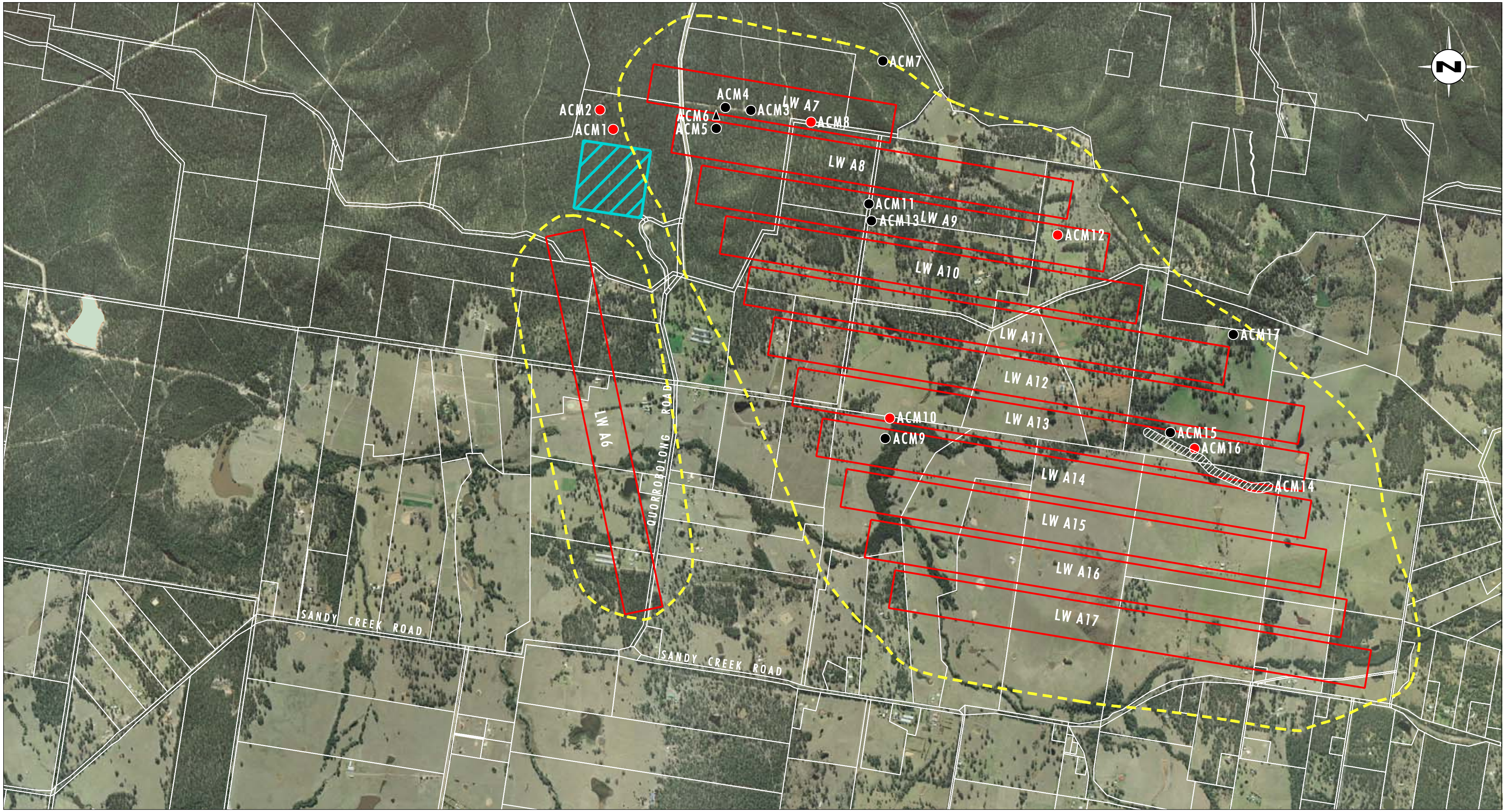
Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Artefact Scatter
- Isolated Find
- Carved Tree

FIGURE 6.7

AHIMS Sites (Stage 3)

File Name (A4): R10_V1/2274_619.dgn



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

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Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Artefact Scatter
- Isolated Find
- Grinding Groove & Isolated Find

FIGURE 6.8

Additional Archaeological Sites Recorded

File Name (A4): R10_V1/2274_620.dgn

6.4.5 Significance Assessment

Aboriginal Cultural Significance

Aboriginal stakeholders involved in the survey identified that all sites are of cultural significance, and the grinding groove is of high cultural significance. Aboriginal stakeholders stated that all archaeological sites identified are of cultural value, but that the ACM6 grinding groove site was of particular significance (refer to **Appendix 6**).

Areas of high archaeological potential were identified to be of cultural value due to the likely occurrence of archaeological sites. Additionally, artefact scatters located in the vicinity of Black Creek reflect periodic use of the area for activities such as hunting, fishing and retooling. However, due to the time that has passed since these areas have been used in a traditional manner, evidence of this use has been degraded. Areas around water courses were identified as culturally significant as they represent a livelihood and a connection to country. The identified grinding groove was perceived to be of particular significance as it represents a tangible link to past traditional use of the area.

Archaeological/Scientific Significance

The archaeological or scientific significance of Aboriginal archaeological sites is primarily assessed according to their value to contribute to the archaeological/scientific understanding of Aboriginal culture (their research potential). Six criteria underlie the scientific assessment process, being rarity, representativeness, integrity, connectedness, complexity, and potential for archaeological deposit.

Of the 16 artefact scatters and isolated finds recorded within the assessment area, 13 sites (ACM1-5, ACM6-8, ACM11-13, ACM15-17) were assessed as having low archaeological significance. The remaining three artefact scatters and isolated finds recorded within the assessment area (ACM9-10, ACM14) were assessed as having low-moderate scientific significance as they deviate from the above sites in two key aspects: archaeological integrity and potential archaeological deposit, both of which have been assessed as moderate at both local and regional levels.

The grinding groove and isolated find site (ACM6) is assessed as having moderate archaeological significance.

6.4.6 Aboriginal Heritage Impact Assessment

The potential changes to the land surface from subsidence were assessed by MSEC (2008) (see **Appendix 11**) and SCT Operations (SCT) (2008) (see **Appendix 6**). MSEC (2008) states that artefact scatter and isolated find sites may be affected by cracking of the soil, but that this is likely to be isolated and as minor cracking is rarely seen in areas where mining is more than 500 metres deep. MSEC (2008) further states that if cracks occur, they are likely to be small and dispersed due to the presence of soil. These small cracks will be partially closed following subsidence or subsequently filled in as a result of soil movement. Such minor cracking of soil may also affect areas of archaeological potential along Cony and Sandy Creek.

MSEC (2008) and SCT (2008) state that fracturing of bedrock at the grinding groove site is possible following removal of LWA7 and LWA8, but this is not likely (no more than 10 to 30% likelihood). Due to the natural jointing of the bedrock at the site, fracturing may occur along the joint to the south of the groove.

Criteria used to determine scientific significance include rarity, representativeness, integrity, connectedness, complexity and potential for archaeological deposit. One site within the

Stage 3 project area was assessed as having moderate archaeological significance, being the ACM6 grinding groove and isolated find located in the Werakata State Conservation Area. Of the remaining sites, three (ACM9-10 and ACM14) (see **Figure 6.8**) were assessed as having low-moderate archaeological significance, as they have some potential for archaeological deposit with archaeological integrity. All remaining sites (ACM1-5, ACM7-8, ACM11-13 and ACM15-17) were assessed as having low archaeological significance.

6.4.7 Aboriginal Heritage Management Strategies

The proposed Stage 3 underground mining may potentially impact the identified grinding groove site. Austar and Aboriginal stakeholders have agreed upon a grinding groove offset strategy of a monetary contribution of $100,000 to an Aboriginal project or program (to be decided by Aboriginal stakeholders). Austar will make this contribution when all necessary government approvals for the Project have been obtained.

Aboriginal stakeholders have requested that no engineering works be conducted at the grinding groove site. Other recommendations regarding the potential impact of underground mining made by the assessment and discussed between Umwelt and Aboriginal stakeholders and committed to by Austar include:

- that an Aboriginal Cultural Heritage Management Plan (ACHMP) be prepared for the Austar Coal Mine to outline all Aboriginal heritage management strategies for the project, responsibilities of all parties and the timeframe for required heritage works;

- that no Aboriginal archaeological site be visited, or have works done there, without Aboriginal stakeholders in attendance;

- that known sites on accessible properties are included in a monitoring program. This will involve recording each site before and after subsidence to identify any impacts. This will be done by an archaeologist and Aboriginal stakeholders;

- that Aboriginal stakeholders (and an archaeologist if requested by Aboriginal stakeholders) provide relevant Austar personnel with a cultural heritage awareness training session; and

- that if any additional sites are found within the Project area, these subject to access will be inspected by an archaeologist and Aboriginal stakeholders to assess the site and decide on how it should be managed.

Some Aboriginal stakeholders have requested that the NSW National Parks and Wildlife Service allow fencing of the grinding groove site (which is in the Werakata State Conservation Area) for its protection, and that this activity could be funded by the grinding groove offset strategy. Department of Environment and Climate Change (DECC) representatives have advised Aboriginal stakeholders that they will liaise directly on this matter.

6.5 Historic Heritage

A comprehensive Historic Heritage Assessment of the proposed Stage 3 mining area was prepared by Umwelt (see **Appendix 7**). The aim of the assessment was to develop an understanding of the historical heritage values of the proposed Stage 3 mining area, through background research, archaeological survey and consultation with local historical organisations.

To identify appropriate management strategies for each identified item, an assessment of heritage significance was required, and impact resulting from the proposed Stage 3 mining development is evaluated. On this basis, management recommendations for each identified heritage item have been formulated. All works were conducted in compliance with the *NSW Heritage Manual* and associated Heritage Office, Department of Planning guidelines for *Archaeological Assessments* (Heritage Office 1996-2001).

6.5.1.1 Historical Context

As part of NSW heritage assessment procedures it is essential to have a full understanding of a site or item based on its historical and physical context. A comprehensive assessment of historical context of the site that is now Austar Coal Mine is outlined in **Appendix 7**. A detailed summary of Land Ownership, Land Use History and Potential Historical Heritage Values is also provided in **Appendix 7**. The Timeline of Local and Regional History is detailed in **Table 6.10**.

Table 6.10 - Timeline of Local and Regional History

Date	Historical Development	Reference
1819	First recorded journey into the Wollombi Valley, by John Howe.	Needham 1981:67.
1820	The Hunter Valley was opened for free settlement.	Heritage Office & DUAP, 1996
1821	First land grant in the Cessnock area, with Benjamin Blackburn receiving 400 acres near Kurri Kurri.	Parkes et al 1979:23
1822 to 1823	A route (roughly in alignment with the present Old Bulga Road) from Windsor was found by Benjamin Singleton, John Howe and others which made possible the overland movement of stock from the Cumberland Plain to the Hunter Valley.	Crago 1979:38
1822 to 1826	Henry Dangar conducted a detailed survey of the lower Hunter between 1822 and 1826	Brayshaw 1984:1.2
1826	'Cessnock' estate established on 2560 acres of land by John Campbell.	Parkes et al 1979:24
1826-1836	Great North Road built by convict labour. Line between Wollombi and Maitland built by 1831.	1826-1836
1830s	Australia's first soldiers settlement was established at Wollombi, with discharged members of the NSW regiments receiving (from 1830) grants of 100 acres along the Wollombi Brook.	Crago 1979:38
1834	Two thousand acre grant granted to B Jacob Josephson on 15 August, forming the Barraba Estate (which contained much of the current Stage 3 assessment area).	Umwelt, 2008d
1850	Population of Wollombi c.1500, while the residents of Cessnock only numbered between 7 and 11	Crago 1979:38
1853-1855	Cessnock estate subdivided and sold as individual lots, basis of future Cessnock township	Parkes et al 1979:166
1880s	South Maitland Coalfields developed. By this time, Cessnock was a farming area on the margins of the Hunter Valley.	HLA-Envirosciences 1995b:5
1892	Coal discovered at Cessnock, by George Brown while excavating in the southwest corner of the old Cessnock estate	Crago 1979:41
1906	Mines established in the Cessnock area by this year. Shire of Cessnock established.	HLA-Envirosciences 1995b:5

Table 6.10 - Timeline of Local and Regional History (cont)

Date	Historical Development	Reference
1916	Underground mining of Pelton/Ellalong commences	Umwelt, 2007c
1926	Cessnock defined as a municipality, with population of 12,000 people	Crago 1979:41
1956	Cessnock municipality merged with the Shire of Kearsley, into the Municipality of Greater Cessnock	Parkes et al 1979:273
1958	Municipality of Greater Cessnock proclaimed the City of Greater Cessnock	Parkes et al 1979:273

A number of themes are also relevant to the assessment area and include settlement, pastoral development, agricultural production, mining infrastructure (including rail and roads) and the abandonment of farms.

6.5.2 Survey Methodology

The assessment included a review of background information and further historical research, register searches of statutory and non-statutory databases, surveys of the assessment area and consultation with the Coalfields Heritage Group, Cessnock District Historical & Family History Society Inc and the Newcastle and Hunter District Historical Society.

Searches of the Australian Heritage Database (Commonwealth Department of Environment and Water Resources (DEWR)), the State Heritage Register and State Heritage Inventory (NSW Heritage Council), and the Register of the National Trust (NSW) did not identify any listed heritage sites located within the project area.

The study area for the project is defined as the area within the predicted 20 millimetre subsidence contour (as defined by MSEC 2008) (see **Appendix 11**) and the proposed Surface Infrastructure Site (see **Figure 4.2**). The predicted 20 millimetre subsidence contour is the area where subsidence is predicted to occur at a level that may indirectly impact on structures and structural features in the Project area. MSEC (2008) notes that subsidence of less than 20 millimetres will have a negligible effect on surface infrastructure.

The surveyed areas included:

- locations of all proposed surface infrastructure, including the pit top area and associated access road and power easement;
- areas within Werakata State Conservation Area, primarily stream and crest areas;
- valley hill slope areas; and
- valley lowlands (mid and southern sections of the Project area), including all crests, creek lines and associated terraces and floodplain areas.

Physical access to only parts of the study area was obtained and as a result the entire study area was not physically surveyed however available literature and photos for the whole study area was reviewed.

6.5.3 Survey Results

The assessment area was surveyed in September and October 2007 jointly with the Aboriginal archaeological survey, which covered 76 hectares by pedestrian and vehicular survey. Survey identified 15 items with potential historical heritage values within and in the vicinity of the study area. Historical research and Land Title searches revealed an additional seven potential heritage items.

All potential items are associated with the pastoral and agricultural history of the assessment area including residential dwellings, a bridge and remains of pastoral infrastructure.

The heritage items identified during site survey are indicated in **Figure 6.9** and listed in **Table 6.11**.

6.5.3.1 Significance Assessment

The Heritage Act protects 'relics' regardless of their significance. However, it is important to undertake an assessment of significance to explain why a particular place/object is important and to enable the determination of appropriate site management. 'Cultural significance' is defined in the Australian ICOMOS Burra Charter 1999 (the Burra Charter) as meaning 'aesthetic, historic, scientific or social value for past, present or future generations' (Article 1.1). A detailed description of the significance assessment process in provided in **Appendix 7**.

Cultural significance may be derived from the fabric of a place, association with a place, or the research potential of a place. The significance of a place is not fixed for all time, and what is of significance to contemporary society now may change as similar sites are located, more research is undertaken and community values change.

All items identified were considered to be of local or no heritage significance with no or low archaeological research potential, and no sites were assessed as having State heritage significance. A summary of the significance of identified items are provided in **Table 6.11** together with respective management strategies.

6.5.4 Impact Assessment

The assessment of subsidence impacts is based on the mine subsidence impact assessment report prepared by MSEC (2008) (see **Appendix 11**).

Fourteen potential historic heritage sites are located within, or in the vicinity of, the predicted 20 mm subsidence contour area (Items 1-10, 14 and 16-18) that encompasses the proposed underground mining area and may potentially experience some minor subsidence impacts. These components, however, have been assessed as having no or low local significance with no or low research potential. There is unlikely to be any direct or indirect impacts on the identified potential historic heritage items within the assessment area.

6.5.5 Cultural Heritage Management Strategies

Table 6.11 provides a management strategy for heritage items within the assessment area that were inspected. Management strategies have also been recommended for those heritage items that were not surveyed as part of this assessment (refer to **Appendix 7**).

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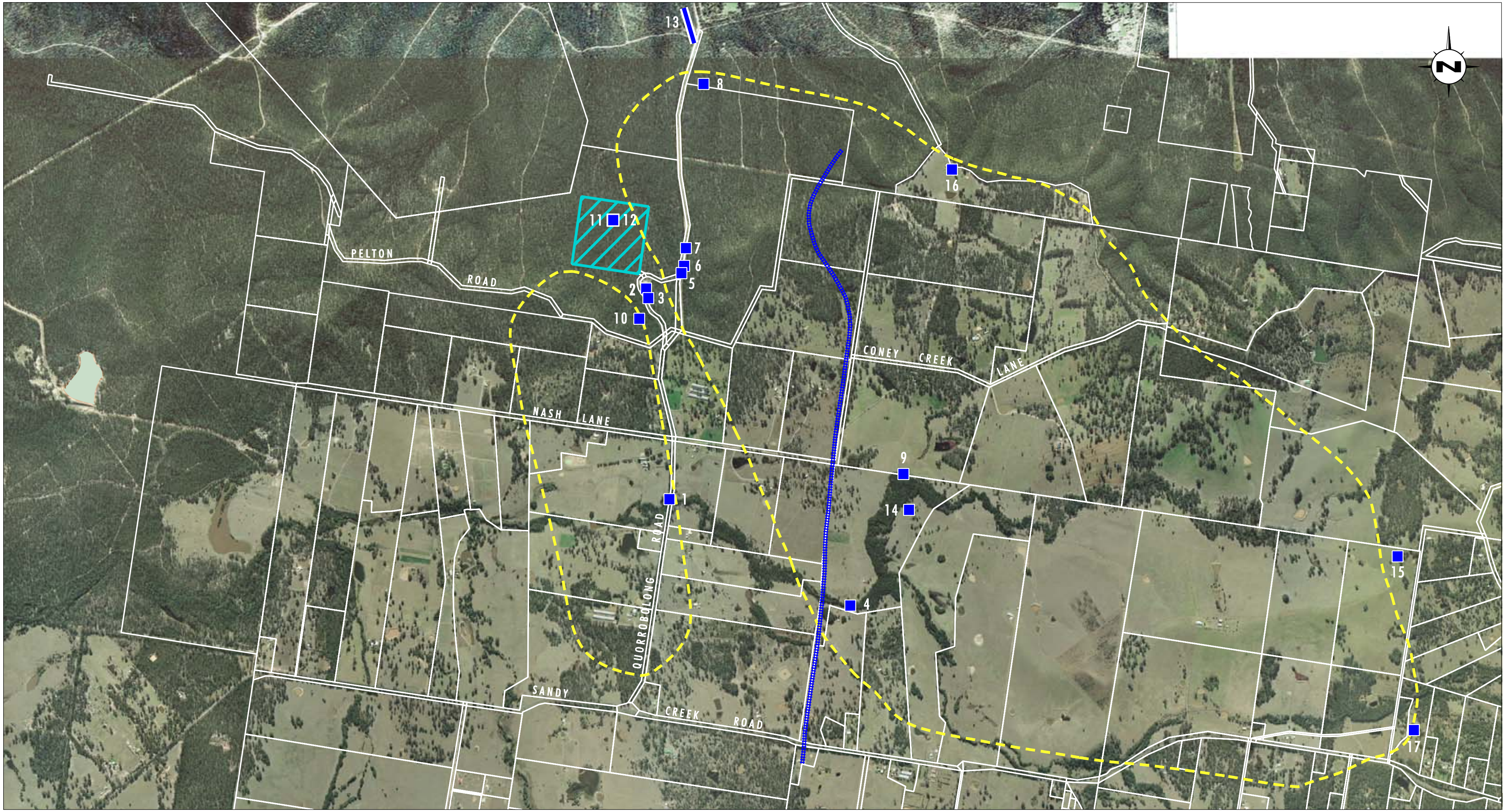

Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

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Legend

- 20mm Subsidence Contour
- Surface Infrastructure Site
- Historical Site
- Proposed PML Railway (Item 20)

FIGURE 6.9

Plan showing Location of Potential Heritage Items in Relation to the Study Area

File Name (A4): R10_V1/2274_621.dgn

Table 6.11 - Management Strategy for Inspected Heritage Items

Item/ Component	Description	Management Strategy
1	Cony Creek Bridge, Quorrobolong Road	• Low local significance and of low research potential. • Unlikely to be any direct or indirect impacts. • Visually monitored during mining. If impacted, a detailed recording of the bridge to Heritage Office, Department of Planning standards for archival recording should be completed by a qualified heritage consultant.
2	Quarry 1	• Nil-low local significance and no research potential.
3	Quarry 2	• No local significance and no research potential.
4	Ford	• No local significance and no research potential.
5	Culvert 1	• No local significance and no research potential.
6	Culvert 2	• No local significance and no research potential.
7	Culvert 3	• No local significance and no research potential.
8	Artefact Scatter	• Nil-low local significance and no research potential.
9	Fencing 1	• Nil-low local significance and no research potential.
10	Fencing 2	• Nil-low local significance and no research potential.
11	Cut Tree	• Nil-low local significance and no research potential.
12	Cut Stump	• Nil-low local significance and no research potential.
13	Railway Embankment	• Outside Stage 3 area.
14	Possible House Site	• Nil-low local significance and no research potential.

6.6 Stage 3 Ecology

A comprehensive assessment of the regional and local ecological context is detailed in **Section 5**, and **Section 5.3**.

A comprehensive Ecological Survey and Assessment for the Project was conducted by Umwelt (see **Appendix 5**) and a summary of the main findings in relation to the proposed Stage 3 mining area are outlined in **Sections 6.6.1** to **6.6.4**. The survey area included all areas potentially affected by the proposed Stage 3 development.

6.6.1 Flora Assessment

Flora fieldwork was undertaken between November 2006 and December 2007. The flora survey locations are indicated in **Appendix 5**. The survey builds on previous studies undertaken for the surrounding area including the Werakata State Conservation Area and the Werakata National Park. The survey completed specifically for the Project incorporated both semi-quantitative plot-based methods, as well as non-quantitative methods such as walking transects.

During field surveys of the proposed Stage 3 mining area, particular emphasis was placed on investigating riparian areas, as this is where the potential ecological impacts from subsidence were predicted to be concentrated. Notwithstanding this, all habitat areas were surveyed and assessed. The flora field surveys incorporated both semi-quantitative plot-based methods, as well as non-quantitative methods such as walking (target and meander) transects. Flora surveys were undertaken in accordance with the Department of

Environment and Conservation (DEC) Draft Threatened Species Survey and Assessment Guidelines (DEC 2004) where appropriate.

6.6.1.1 Vegetation of the Project Area

A total of 313 species were recorded within the entire assessment area, of which 272 (87%) are native and 41 (13%) are introduced species. A full list of the flora species recorded during surveys of the landform above proposed Stage 3 mining area is presented with **Appendix 5**. The landform above the proposed Stage 3 mining area supports seven vegetation communities (refer to **Figure 6.10**).

- the slopes and ridges of the assessment area support Spotted Gum – Ironbark Forest, which is one of the most widespread communities;
- communities of riparian and floodplain environments include Redgum – Grey Box Forest on Drainage Flats, Riparian Redgum Forest and Swamp Oak Riparian Forest, the latter occurring in more disturbed situations to the former;
- two small restricted communities occur in the Project area, Quorrobolong Scribbly Gum Woodland and the Woollybutt Open Forest Remnant; and
- the remaining areas of the assessment area comprise Derived Grassland or Derived Grassland with Scattered Canopy Trees.

6.6.1.2 Threatened Species and Endangered Populations

Two threatened flora species were recorded within the ecological assessment area during the field surveys, being heath wrinklewort (*Rutidosis heterogama*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). Both species were recorded less commonly in the northern portions of the proposed Stage 3 mining area. The recorded locations of these species are shown on **Figure 6.11**, however the actual extent of occurrence of each species is expected to be greater.

In order to provide context to the distribution of heath wrinklewort (*Rutidosis heterogama*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) within the locality, a map showing all records from the DECC Atlas of NSW Wildlife for the Cessnock 1:100,000 topographic map sheet is provided in **Appendix 5**. This shows that potential habitat for the two species is relatively widespread within the locality, particularly to the north-east of the assessment area.

6.6.1.3 Regionally Significant Flora Species and Communities

Briggs and Leigh (1996) list species in Australia regarded to be a 'Rare or Threatened Australian Plant' (ROTAP). From this list, three species were recorded: *Grevillea montana*, *Macrozamia flexuosa* and *Eucalyptus fergusonii* subsp. *fergusonii*. Several individuals of each of the three species were observed throughout the Project area. Both *Grevillea montana* and *Macrozamia flexuosa* are reported to be widespread within the Cessnock area (Bell and Driscoll 2008).

A relictual population of woollybutt (*Eucalyptus longifolia*) occurs in the Quorrobolong area, which forms the northern limit to the species' known distribution. The significance of this population is currently being investigated by Bell and Driscoll (in prep.). The community may meet criteria for listing as an EEC, or, it may form a population that should be listed as an endangered population under the TSC Act. This species was found in a small remnant in low numbers within the Stage 3 Project area (refer to **Appendix 5**).

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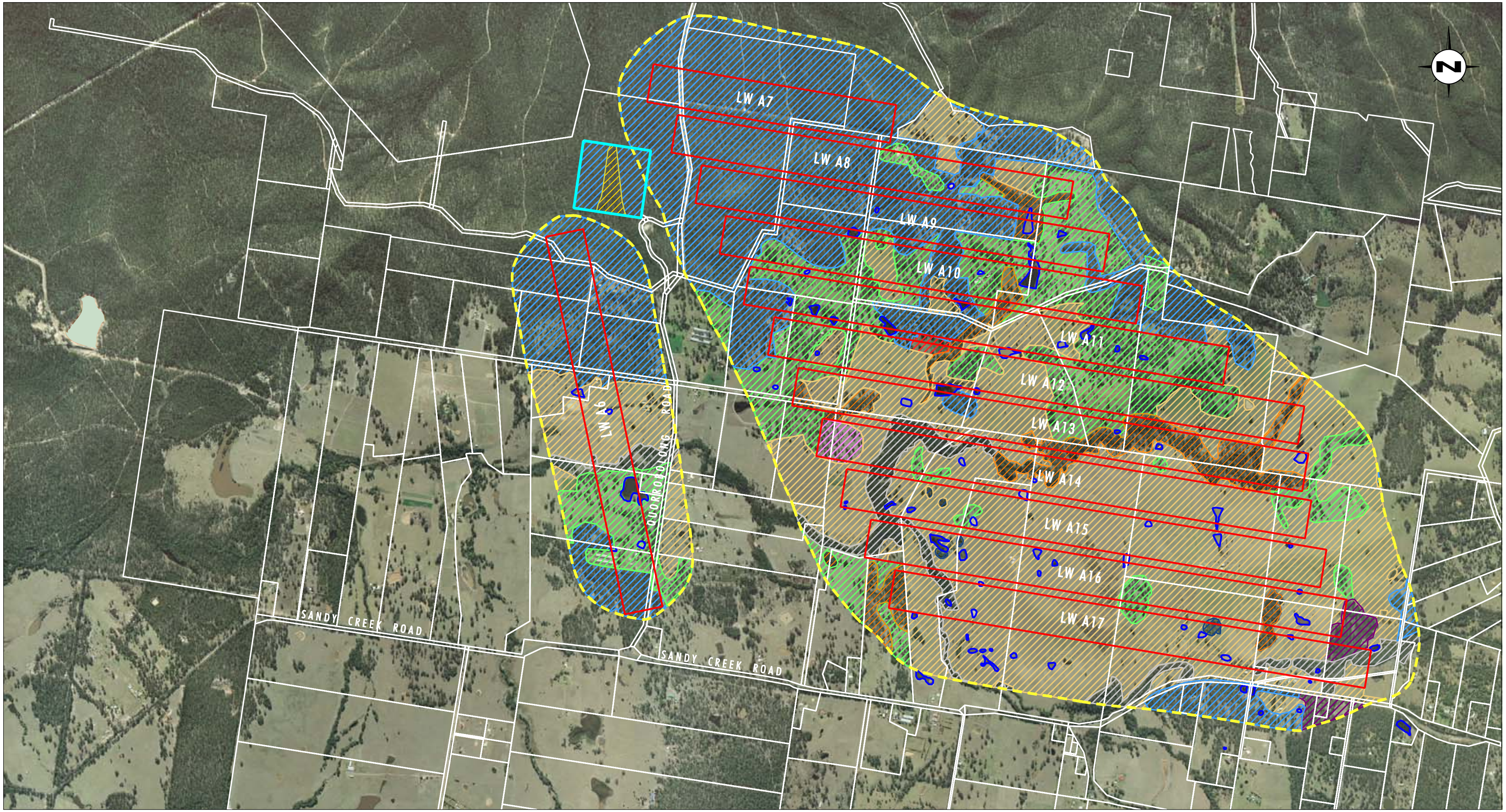

Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

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Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Spotted Gum - Ironbark Forest
- Red Gum - Grey Box Forest on Drainage Flats
- Quorrobolong Scribbly Gum Woodland
- Swamp Oak Riparian Forest
- Derived Grassland with Scattered Canopy Trees
- Derived Grassland
- Woolybutt Open Forest
- Riparian Red Gum Forest
- Dam

FIGURE 6.10

Vegetation Communities

File Name (A4): R10_V1/2274_622.dgn

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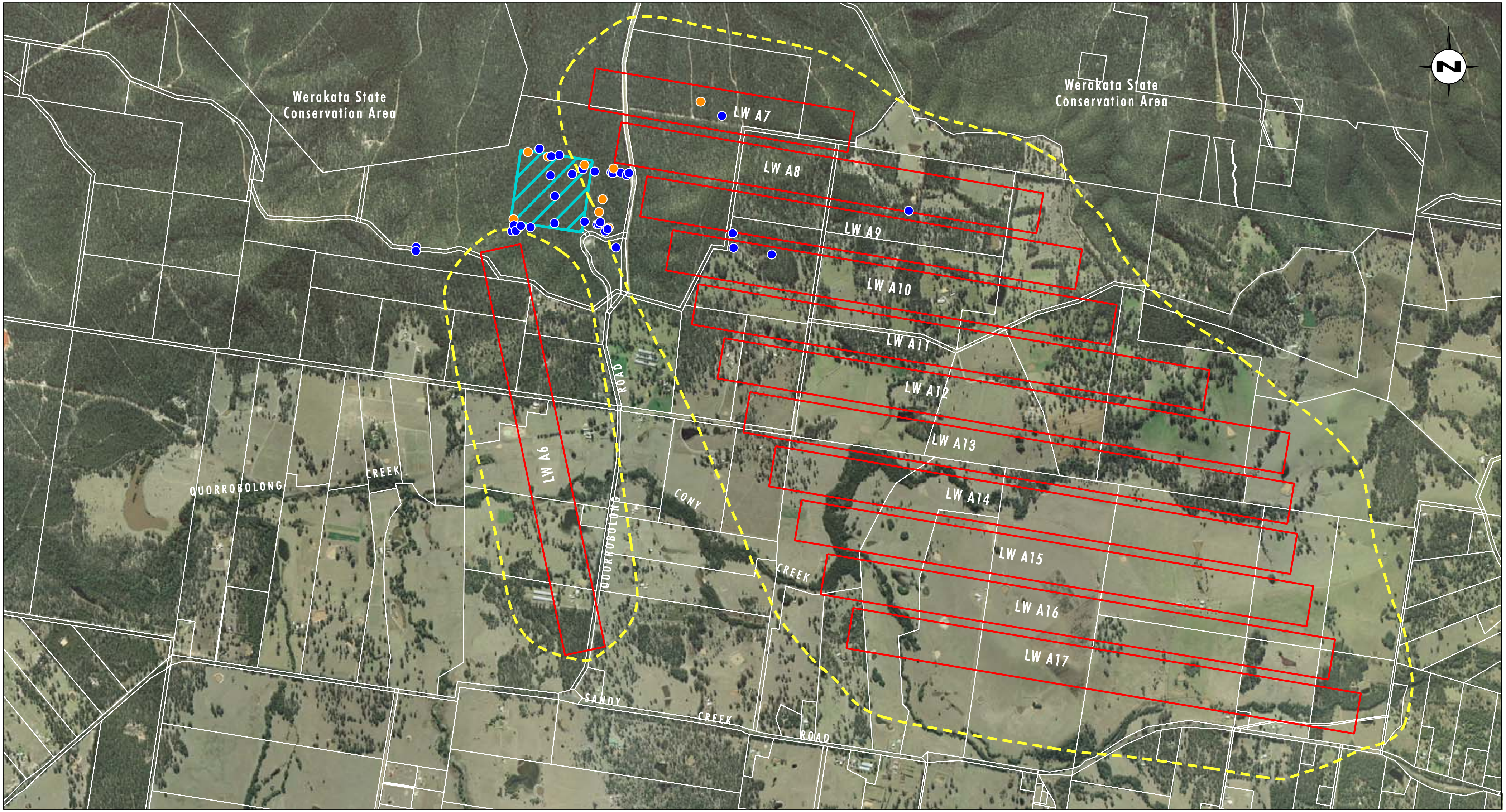

Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW,
Aerial Photography: AAM Hatch 2006

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Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- *Rutidosis heterogama*
- *Grevillea parviflora* subsp. *parviflora*

FIGURE 6.11

Threatened Flora Locations

File Name (A4): R10_V1/2274_623.dgn

6.6.1.4 Endangered Ecological Communities (EECs)

Four EECs that were found to be present within the assessment area are (refer to **Figure 6.12**):

- the Hunter Lowland Redgum Forest;
- Lower Hunter Spotted Gum – Ironbark Forest;
- River-flat Eucalypt Forest; and
- the Quorrobolong Scribbly Gum Woodland.

A summary of the extent of the four EECs within the Project area is provided in **Table 6.12**.

Table 6.12 – EECs Recorded within the Assessment Area

Endangered Ecological Communities	**Area (ha)**	
	Surface Infrastructure Site (refer to Section 7.4)	**Project Area**
Lower Hunter Spotted Gum – Ironbark Forest	10	428.6
Quorrobolong Scribbly Gum Woodland	-	11.2
Hunter Lowland Redgum Forest	0.05	0
River-flat Eucalypt Forest	0	66.7

There are no aquatic EECs listed under the FM Act occurring within or with potential to occur within the assessment area.

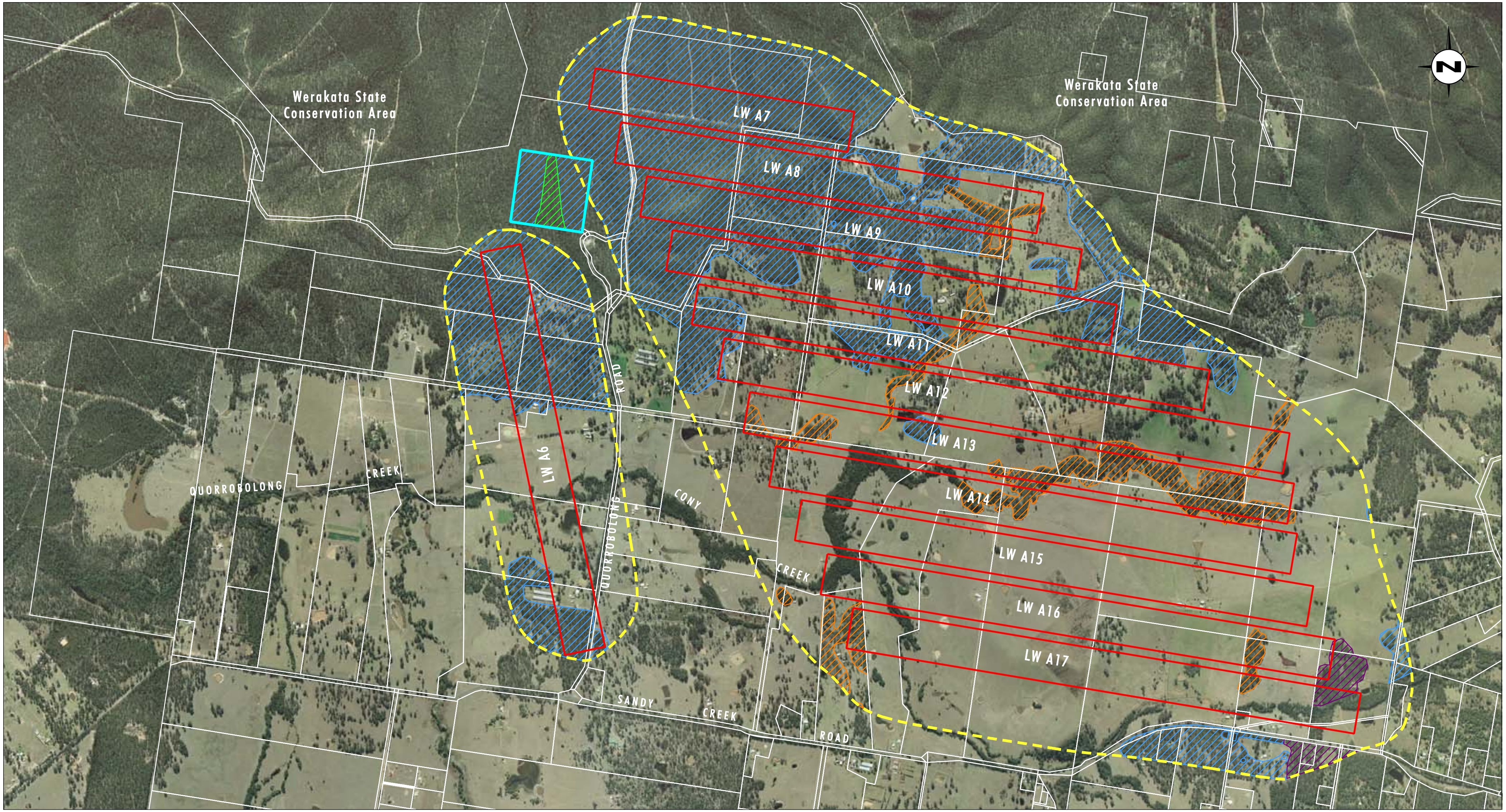
No endangered flora species were identified within the assessment area. Four endangered flora populations are relevant to the Hunter Valley catchment (in which the assessment area occurs):

- weeping myall (*Acacia pendula*) population in the Hunter Valley;
- river redgum (*Eucalyptus camaldulensis*) population in the Hunter Valley;
- tiger orchid (*Cymbidium canaliculatum*) population in the Hunter Valley; and
- *Leionema lamprophyllum* subsp. *obovatus* population in the Hunter Valley.

The assessment concludes that no endangered flora populations have potential to occur within the assessment area (refer to **Appendix 5**).

6.6.2 Fauna

Fauna fieldwork was undertaken between winter and spring in 2007. The fauna survey locations are indicated in **Appendix 5**. The fauna survey included mammal trapping, bird searches, diurnal reptile and amphibian searches, spotlighting transects, nocturnal reptile and amphibian searches, Anabat II echolocation recording transects, fixed all night Anabat II echolocation recording, harp traps and habitat assessment.



Source: Longwall Layout: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.5 1 1.5km
1:30 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Lower Hunter Spotted Gum - Ironbark Forest
- River-flat Eucalypt Forest
- Hunter Lowland Red Gum Forest
- Quorrobolong Scribbly Gum Woodland

FIGURE 6.12

Endangered Ecological Communities

File Name (A4): R10_V1/2274_624.dgn

An assessment of the aquatic habitats within the assessment area consisted of both field surveys and desktop review of previous studies and relevant legislation. The aquatic field surveys were undertaken on 26 September 2007 and 18 December 2007. Six sites within Project area were sampled. Aquatic ecology survey and assessment was undertaken in accordance with the legislative requirements of the FM Act, the TSC Act, EPBC Act, the EP&A Act and relevant policies and guidelines.

6.6.2.1 Fauna Habitat of the Project Area

Local Habitat Connectivity

The vegetation within the Project area is dominated by grassland and pastures. Much of the area has been logged and grazed and continues to be used for agricultural purposes. This is with the exception of the densely vegetated areas to the north of the Project area which are integrated with the Werakata State Conservation Area. Consequently, the existing native habitats within the proposed Stage 3 mining area are highly fragmented and isolated. Five broad habitat types occur within the assessment area. These habitats include:

- Riparian habitat;
- Open Forest habitat;
- Woodland Habitat;
- Derived Grassland Habitat; and
- Constructed Dam Habitat.

The vegetation and associated habitats along Cony Creek, crossing the site in a general east-west direction, represent the most sizable and significant habitat corridor across the Project area. The habitat of Sandy Creek, Black Creek and Dams were also assessed.

Habitat connectivity in a north-south direction across the site is generally poor. Although, a number of remnants of native vegetation occur across the Project area, links between habitats within these and other, more extensive areas of habitat to the north and south of the assessment area are limited.

Regional Habitat Connectivity

The NPWS Key Habitats and Corridors (Scotts 2003) project does not identify any fauna movement corridors or key habitats for threatened species within the assessment area or nearby locality. Given that the proposed Stage 3 mining will involve negligible surface disturbances, there will be no fragmentation of currently connected habitats.

6.6.2.2 Fauna of the Project Area

A full list of the fauna and aquatic species recorded in the Project area is provided in **Appendix 5**. The results included:

- a total of 62 bird species were recorded during the winter and spring 2007 surveys. The species recorded are typical of those associated with open woodland and grassland habitats, such as the Australian magpie (*Gymnorhina tibicen*), noisy miner (*Manorina melanocephala*), masked lapwing (*Vanellus miles*) and Australian magpie-lark (*Grallina cyanoleuca*);

- nine frog species were recorded during the winter and spring 2007 surveys. This primarily included locally common species such as the common eastern froglet (*Crinia signifera*), striped marsh-frog (*Limnodynastes peroni*) and the spotted marsh-frog (*Limnodynastes tasmaniensis*);
- four reptile species, were recorded during the surveys;
- a total of 22 mammal species were recorded within the proposed Project area during the winter and spring 2007 surveys; and
- a total of 39 taxa of macroinvertebrates were recorded across the six sampling sites. No freshwater vertebrates were recorded.

6.6.3 Threatened Species, Migratory Species and Endangered Populations

Appendix 5 provides a full list of threatened fauna species (derived from literature review and expert knowledge) that were assessed for their potential to occur within the assessment area. EPBC Act listed threatened fauna species are also considered in **Appendix 5**.

The nine threatened fauna species recorded within the Project are listed in **Table 6.13.** The location where these species were recorded is provided in **Appendix 5**.

Table 6.13 – Threatened Fauna recorded in the Assessment Area

Species	Status	Site Recorded	Method of Record
gang-gang cockatoo *Callocephalon fimbriatum*	V (TSC)	Stage 3 Mine Area	sighted and heard
grey-crowned babbler *Pomatostomus temporalis temporalis*	V (TSC)	Stage 3 Mine Area	sighted and heard
speckled warbler *Pyrrholaemus saggitata*	V (TSC)	Stage 3 Mine Area	sighted
powerful owl *Ninox strenua*	V (TSC)	Stage 3 Mine Area	identification of call during call-playback survey
squirrel glider *Petaurus norfolcensis*	V (TSC)	Stage 3 Mine Area	hair analysis and trap capture
little bentwing-bat *Miniopterus australis*	V (TSC)	Surface Infrastructure Site Stage 3 Mine Area	Anabat echolocation analysis
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V (TSC)	Surface Infrastructure Site Stage 3 Mine Area	Anabat echolocation analysis
large-footed myotis *Myotis adversus*	V (TSC)	Surface Infrastructure Site Stage 3 Mine Area	Anabat echolocation analysis
eastern freetail-bat *Mormopterus norfolkensis*	V (TSC)	Stage 3 Mine Area	Anabat echolocation analysis

Notes:

V=vulnerable

TSC = *Threatened Species Conservation Act 1995*

- There are no endangered fauna populations known to occur within the landform above the proposed Stage 3 mining area. There are no endangered fauna populations with potential to occur within the assessment area.

- There are no areas of critical habitat occurring within or in proximity to the Project area.

- No *Fisheries Management Act 1994* listed threatened species or endangered populations were recorded within the Project area during surveys, and there is no record of any having been previously recorded within the locality. There is no potential for any FM Act listed threatened species or endangered populations to occur in the aquatic habitats of the ecological assessment area.

6.6.3.1 Endangered Ecological Communities (EECs)

There are no endangered fauna populations known to occur within the Project area. There are no endangered fauna populations with potential to occur within the ecological assessment area. Of the 13 EPBC-listed migratory and marine species (refer to **Appendix 5**), only one was recorded during surveys of the ecological assessment area, being the white-bellied sea-eagle (*Haliaeetus leucogaster*), which was observed in the Project area.

SEPP 44 (Koala Habitat) Assessment Results

Two SEPP 44 listed tree species, forest red gum (*Eucalyptus tereticornis*) and grey gum (*Eucalyptus punctata*), were recorded within vegetation communities of the ecological assessment area. These species, also hybridising, account for approximately 15% of trees in the area. Given the connectivity with large tracts of bushland to the north and south of the ecological assessment area, there is potential for the koala to utilise the resources of the area when travelling between habitats within this larger remnant.

6.6.4 Ecological Impact Assessment

6.6.4.1 Flora Impact Assessment

Subsidence impacts are not expected to have a significant impact on the ecology or ecological communities of the proposed Stage 3 mining area. In addition, due to the depth of cover and relative predicted uniformity of subsidence over the Project area, it is predicted that surface mitigation works along creeks and drainage channels will not be required and hence disturbance of these areas is not likely to be necessary.

Mining of the Project area is not expected to significantly impact on runoff regimes, bank stability, channel alignment, in-channel and out of channel ponding or groundwater availability. Drainage line analysis of the predicted subsided landform indicates that all creek systems will remain free draining without mitigation works.

Impact on Threatened Species

There are no EPBC Act listed threatened flora species with potential to be impacted by the Project and therefore further assessment under that Act is not required.

Impact on Endangered Ecological Communities (EECs)

The potential for the proposed underground mining to have an impact on River-flat Eucalypt Forest EEC was assessed using the seven part test of significance (in accordance with the EP&A Act). The assessment concluded that the impacts of the proposed underground mining on the River-flat Eucalypt Forest EEC would be minimal, and would not result in the modification or loss of any areas of this EEC.

Given the negligible subsidence impacts on habitat characteristics predicted for the proposed Stage 3 mining area, it is not expected to have any impact on the Lower Hunter Spotted Gum Ironbark Forest EEC and the Quorrobolong Scribbly Gum Woodland EEC.

No EPBC Act listed EECs were found within the proposed Stage 3 mining area, and therefore an assessment of significance under that Act is not required for any EECs.

6.6.4.2 Fauna Impact Assessment

Impact on Threatened Species

Nine threatened fauna species were recorded within the Project area, while 19 were found to have potential to occur. There is one threatened fauna species also listed under the EPBC Act that has potential to be impacted by the proposed development. An assessment of significance under the EPBC Act for the grey-headed flying-fox (*Pteropus poliocephalus*) is provided in **Appendix 5**.

The assessment process identifies longwall mining as a Key Threatening Process (NSW Scientific Committees, 2005e).

Given that the surface disturbances associated with the proposed Stage 3 mining area will be negligible, there is no requirement to undertake an assessment of significance for all species recorded or with potential to occur within the Project area.

As such, a seven part test of significance, in accordance with the requirements of the EP&A Act, has been prepared only for the three threatened fauna species which have potential to be impacted upon by the proposed Stage 3 Mining Development (refer to **Appendix 5**). These species are the green-thighed frog (*Litoria brevipalmata*), grey-headed flying-fox (*Pteropus poliocephalus*) and large-footed myotis (*Myotis adversus*).

6.6.5 Ecological Mitigation and Monitoring

No specific ecological impact mitigation measures are necessary for the underground mining of the Project, as the subsidence predictions indicate no impact on ecological entities. The proposed Stage 3 mining development has negligible potential to cause degradation of riparian vegetation.

Provided that the subsidence impacts are as predicted, no specific ecological monitoring or mitigation measures are deemed to be necessary. Ongoing monitoring of the subsidence impacts as mining progresses will be undertaken to ensure that this status remains. In the event that the subsidence impacts are not consistent with those predicted, a review of the ecological assessment will be made to adequately determine the impact on any significant ecological values.

If, however, unforeseen impacts are identified, appropriate mitigation measures will be implemented to minimise these impacts. An ecological monitoring program will be established to detect any changes in the condition of riparian vegetation.

7.0 Surface Infrastructure Site Impacts and Management

7.1 Surface Infrastructure Site Overview

It is proposed to construct the Surface Infrastructure Site on approximately 10 hectares of a 16 hectare parcel of land to the south-west of Kitchener. A conceptual layout for the Surface Infrastructure Site and its access to Quorrobolong Road is shown on **Figure 3.2**.

This land is owned by Austar and was originally purchased with the sole intent of developing a Surface Infrastructure Site. The land is surrounded by the Werakata State Conservation Area that is managed by DECC and a section of former Aberdare State Forest between the Surface Infrastructure Site and Quorrobolong Road that was not included in Werakata State Conservation Area.

The following infrastructure will be established on the proposed Surface Infrastructure Site:

- upcast and downcast ventilation shafts;
- main ventilation fan;
- access to the mine for personnel;
- workshop;
- store;
- service boreholes;
- bathhouse;
- offices;
- car parking; and
- services such as an electricity sub-station.

The Site will provide access to the proposed Stage 3 mining area for employees and materials. Heavy equipment will continue to access the underground mining operations via the Ellalong Drift and Pit Top facilities.

The proposed Surface Infrastructure Site has been located to have minimal impact on the visual amenity of the area and will maximise screening through the retention of the surrounding native vegetation.

Assessment and analysis of the potential environmental aspects, impacts, monitoring, and management measures from the construction and operation of the Surface Infrastructure Site are detailed in this **Sections 7.2** to **7.9**.

7.2 Surface Infrastructure Site Ecology

A comprehensive Ecological Survey and Assessment of the Surface Infrastructure Site was conducted by Umwelt, (2008e) (see **Appendix 5**).

7.2.1 Flora Assessment

Flora fieldwork for the Surface Infrastructure Site was undertaken between November 2006 and December 2007 (see **Appendix 5)**. The survey builds on previous studies undertaken for the Werakata State Conservation Area and the Werakata National Park.

Flora surveys were undertaken in accordance with the Department of Environment and Conservation (DEC) Draft Threatened Species Survey and Assessment Guidelines (DEC 2004) where appropriate.

A total of 125 flora species were recorded within the boundaries of the proposed Surface Infrastructure Site. The Site also supports two vegetation communities:

1. A remnant of Redgum – Grey Box Forest on Drainage Flats (0.5 hectares)

   This community comprises a narrow riparian band following an upper tributary of Black Creek, which drains to the north of the Site. This community principally differs from the Riparian Red Gum Forest in that it has: a lower abundance of cabbage gum (*Eucalyptus amplifolia* subsp. *amplifolia*); a greater abundance of grey box (*Eucalyptus moluccana*) and grey gum (*Eucalyptus canaliculata*); and a dominance of prickly-leaved paperbark (*Melaleuca styphelioides*) in the mid-stratum.

2. The Spotted Gum – Ironbark Forest occupies the dry slopes and crests of the Site where the soil is relatively infertile.

   It intergrades with the Hunter Lowland Redgum Forest on the lower slopes. This community is widespread within the local area, and is also the dominant community within Werakata National Park and Werakata State Conservation Area.

Two threatened flora species were recorded extensively within the Site area being heath wrinklewort (*Rutidosis heterogama*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). Heath wrinklewort (*Rutidosis heterogama*) was found at 15 locations within the Site. Approximately 70 individuals of heath wrinklewort were recorded in total within in the Site. Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded at four locations within the Site, across which approximately 30 individuals were counted in total.

Both species were recorded extensively in the Surface Infrastructure Site. The recorded locations of these species are shown on **Figure 6.11**, however, the actual extent of occurrence of each species is expected to be greater.

No endangered flora species were identified within the assessment area. Briggs and Leigh (1996) list species in Australia regarded to be a 'Rare or Threatened Australian Plant' (ROTAP). From this list, one species was recorded within the Surface Infrastructure Site, being *Macrozamia flexuosa*, of which several individuals were recorded.

Two EECs were found to be present within Surface Infrastructure Site and include approximately 0.5 hectares of Hunter Lowland Redgum Forest and 10 hectares of Lower Hunter Spotted Gum – Ironbark Forest (refer to **Figure 6.10**).

7.2.2 Fauna Assessment

Fauna fieldwork was undertaken between winter and spring in 2007 (see **Appendix 5**) and included mammal trapping, bird searches, diurnal reptile and amphibian searches, spotlighting transects, nocturnal reptile and amphibian searches, Anabat II echolocation recording transects, fixed all night Anabat II echolocation recording, harp traps and habitat assessment.

A total of 56 fauna species were recorded within the Surface Infrastructure Site. A full list of the fauna and aquatic species recorded in the area is provided in **Appendix 5**. The results included:

- A total of 36 bird species were recorded. The species recorded are typical of those associated with woodland habitats, such as the superb fairy wren (*Malurus cyaneus*), spotted pardalote (*Pardalotus punctatus*), striated pardalote (*Pardalotus striatus*), white-plumed honeyeater (*Lichenostomus penicillatus*) and eastern rosella (*Platycercus eximius*).

- Two frogs were recorded calling, being the brown froglet (*Crinia signifera*) and Vereauxs tree frog (*Litoria vereauxii*).

- Two reptile species, Jacky lizard (*Amphibolurus muricatus*) and the eastern bearded dragon (*Pogona barbata*).

- A total of 16 mammal species.

- Very few strictly aquatic species were recorded; a reflection of its generally dry, ephemeral nature. It is unlikely that any fish species would occur within drainage lines on the site, however a diversity of macroinvertebrates could be present, particularly when higher volumes of water are present.

Appendix 5 provides a full list of threatened fauna species (derived from literature review and expert knowledge) that were assessed for their potential to occur within the assessment area. EPBC Act listed threatened fauna species are also considered in **Appendix 5**.

Three threatened fauna species, the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-footed myotis (*Myotis adversus*) and the little bentwing-bat (*Miniopterus australis*) were recorded within the Surface Infrastructure Site. The location where these species were recorded is provided in **Appendix 5**.

Results of the fauna surveys for the proposed Surface Infrastructure Site indicate:

- there are no endangered fauna populations known to occur;

- there are no endangered fauna populations with potential to occur ;

- there are no areas of critical habitat;

- no *Fisheries Management Act 1994* listed threatened species or endangered populations were recorded and there is no record of any having been previously recorded within the locality. There is no potential for any FM Act listed threatened species or endangered populations to occur in the aquatic habitats of the ecological assessment area; and

- no EPBC-listed migratory species were identified in the Surface Infrastructure Site.

7.2.3 Ecological Impact Assessment

7.2.3.1 Flora Impact Assessment

Historically, much of the vegetation within the Surface Infrastructure Site has been logged and is now predominantly relatively young native vegetation (estimated to be younger than 50 years old).

The proposed Surface Infrastructure Site lies within a much larger bushland remnant which is part of the Broken Back Range now comprising Werakata State Conservation Area. Habitats within the assessment area are well connected to others in the north and west of the site. On a regional scale, this large remnant ultimately links with larger bushland areas to the south including Pokolbin State Forest, Corrabare State Forest, Watagan National Park and Yengo National Park. Locally, habitat connectivity to the east of the site is limited by the presence of Quorrobolong Road and to the south by Pelton fire trail.

The vegetation to be removed largely comprises the Lower Hunter Spotted Gum – Ironbark EEC (10 hectares), while a small area of Hunter Lowland Redgum Forest EEC (0.2 hectares) will also be disturbed. The proposed Site development will also disturb known habitat for heath wrinklewort (*Rutidosis heterogama*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*).

The potential impact on the threatened species is projected to be limited. The assessment has considered their distribution and abundance within the locality, their protection within conservation reserves, and the proposed protection of 17 hectares of known and potential habitat within the biodiversity offset area (see **Section 7.2.4**). This considered, it is concluded that the proposed development of the Surface Infrastructure Site will not have a significant impact on the heath wrinklewort (*Rutidosis heterogama*) or small-flowered grevillea (*Grevillea parviflora* subsp. *parviflora*) such that their local population would be placed at risk of extinction.

Both species are also known to have a moderately widespread occurrence within the locality. Known individuals and habitat of both species are now protected within the adjacent Werakata State Conservation Area and the nearby Werakata National Park. The seven part test (see **Appendix 5**) finds that the project will not have a significant impact on any other threatened flora species.

The proposed development of the Surface Infrastructure Site will have an impact on 0.05 hectares of the Hunter Lowland Redgum Forest EEC, and 10 hectares of the Lower Hunter Spotted Gum – Ironbark Forest, the significance of which is assessed through a seven part test (see **Appendix 5**). This assessment of significance also takes into consideration the proposed biodiversity offsets and impact mitigation measures described in **Section 7.2.4**.

The proposed Surface Infrastructure Site will require a relatively small area of disturbance of the two EECs, both of which are conserved within the adjacent Werakata State Conservation Area and Werakata National Park. Approximately 7871 hectares of the Lower Hunter Spotted Gum – Ironbark Forest EEC was found to be present in the Cessnock-Kurri region (Bell and Driscoll 2008), while only 127.03 hectares of the Hunter Lowland Redgum Forest EEC was identified.

Given the small area of each EEC to be disturbed relative to the regional extent, and taking into consideration the proposed offset area, the impacts on the regional conservation of the EECs will not be significant nor at risk of extinction.

7.2.3.2 Fauna Impact Assessment

The three threatened fauna species recorded on the proposed Surface Infrastructure Site are all micro-bat species, and therefore are highly mobile and likely to utilise the resources of the Surface Infrastructure Site as part of a wider foraging range. As such, the habitats of the Surface Infrastructure Site are not likely to be significant for the persistence of any local populations of these micro-bat species.

While there is not likely to be a significant impact as a result of the development, the proposed biodiversity offsets area contains similar habitat values to those proposed to be disturbed within the Surface Infrastructure Site. The assessment of recorded and potentially occurring threatened fauna species indicates that the proposed Surface Infrastructure Site will not have a significant impact on the long-term conservation of any threatened fauna species within the locality.

Due to the very small area of vegetation to be disturbed for the proposed Surface Infrastructure Site, and considering the large expanse of Werakata State Conservation Area, there will be very limited impact on current corridor functions, including fauna movement and plant propagule dispersal. The impacts on fauna movement corridors will be localised and not likely to result in the decline of any locally occurring population. Relative to the broader habitat remnant, the removal of this small extent of vegetation will not lead to the fragmentation of habitats on either a local or regional scale. Given that the proposed Stage 3 mining will involve negligible surface disturbances, there will be no fragmentation of currently connected habitats.

7.2.4 Biodiversity Offset Area

The clearing of native vegetation is listed as a major factor contributing to the loss of biological diversity. The implications of this key threatening process (KTP) will be limited to the proposed development of the Surface Infrastructure Site.

One small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded within the proposed biodiversity offset area during a site inspection. No individuals of heath wrinklewort (*Rutidosis heterogama*) were recorded, however the habitats are similar to those of the Site, and therefore this species is regarded likely to occur.

As part of biodiversity considerations a number of land parcels owned by Austar were investigated to determine if they supported similar or comparable ecological values to those identified within the Surface Infrastructure Site, and therefore their potential to compensate for the disturbances associated with its development.

The following criteria were considered when investigating the suitability of each land parcel as a Biodiversity Offset Area:

- the length of edge adjacent to Werakata State Conservation Area (and therefore the influence of edge effects) and connectivity between habitats (where possible taking into consideration the potential for any future land developments);
- the presence of similar vegetation communities of similar or better condition to those occurring in the Surface Infrastructure Site;
- identification of areas of potential future development and how this may influence the integrity of the biodiversity offsets area; and
- the presence of any ecological values additional to those present within the Surface Infrastructure Site.

Through this process a parcel of land approximately 17 hectares in size was found to comprise similar characteristics to those to be disturbed for the proposed Surface Infrastructure Site. This area was found suitable for the proposed biodiversity offsets, and is herein referred to as the proposed Biodiversity Offset Area. The location of the proposed Biodiversity Offset Area is shown in **Figure 7.1**.

The proposed Biodiversity Offset Area was found to support the following three vegetation communities, one of which is a known EEC, one of which is a potential EECs and one of which is of regional significance:

- Lower Hunter Spotted Gum – Ironbark Forest (known EEC);
- Hunter Lowland Redgum Forest (EEC); and
- Yellow Bloodwood Low Open Forest (regionally significant ecological community).

The Lower Hunter Spotted Gum – Ironbark Forest EEC and the Hunter Lowland Red Gum Forest EEC were both recorded within the Site, however the Yellow Bloodwood Low Open Forest was not. The presence of the Hunter Lowland Red Gum Forest EEC is based largely on a broad assessment of the structure and floristic composition of the riparian community, rather than a systematic and quantitative assessment. Due to the strong similarities with the EEC, the riparian community in the proposed Biodiversity Offset Area is regarded as being highly likely to be consistent with the EEC.

The Yellow Bloodwood Low Open Forest is a community thought to have a highly restricted distribution in the Hunter Valley and may meet criteria for listing as an EEC.

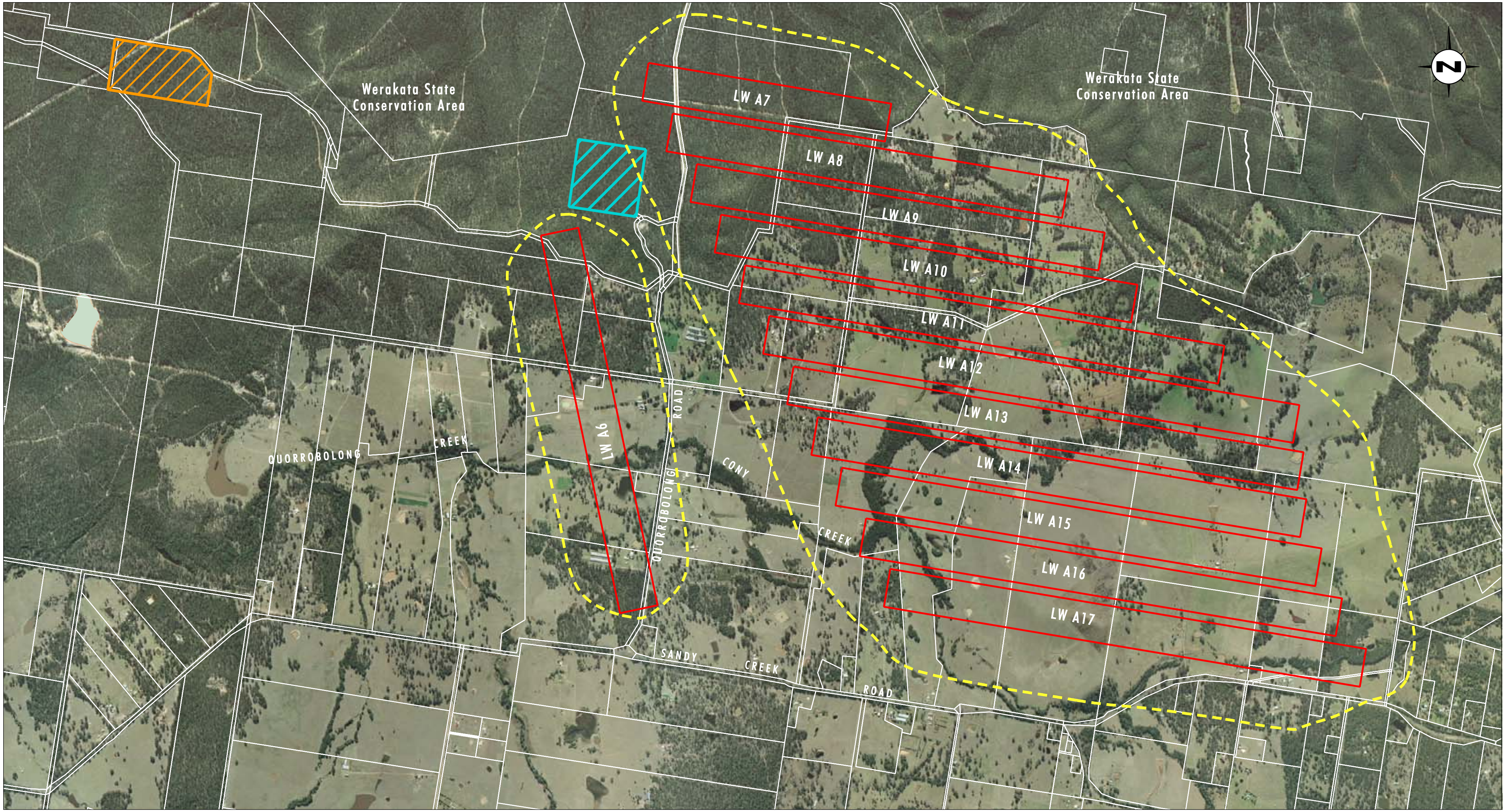
The proposed Biodiversity Offsets Area also contains potential habitat for the two threatened flora species that were recorded within the Site: heath wrinklewort (*Rutidosis heterogama*) and the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). The latter species was recorded in low numbers in the proposed Biodiversity Offset Area. The relevant components of the habitats of the proposed Surface Infrastructure Site which are important for these threatened flora species are consistent with those of the proposed Biodiversity Offset Area.

The habitat characteristics of the proposed Biodiversity Offset Area are similar to those of the proposed Surface Infrastructure Site, and for some characteristics support values of slightly higher significance. For example, there is a greater density of mature trees in the canopy stratum comparative to the proposed Surface Infrastructure Site which generally supports canopy trees of a younger age class. Additionally, the understorey of the proposed Biodiversity Offset Area is more developed than that of the proposed Surface Infrastructure Site.

Given the similarity in habitats, the proposed Biodiversity Offset Area is expected to have potential habitat for a similar suite of fauna species, including the threatened fauna species which were recorded or have potential to occur within the proposed Surface Infrastructure Site.

7.2.5 Management and Monitoring

Due to the presence of a number of features of ecological importance within the Surface Infrastructure Site (including threatened species and EECs) and the fact that it is adjacent to Werakata State Conservation Area, it is necessary to put in place mitigation measures to ensure that the impacts of the construction and operation of the proposed Surface Infrastructure Site are minimised.



Source: Longwall Layout: Austar Caol Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- 20mm Subsidence Contour
- Surface Infrastructure Site
- Proposed Biodiversity Offset Area

FIGURE 7.1

Proposed Biodiversity Offset Area

File Name (A4): R10_V1/2274_625.dgn

The following mitigation measures are proposed to be incorporated into the development:

- clearing of vegetation will be restricted to the minimum area necessary to construct the proposed infrastructure and provide adequate fire protection and will be undertaken in accordance with the tree felling procedure outlined in **Section 7.5.3**;

- an appropriate speed limit on access roads will be implemented to minimise the risk of vehicle collision with ground-dwelling fauna dispersing between adjacent habitats;

- an appropriately designed nest box will be erected (either within remaining bushland areas or within the Biodiversity Offset Area) for the compensation of each tree hollow removed as a result of clearing required for construction of the proposed Surface Infrastructure Site;

- any outbreaks of invasive weeds observed on the property boundary will be appropriately controlled to avoid their escape into the surrounding Werakata State Conservation Area and subsequently competing with threatened flora species. Early detection will ensure the management required is not extensively onerous. Particular weeds of concern within the area that have potential to invade the disturbed edges include lantana (*Lantana camara*), prickly pear (*Opuntia stricta* var. *stricta*), asparagus fern (*Asparagus aethiopicus*) and blackberry (*Rubus fruticosus* sp. agg.); and

- any landscaping undertaken around infrastructure areas will use only locally occurring native plant species to reduce the risk of invasive plant species escaping into the adjacent reserve and competing with threatened flora species. Particular care will be taken to avoid planting species which are known to escape and naturalise into native bushland.

7.3 Surface Infrastructure Site Heritage

7.3.1 Aboriginal Cultural Heritage

The objectives, aims and methodology used during the Aboriginal Heritage Assessment are detailed in **Appendix 6**.

Aboriginal stakeholders were involved in all stages of the assessment process. Aboriginal Stakeholder Meetings were held at Austar Coal Mine in September 2007, December 2007, January 2008 and July 2008 to discuss the aims, methods, results and recommendations of the assessment.

Surface works for the Surface Infrastructure Site will not impact on known Aboriginal heritage as no archaeological sites or areas of archaeological potential were found in the proposed Surface Infrastructure Site area. The discussed and agreed recommendations for the proposed Stage 3 development are outlined **Section 6.5**.

7.3.2 Historic Heritage

The objectives, aims and methodology used during the Historical Heritage Assessment process for the proposed Surface Infrastructure Site are detailed in **Appendix 7**.

All items identified during the assessment process were considered to be of local or no heritage significance with no or low archaeological research potential. No sites were assessed as having State heritage significance.

Two potential historic heritage items (Items 11 (cut tree) and 12 (cut stump)) (see **Figure 6.9**) are to be disturbed and/or removed as a result of the construction of the new Surface Infrastructure Site. These components of the site are considered to be of no or low local significance with no research potential.

No specific management requirements are recommended for items within the proposed Surface Infrastructure Site (Items 11 and 12).

In the unlikely event that unexpected or significant archaeological remains are discovered within the study area, all works in the immediate area should cease, the archaeological remains and potential impacts should be assessed by a qualified archaeologist and, if necessary, the Heritage Branch, Department of Planning notified.

7.4 Construction Works

7.4.1 Construction Activities

The construction of the proposed Surface Infrastructure Site is expected to take approximately 15 to 18 months to complete. A Conceptual Plan of the Surface Infrastructure Site is detailed in **Figure 3.3**. Construction activities will involve the following:

- survey and delineation of the proposed disturbance area including the access road connecting to Quorrobolong Road;
- establishment of diversion drains and surface water controls as detailed in **Section 7.5**;
- clearing of vegetation within the delineated disturbance area in accordance with procedures set out in **Section 7.4.3**;
- preliminary earthworks for the construction of the access road and sediment and erosion controls as detailed in **Section 7.5.2**;
- earthworks to reshape the site as required and provide for construction of shafts and required hardstand areas;
- construction of the three shafts on-site using drill and blast or raised boring techniques or a combination of both;
- construction of acoustic mounds using material generated by constructing the shafts;
- construction of offices, workshops, car parks, helipads, sumps and bunded areas etc to service the ongoing operation of the Surface Infrastructure Site; and
- connection of services (access road, water, sewer, electricity and telecommunications.

The surface facilities required during the construction of the shafts will include sumps for water used during drilling. Surface facilities required during construction will also include a generator and a concrete pad (approximately 5 x 5 metres in area) for generators and drilling equipment.

The proposed upcast and downcast ventilation shafts will be approximately 4.5 metres to 6.5 metres in diameter with a depth of approximately 460 metres.

The upcast ventilation shaft will allow air to be extracted from the mine and an exhaust fan will be placed over the shaft in order to draw air out of the workings. The downcast shaft will allow air to enter the mine.

An acoustic bund will also be constructed as part of the Site to ensure that any potential noise impacts are minimised.

7.4.2 Services and Access

Associated with the proposed development of the Surface Infrastructure Site will be the construction and installation of site services. Services will include:

- the construction of an intersection and access road to connect the Surface Infrastructure Site with Quorrobolong Road;
- installation of a powerline to connect to the existing electricity supply within Quorrobolong Road easement;
- establishment of on-site sewerage facilities and a pipeline to connect to Hunter Water Corporation reticulated sewerage within Quorrobolong Road easement;
- provision of reticulated water via a pipeline connecting to Hunter Water reticulated water in Quorrobolong Road easement; and
- telecommunications that will be connected to existing telecommunication services in Quorrobolong Road easement.

Austar also proposes to construct a new intersection on Quorrobolong Road to allow for the safe entry and exit of all vehicles to and from the Surface Infrastructure Site. Design and function of this intersection is discussed further in **Section 7.10**.

The Surface Infrastructure Site is located on land that is owned by Austar but is physically landlocked by Crown land including Werakata State Conservation Area. To provide access to the site at the proposed entry point at Quorrobolong Road an agreement in the form of an easement or licence is required. To facilitate ongoing and long term access to the Site, a request has been submitted to the Minister for the DECC to grant an inholding access agreement between DECC and Austar.

7.4.3 Clearing Controls

The most appropriate timing for the clearing of woody vegetation is in the period between February and June, as this is outside of the breeding time for many native fauna species, particularly threatened species. In the event that project planning schedules prevent the clearing procedure to be implemented in the ideal period between February and June, additional measures may need to be incorporated (see **Appendix 5**).

Pre-clearing requirements involve the completion of adequate pre-clearing surveys by a suitably qualified, experienced and licensed person and the erection of nest boxes as compensatory habitat for tree hollows to be removed. The requirements for the pre-clearing surveys are detailed in **Appendix 5** and include:

- The area to be cleared must be appropriately identified in the field, prior to the pre-clearing surveys.
- A pre-clearance inspection will be undertaken no more than two weeks prior to the scheduled clearing by a suitably qualified, experienced and licensed person. All

hollow-bearing trees and habitat trees within the area to be cleared will be identified and marked using spray paint.

- The number of hollows present in each tree will be recorded, as will the size class of each hollow.

- A suitably qualified, experienced and licensed person will recommend any specific activities that are deemed necessary as a result of any findings of the pre-clearance survey.

- The total number of hollows in each tree to be cleared will define the number of nest boxes that are required to compensate for the clearing. One nest box per tree hollow removed will be erected in nearby secure habitats.

- All nest boxes will be erected prior to clearing, and will be mounted using an appropriate method, such as the 'HabisureTM' system.

- All nest boxes will be subject to regular monitoring for their condition and usage by target native species.

The clearing of vegetation will incorporate the following:

- Prior to clearing, the site Environmental Officer will contact the local wildlife rescue organisation and have them on standby should the need arise to recover any fauna from the felled habitat trees.

- All non-habitat trees will be cleared first, taking care to avoid all marked habitat trees. Providing that pre-clearing surveys have been completed, it is not necessary for an ecologist to be present while clearing non-habitat trees.

- Within one to two days following the clearing of non-habitat trees, habitat trees will be cleared in the presence of a suitably qualified, experienced and licensed person. Before clearing, the trunk of the hollow-bearing tree will be shaken vigorously with heavy machinery. The machinery operator will then push the tree over as slowly as possible, so as to minimise the intensity of impact when hitting the ground.

- Once the tree has been felled, a suitably qualified, experienced and licensed person will inspect the tree (particularly tree hollows) for signs of any trapped or injured fauna. Where necessary, a spotlight will be used to inspect deep hollows.

- Any injured fauna will be carefully captured and taken to a wildlife carer or veterinary clinic.

In the event that clearing activities have to be undertaken in spring or summer, additional steps may need to be incorporated into this procedure. This may include such things as increased vigilance during the pre-clearance inspection and gradual felling of trees limb by limb to avoid harm to any residing fauna.

7.5 Soil and Water Management

7.5.1 Soil and Water Management Strategy

Overall, water management operations will be incorporated into Austar's Site Water Management Plan that has been developed for the Austar Mine Complex. This includes a detailed site water balance and water treatment measures. A Soil and Water Management Plan has been developed for the proposed development of the Surface Infrastructure Site (Umwelt, 2008f) and is provide din **Appendix 15**.

The soil and water management strategy for the Surface Infrastructure Site has been designed to minimise the potential impacts on the surrounding environment and downstream catchment areas, including:

- minimise erosion potential of the site and sediment transport off site;
- maintain water quality in downstream watercourses; and
- protect the existing streamlines and riparian habitat.

The natural topography of the site includes three natural catchment areas upstream of the proposed infrastructure locations. As such four diversion drains are required to convey natural catchment runoff away from the Surface Infrastructure Site. The first diversion drain will be located on the southern side of the ventilation shaft compound, the second and third upstream of the access road to the ventilation shaft compound and the fourth upslope of the southern acoustic bund.

It is proposed to capture and treat the majority of surface water runoff from the disturbed areas of the site prior to discharge to downstream drainage systems. The site runoff to the east of the central drainage line will be collected in two catch drains prior to flowing through a series of bio-retention areas to be located at the northern (downslope) boundary of the site (refer to **Figure 7.2**) and into a proposed sediment dam for treatment.

On the western side of the drainage line (see **Figure 7.2**) a small sump will be located in the north-western corner of the ventilation shaft compound. This sump will collect surface water runoff from within the ventilation shaft compound. The collected runoff will be discharged through the acoustic bund wall via a pipe to the downstream drainage system.

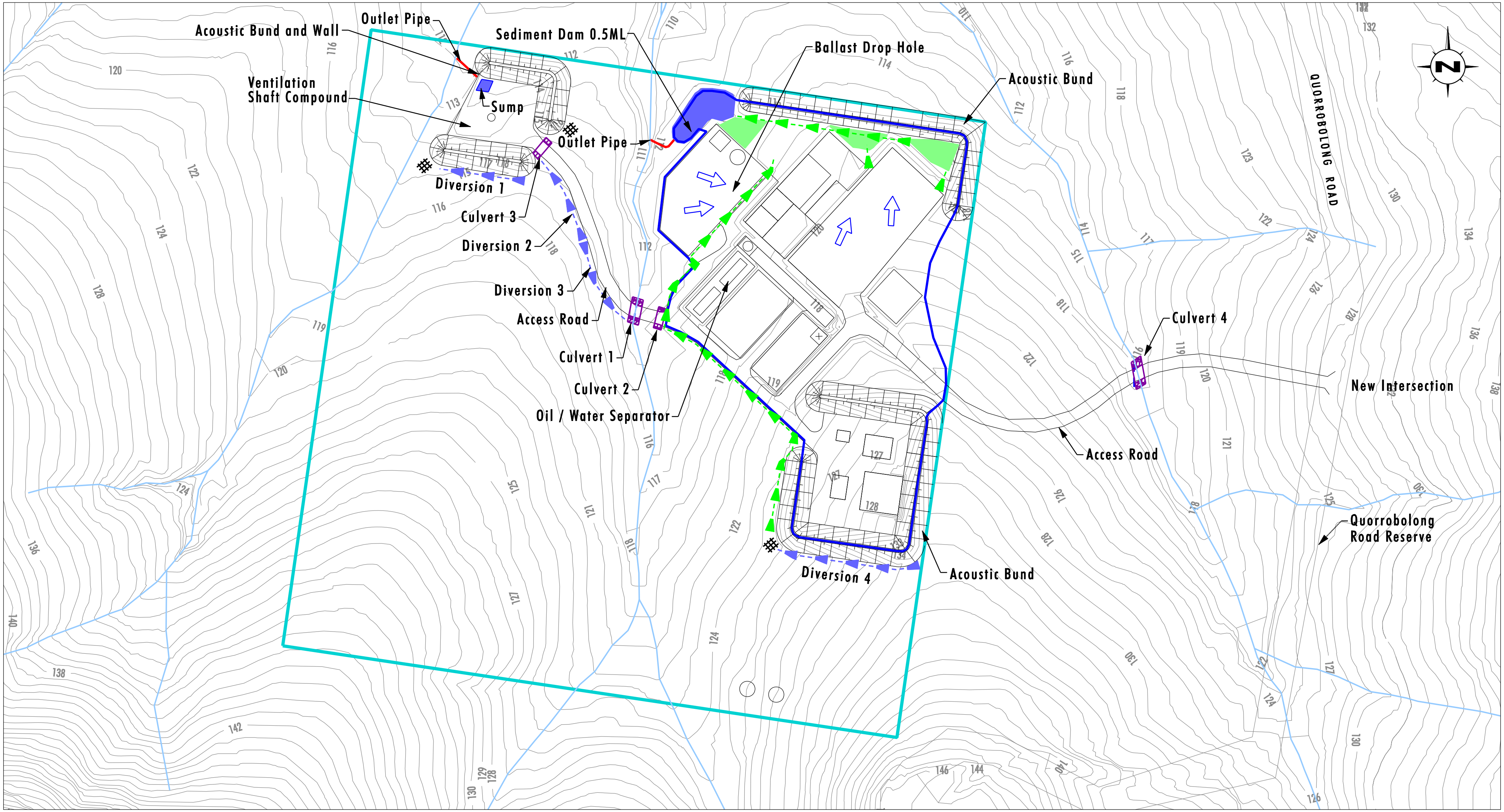
A vehicle access road will be constructed from Quorrobolong Road to the ventilation shaft on the western side of the Surface Infrastructure Site. The access road will be sealed with formalised road batters/retaining systems and drainage infrastructure, including culverts and scour protection.

Four culverts will need to be constructed along the access road. The first culvert (Culvert 1) will be required on the access road between the major compound area and the ventilation shaft compound at the western edge of the site. A second culvert (Culvert 2) will be required to convey site water runoff from the catch drain running along the south-eastern edge of the main compound under this road. The third culvert (Culvert 3) will be also be required to convey runoff from upstream of the access road east of the ventilation shaft compound.

The fourth culvert (Culvert 4) will also be required on the access road to the Surface Infrastructure Site from Quorrobolong Road.

Water needs for the administration building and bathhouse will be drawn from Hunter Water's reticulated system. Rainwater will be collected from roofs onsite and either used to top up fire fighting tanks or water landscaped areas.

Umwelt
Environmental Consultants



Source: Cadastre: LPI NSW
Note: Contour Interval 1m

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Legend

- Surface Infrastructure Site
- Catchment Boundary
- Bio-Retention Area (Grassed Surface)
- Diversion Drain
- Catch Drain
- Drainage Line
- Culvert
- Flow Direction
- Level Spreader

FIGURE 7.2

Soil and Water Management Controls

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7.5.2 Erosion and Sediment Controls

The erosion and sediment controls for the site have been developed in accordance with the practices detailed in *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) (the Blue Book).

The proposed erosion and sediment controls for the construction phase of the Surface Infrastructure Site are shown on **Figure 7.2**. Specific erosion and sediment controls will be contained in the construction plans for works on the site. These plans will include measures to be adopted to control the quality of runoff, including the following:

- construction of an on-site sediment dam prior to the commencement of any substantial construction works within the catchment area;
- construction and regular maintenance of silt fences downslope of disturbed areas, including the construction sites for the sedimentation dam and catch/diversion drains;
- applying gypsum, where required, to reduce the dispersibility of the subsoils that will be disturbed and to minimise the potential for tunnel erosion and surface rilling of disturbed or reshaped areas. The application rate to be determined by site specific soil testing as required;
- seeding and controlled fertilising of disturbed areas to provide for rapid grass cover. Areas will be seeded with a grass mix specific to the needs of the area to be grassed;
- inspection of all works daily and immediately after storm events to ensure sediment and erosion controls are performing adequately;
- provision for the immediate repair or redesign of sediment and erosion controls that are not performing adequately; and
- placement of floatation curtains (or other devices performing the same function) at the outlet of the sediment dam to trap possible oil and grease spills.

7.6 Bushfire Control Zones

The Cessnock City Council bushfire hazard map as prepared by the Cessnock Rural Fire Service indicates that the centre of the LGA is dominated by areas of high bushfire hazard whilst in the west there is a mix of low, medium and high bushfire hazard (CWSS, 2004).

Bushfire control zones are integral to the *Bushfire Management Plan* ('BMP') that was developed in 2002. The FMP was developed in consultation with the Bellbird Fire Brigade and Rural Fire Service (RFS). The Austar Mining Operation Plan (MOP) also identified a bushfire control strategy for all lands under Austar's control including the proposed Surface Infrastructure Site.

The Surface Infrastructure Site supports native woodland and forests. These areas provide a valuable buffer zone to reduce the impact of operations on nearby private residences, however do require active management to minimise the risk of bushfires originating, or spreading through Austar owned property. As shown on **Figure 3.3**, a series of grassed bunds will be established around the perimeter of the site to assist in bushfire management.

The management of fuel loads on site and the maintenance of fire breaks will be undertaken to minimise the risk of fire on-site and on surrounding properties. Activities at the Surface

Infrastructure Site will be managed in accordance with Austar's existing bushfire management strategy.

7.7 Noise

7.7.1 Existing Acoustic Environment and Assessment Criteria

A detailed Noise impact Assessment of construction and ongoing operations at the proposed Surface Infrastructure Site has been undertaken by Heggies Pty Limited (Heggies) and is provided in **Appendix 16**.

To determine background noise levels in the vicinity attended and unattended monitoring was undertaken in the area surrounding the proposed Surface Infrastructure Site in September 2007. Results from the unattended and attended monitoring are provided in **Tables 7.1** and **7.2** respectively. Locations of noise monitoring sites and nearest residences to the proposed Surface Infrastructure Site are shown on **Figure 7.3**.

Table 7.1 – Summary of Existing Ambient Noise Levels

Location	Period	Background L_{A90} Noise Level	Measured $L_{Aeq(Period)}$	Estimated Existing Industrial Contribution L_{Aeq}
1 Kitchener Park	Day	33 dBA	48 dBA	<44 dBA
	Evening	<30 dBA	37 dBA	<39 dBA
	Night	<30 dBA	43 dBA	<34 dBA
2 Serradilla Residence	Day	<30 dBA	45 dBA	<44 dBA
	Evening	32 dBA	40 dBA	<39 dBA
	Night	<30 dBA	45 dBA	<34 dBA

Table 7.2 – Operator Attended Noise Survey Results

Location	Date/ Start Time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Levels L_{amax} (dBA) and Estimated Existing L_{Aeq} Contribution
		L_{amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
1 Kitchener Park	27/09/2007 1150 Day Calm Temp=24 ºC	55	47	43	33	40	Birds/insects dominant 40-47 Car pass-by ~ 46 People in park <33 No mine contribution
2 Serradilla Residence	27/09/2007 1130 Day Calm Temp=24 ºC	61	56	49	36	46	Birds/insects 40-45 Distant traffic/near traffic <36 Aircraft noise 54-58 Distant pump or compressor noise ~33

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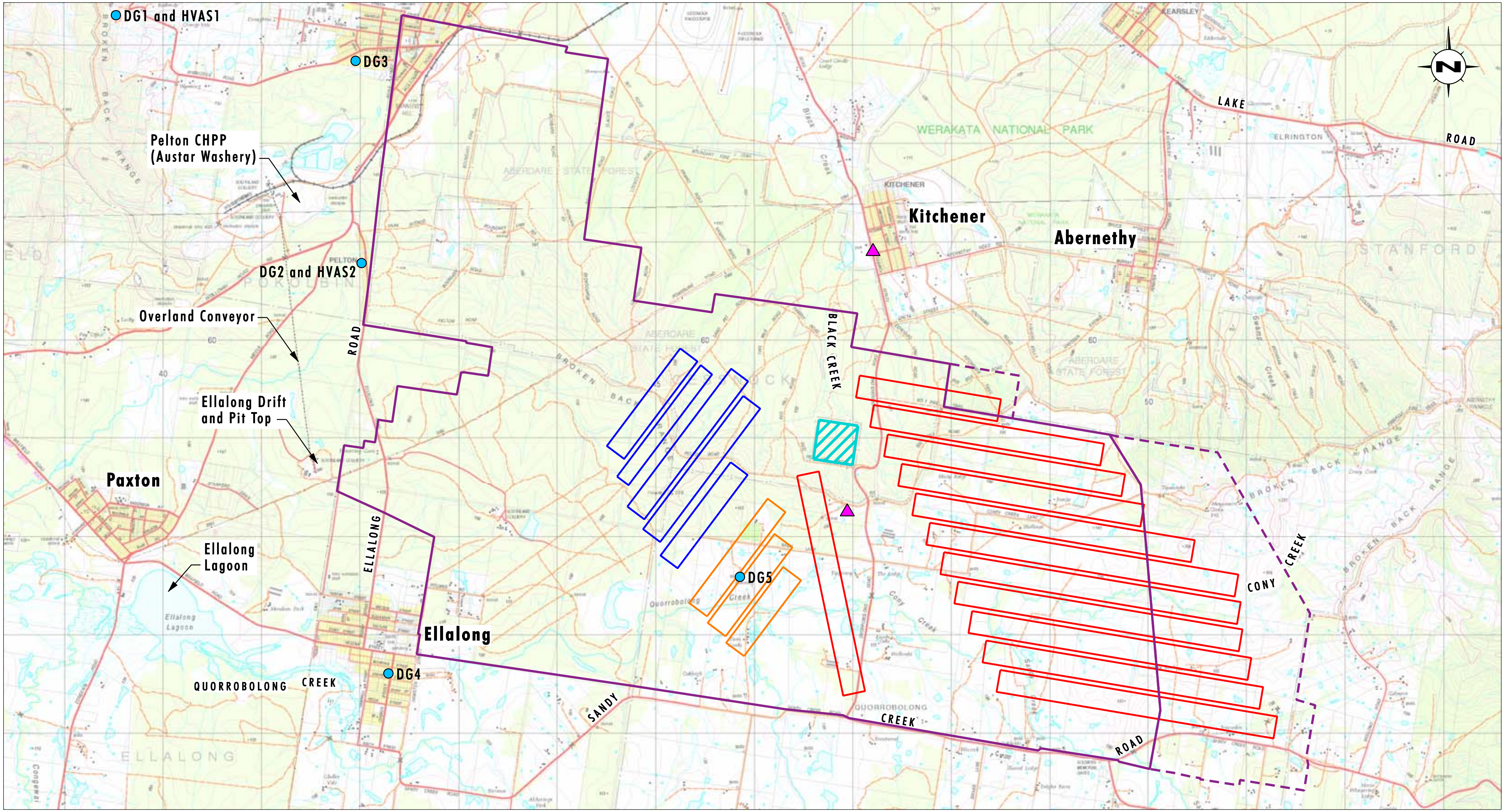


Source: Topo Maps: LPI NSW, Longwall Layout: Austar Coal Mine

0 1 2 3km
1:55 000

Legend

- Layout for Stage 1 Longwall Panels
- Layout for Stage 2 Longwall Panels
- Conceptual Layout for Stage 3 Longwall Panels
- Surface Infrastructure Site
- Consolidated Mining Lease (CML) 2
- Proposed Stage 3 Extension Boundary
- Air Quality Monitoring Site
- Noise Monitoring Sites and Receiver Locations

FIGURE 7.3

Location of Air and Noise Monitoring Sites

File Name (A4): R10_V1/2274_627.dgn

Results from the operator attended noise surveys indicate that the acoustic environment surrounding the proposed Surface Infrastructure Site is dominated by natural sounds (birds/insects) with little or no contribution from traffic or existing industrial operations.

In accordance with the requirements of the Industrial Noise Policy (INP), noise survey results have been used to determine Project Specific Noise Criteria (see **Appendix 16**). Project Specific Noise Criteria are set out in **Table 7.3**.

Table 7.3 – Project Specific Noise Criteria – Austar Coal Mine

Location	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$	Amenity Criteria $L_{Aeq(Period)}$	Project Specific Noise Criteria $L_{Aeq(15minute)}$
1 Kitchener Residences	Day	38 dBA	50 dBA	38 dBA
	Evening	35 dBA	45 dBA	35 dBA
	Night	35 dBA	40 dBA*	35 dBA
2 Serradilla & Kauter Residence Penney and Linton Property	Day	37 dBA	50 dBA	37 dBA
	Evening	37 dBA	45 dBA	37 dBA
	Night	35 dBA	40 dBA	35 dBA

Construction Noise Design Goals for the project have been determined (see **Appendix 16**) and are provided in **Table 7.4**.

Table 7.4 – Construction Noise Design Goals

Location	Acceptable L_{A10} Noise Level (4 weeks and under)	Acceptable L_{A10} Noise Level (between 4 and 26 weeks)	Acceptable L_{A10} Noise Level (> than 26 weeks)
1 Kitchener	53	43	38
2 Serradilla Residence	52	42	37

Road Traffic Noise Goals for the project have been determined (see **Appendix 16**) and are provided in **Table 7.5**.

Table 7.5 – Road Traffic Noise Goals

Type of Development	Criteria		
	Day 7 am – 10 pm	**Night 10 pm – 7 am**	**Where Criteria are Already Exceeded**
Land use developments with potential to create additional traffic on collector road	$L_{Aeq(1hour)}$ 60 dBA	$L_{Aeq(1hour)}$ 55 dBA	Where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dBA.

7.7.2 Potential Sources of Noise Emissions

The site is distant from Austar operations at Ellalong Drift and Pit Top and Pelton CHPP. These existing industrial noise sources will not contribute to noise generated at the proposed Surface Infrastructure Site and similarly noise emissions from the proposed Surface Infrastructure Site will not contribute to noise emissions from Ellalong Drift and Pit Top and Pelton CHPP.

Potential noise sources during construction and operations along with Sound Power Levels for proposed acoustically significant equipment have been identified (see **Appendix 16**) and are set out in **Tables 7.6** and **7.7** respectively.

Table 7.6 – Acoustically Significant Equipment Sound Power Levels (SWL)

Equipment	Sound Power Level (L_{A10}, dBA)
Earthworks	
Grader	111
Excavator	106
Dozer	110
Roller	110
Articulated dump trucks	102
Construction	
Blasting drill rig	110
Hydraulic winch	105
Genset	107
Transit mixer	111
Concrete boom pump	107
Delivery truck	102
Crane	104
Hand tools (grinder)	104

Table 7.7 – Acoustically Significant Plant & Equipment Sound Power Levels (SWL)

Equipment	Sound Power Level (L_{Aeq}, dBA)
Ventilation fan	108
Ventilation plant	98
Compressor plant	90
Nitrogen inertisation plant	101
Water storage pumps	97
Winders (electric motor and gearbox noise)	105
Light weight trucks	101
Employee vehicles – drive off	74
Workshop noise (grinder)	96
Air-conditioning roof-top plant	93

Car and truck movements associated with the operation of the proposed Surface Infrastructure Site also have the potential to generate noise. In the noise assessment it has been assumed that there will typically be 10 heavy vehicle movements throughout the day and car movements associated with employees entering and leaving the site at shift changes. Estimated times and employee vehicle movements are set out in **Table 7.8**.

Table 7.8 – Austar SIS Traffic Generation

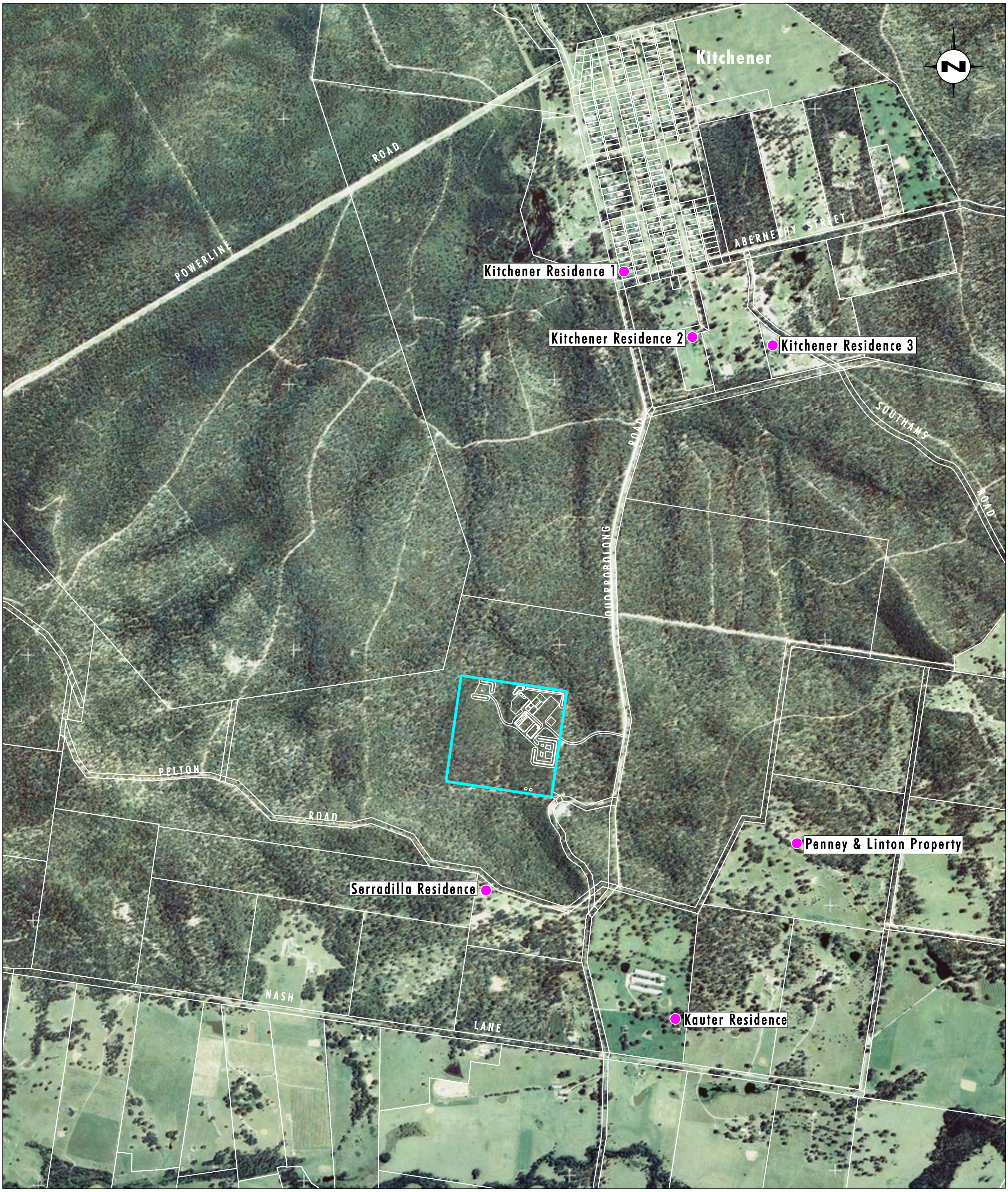
Shift	Time	Projected Vehicle Movements Before and After Shift
Night Crew	11.30 pm to 8.00 am	43
Day Crew	6.30 am to 3.00 pm	43
General Day Staff	7.00 am to 4.00 pm	20
Other Staff	7.00 am to 4.00 pm	58

7.7.3 Noise Impact Assessment

To assess potential construction and operational noise impacts of the proposed development a computer model was developed using Environmental Noise Model (ENM) taking into account:

- the terrain surrounding the site;
- noise sources identified in **Section 7.7.2**;
- prevailing weather conditions (see **Appendix 16**); and
- proximity to surrounding receivers (see **Figure 7.4**).

Results from the modelling are discussed in full in **Appendix 16** and summarised in **Table 7.9** (Construction Phase) and **Table 7.10** (Operational Phase) respectively.



Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.25 0.5 1km
1:20 000

Legend

Surface Infrastructure Site
Nearest Receiver Locations

FIGURE 7.4

Nearest Noise Receiver Locations

Table 7.9 – Predicted $L_{A10(15minute)}$ Construction Noise Emission

Location	Predicted Noise Level L_{A10} dBA		Construction Design Goal L_{A10} dBA
	Earthworks	Construction	
Kitchener Residence 1	26	27	
Kitchener Residence 2	28	28	38
Kitchener Residence 3	28	28	
Serradilla Residence	35	34	
Kauter Residence	19	19	37
Penney & Linton Residence	25	24	

Table 7.10 – Predicted Austar SIS Noise Levels

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$(dBA)				Project Specific Noise Criteria (L_{Aeq})
		Calm	Inversion	S Wind	SSW Wind	
Kitchener Residence 1	Day	<30	n/a	n/a	n/a	38 dBA
	Evening	<30	n/a	35	34	35 dBA
	Night	<30	34	35	n/a	35 dBA
Kitchener Residence 2	Day	<30	n/a	n/a	n/a	38 dBA
	Evening	<30	n/a	35	35	35 dBA
	Night	<30	34	35	n/a	35 dBA
Kitchener Residence 3	Day	<30	n/a	n/a	n/a	38 dBA
	Evening	<30	n/a	33	33	35 dBA
	Night	<30	34	33	n/a	35 dBA
Serradilla Residence	Day	31	n/a	n/a	n/a	37 dBA
	Evening	31	n/a	<30	<30	37 dBA
	Night	31	35	<30	n/a	35 dBA
Kauter Residence	Day	<30	n/a	n/a	n/a	37 dBA
	Evening	<30	n/a	<30	<30	37 dBA
	Night	<30	<30	<30	n/a	35 dBA
Penney & Linton Property	Day	<30	n/a	n/a	n/a	37 dBA
	Evening	<30	n/a	<30	<30	37 dBA
	Night	<30	<30	<30	n/a	35 dBA

As can be seen from **Tables 7.9** and **7.10** predicted noise contributions for the proposed development during construction phase and operational phase comply with INP noise guidelines at nearest residences for all scenarios assessed.

Predicted noise emissions from road traffic for operations during 2008 and 2013 with and without the proposed Surface Infrastructure Site operating have been assessed against road traffic noise criteria set out in ECRTN (see **Appendix 16**). Results from the traffic noise assessment are summarised in **Table 7.11**.

Table 7.11 – Road Traffic Noise Predictions

Year	Location	Traffic Noise Level $L_{eq(1hour)}$		ECRTN Collector Road Criteria $L_{eq(1hour)}$	
		Day	Night	Day	Night
2008	Kitchener Residence (existing traffic)	58 dBA	53 dBA	60 dBA	55 dBA
2013	Kitchener Residence (without development)	59 dBA	54 dBA	60 dBA	55 dBA
2013	Kitchener Residence (with development)	61 dBA	55 dBA	60 dBA	55 dBA

As set out in **Table 7.11**, the predicted traffic noise levels meet ECRTN criteria for night time period operations but are predicted to have a 1 dBA exceedence during the afternoon peak period. As the predicted afternoon peak level is within 2 dBA of that predicted without the Surface Infrastructure Site operating, this exceedence is considered acceptable.

7.7.4 Blasting Impact Assessment

Minor blasting may be undertaken during the construction of the shafts using small charges with a Maximum Instantaneous Charge (MIC) of 8 kg. No other blasting near the surface will be undertaken as part of the proposed development.

Results from the Blasting Impact Assessment (see **Appendix 16**) indicate that air blast overpressure from all blasting will be less than 107 dB which is less than relevant DECC guidelines which specify a maximum airblast overpressure of 120 dB Linear Peak with no more than 5% of blasts in a 12 month period exceeding 115 dBL.

Similarly modelling (see **Appendix 16**) indicates that peak predicted ground vibration at surrounding receivers will not exceed 1 m/s (predicted 0.06 mm/s) at surrounding receivers compared to a maximum of 10 mm/s as recommended by DECC guidelines with no more than 5% of blasts in a 12 month period exceeding 5 mm/s.

It is concluded that the proposed blasting to facilitate shaft construction will be well within acceptable criteria.

7.7.5 Noise and Blasting Management and Mitigation

In undertaking the Noise and Blasting Impact Assessments the following management and mitigation measures were assumed:

- acoustic bunding as shown on **Figure 3.3** is constructed to a height of 3.5 metres above ground level;
- the ventilation fan outlet is directed to the west;
- man and materials winder and second egress winder motors are enclosed; and
- blasting should generally take place only once per day and should be undertaken between the hours of 9.00 am to 5.00 pm Monday to Saturday with no blasting on Sundays or Public Holidays.

7.8 Air Quality

7.8.1 Air Emission Sources

The Surface Infrastructure Site is situated approximately 1.5 kilometres south of Kitchener and approximately 6 kilometres south of Cessnock. The ventilation system at Surface Infrastructure Site will consist of an upcast ventilation shaft and downcast ventilation shaft designed to provide sufficient quantity of air to support the proposed longwall mining. The new ventilation system is central to the operations of ongoing LTCC longwall mining beyond 2010.

The potential impacts of the discharge air from the operation of the upcast ventilation shaft on the surrounding environment have been assessed and a detailed Air Quality Impact Assessment (Umwelt, 2008g) is provided in **Appendix 17**.

7.8.2 Existing Air Quality Environment

Background dust deposition monitoring has been undertaken in the area surrounding Austar lease boundaries since March 2007 using five dust deposition gauges. The locations of the gauges are provided in **Figure 7.3**. Monthly monitoring results for the period April 2007 to September 2007 are summarised in **Table 7.12**.

Table 7.12 – Summary of Monthly Dust Deposition (g/m^2/month)

Month	Monitoring Gauge Number and Location					All Sites Average
	DG01 Pynes	DG02 Pelton	DG03 Bellbird	DG04 Ellalong	DG05 Fan	
April	-	0.9	2.8	1.4	1.5	1.7
May	0.4	0.5	0.2	1.0	1.4	0.7
June	0.4	0.4	0.4	0.2	-	0.4
July	0.6	0.3	0.4	0.3	1.1	0.5
August	0.9	0.6	1.5	0.5	-	0.9
September	0.6	2.5	1.2	0.6	1.4	1.3
Period Average	0.6	0.9	1.1	0.7	1.4	0.9

The results of the measurements indicate that the dust deposition level at the monitoring sites for the period from April 2007 to September 2007 is below the DECC Air Quality Impact Assessment criteria for insoluble solids of 4 g/m^2/month.

The highest measured dust deposition rate at monitoring location DG05 of 1.5 g/m^2/month has been assumed as a conservative value for annual background ambient dust fallout in the assessment area. DG05 is located is located in a rural and forest context similar to that of the Surface Infrastructure Site and is approximately 2 kilometres to the west.

Two PM_{10} High Volume Air Samplers (HVAS) separate and collect fine particulates with an effective aerodynamic diameter of less than 10 µm. The PM_{10} HVAS have been installed at the Pelton and Pynes sites. The HVAS commenced monitoring on the 24 March 2007, and are operated for 24 hours every sixth day. The HVAS locations are shown in **Figure 7.3**.

Analysis of PM_{10} concentrations for each PM_{10} HVAS monitoring site for period from April to September 2007 (see **Table 7.13**) indicates that the measured average for PM_{10} for period of 13 µg/m^3 is below the annual average DECC criteria of 30 µg/m^3. The measured daily PM_{10} concentrations presented in **Table 7.13** do not exceed the 24-hour average DECC criteria of 50 µg/m^3. The estimated average for TSP for period (32 µg/m^3) is less than the annual average DECC criteria of 90 µg/m^3.

Table 7.13 – PM_{10} HVAS Monitoring Results

Sampling Date	Pelton – PM_{10} (µg/m^3)	Pynes – PM_{10} (µg/m^3)	Two sites average - PM_{10} (µg/m^3)	Estimated TSP (µg/m^3)
24/03/2007	17	16	17	41
30/03/2007	14	13	14	34
05/04/2007	23	27	25	63
11/04/2007	22	21	22	54
17/03/2007	31	34	33	81
23/03/2007	13	16	15	36
29/03/2007	12	14	13	33
05/05/2007	39	42	41	101
11/05/2007	17	17	17	43
17/05/2007	16	19	18	44
23/05/2007	12	7	10	24
29/05/2007	23	14	19	46
04/06/2007	13	8	11	26
10/06/2007	6	3	5	11
16/06/2007	0	0	0	0
22/06/2007	1	1	1	3
28/06/2007	6	0	3	8
04/07/2007	4	2	3	8
10/07/2007	1	1	1	3
16/07/2007	10	5	8	19
22/07/2007	9	4	7	16
28/07/2007	5	3	4	10
03/08/2007	11	8	10	24
09/08/2007	12	4	8	20
15/08/2007	12	10	11	28
21/08/2007	12	9	11	26
27/08/2007	20	14	17	43
02/09/2007	19	24	22	54
08/09/2007	6	5	6	14
14/09/2007	18	16	17	43
20/09/2007	8	11	10	24
26/09/2007	16	19	18	44
Average	**13**	**12**	**13**	**32**

7.8.3 Air Quality Criteria

A summary of the applicable Air Quality Goals for this assessment are outlined in **Table 7.14**.

Table 7.14 – DECC Air Quality Goals

Pollutant	Maximum Concentration	Averaging Time
PM_{10}	50 µg/m^3 30 µg/m^3	24 hours Annual
TSP	90 µg/m^3	Annual
Dust Deposition	2 g/m^2/month (maximum increase in deposited dust level) 4 g/m^2/month (maximum total in deposited dust level)	Annual

7.8.4 Assessment Methodology

This Air Quality Impact Assessment has been undertaken as part of the overall Environmental Assessment for the project. The key objectives of the assessment are to:

- identify the existing ambient air quality environment (dust concentration and deposition) around the site;
- identify potential emission rates from the proposed vent; and
- identify possible air quality impacts on potentially affected nearest sensitive receptors (private residences).

Dispersion modelling (see **Appendix 17**) was undertaken using AUSPLUME Gaussian plume dispersion model software (Version 6.0) developed by the Environment Protection Authority (EPA). AUSPLUME is an approved dispersion model that is widely used for air quality impact assessments in New South Wales.

The dispersion modelling was conducted according to methodology published in the AUSPLUME Gaussian Plume Dispersion Model: Technical User Manual (EPA, 2000) and the AMMAAP. The default options specified in the manual have been applied in the modelling, as per the AMMAAP.

The dispersion model requires atmospheric dispersion data, in particular, wind speed, wind direction, atmospheric stability class and mixing heights. A meteorological dataset for the year 2003 has been used in the creation of the meteorological input file for modelling purposes using data from Cessnock AWS which is the closest weather observation site to the study area and cloudiness and vertical air temperature profile information from Williamtown weather station, located approximately 45 kilometres east of the study area (see **Appendix 17**).

In accordance with *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, DECC 2006 a Level 1 assessment has been used to predicted worst-case impact of the proposed ventilation system. This assessment reports the 100th percentile or maximum pollutant loadings and as a consequence generates maximum exposed levels for off-site receptors.

7.8.5 Air Quality Impact Assessment

As shown on **Figure 7.6** the nearest potentially affected residences to the Surface Infrastructure Site are situated on southern side of Broken Back Range within Quorrobolong Creek catchment.

The Air Quality Impact Assessment (see **Appendix 17**) of the proposed operation of a ventilation system indicates very small incremental increases in particulate matter concentration and dust deposition at all nearest potentially affected residences. The predictions indicate that dust deposition rates, PM_{10} and TSP concentrations will be well within the relevant DECC air quality criteria at all surrounding residences.

Gas monitoring of the existing Austar ventilation shaft indicated that the concentration coal related gases such as methane and sulphur compounds is negligible and will not have an impact on the surround environment.

7.9 Visual Impact

7.9.1 Visual Assessment Context

The proposed Surface Infrastructure Site, located approximately one kilometre south of Kitchener, is well screened from a visual perspective and is surrounded by extensive native vegetation, limiting views from public or landholder areas. Views of the site from the surrounding area are of native forest vegetation with cleared areas at the eastern periphery of the site in the form of Quorrobolong Road and a powerline easement.

The site is vegetated with native forest with trees 15 to 25 metres high and is surrounded by the Werakata State Conservation Area which is similarly vegetated. As illustrated in **Plate 1** and **Plate 2**, the facility site is located within relatively dense native vegetation which provides substantial visual screening from the surrounding area.

The proposed development of the Surface Infrastructure Site (see **Figure 3.3**) will involve clearing of the northern portion of the site and then construction of ground level hard stand areas and single storey buildings which will be readily screened by surrounding vegetation.

The winder on the employees and materials access shaft which will be constructed at the north-western corner of the site will be approximately 30 metres high and will potentially project above the surrounding vegetation. In addition, night lighting will be provided at the site for operational, safety and security purposes. All lighting will be positioned below the tops of the surrounding trees and will be directed into the site.

In order to assess the potential visual impacts of the proposed development, the following steps were undertaken:

1. compilation of baseline data including topographic information depicting landform details, location of surrounding residences and viewpoints, vegetation characteristics and photos of typical views of the proposed site from the surrounding area;

2. development of suitable assessment criteria;

3. selection of representative locations with potential views of the proposed Surface Infrastructure Site using radial analysis (see **Figure 7.5**);

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Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.25 0.5 1km
1:20 000

Legend

- Surface Infrastructure Site
- Radial Analysis
- Centre of Proposed Building

FIGURE 7.5

Radial Analysis from Surface Infrastructure Site (Height 30m - Centre of Proposed Building)

File Name (A4): R10_V1/2274_419.dgn

Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

0 0.5 1.0 1.5km
1:25 000

Legend
Surface Infrastructure Site
Transect

FIGURE 7.6

Visual Transect Locations

PLATE 1
Existing Visual Amenity and Proposed Surface Infrastructure Site

PLATE 2
Existing Visual Amenity and Proposed Surface Infrastructure Site

4. development of Digital Terrain Models (DTMs) for the existing landform and proposed buildings on the Surface Infrastructure Site, and then use of these models and information on the location and height of existing vegetation to generate visual transects from selected viewpoints; and

5. development of suitable visual mitigation measures.

7.9.2 Visual Assessment Criteria

The visual impact of the proposed Surface Infrastructure Site was assessed by considering the extent to which visual modification will occur as a result of the proposed development and the visual sensitivity of the surrounding land use area.

Visual modification refers to the visual changes that occur as a result of the development when compared with the existing visual landscape. The extent of visual modification is influenced by various factors, including:

Vegetation: Tree height and density can contribute to the visual quality of the landscape and contribute to screening. Conversely a lack of vegetation may maximise views of the extension from particular viewpoints. Vegetation attributes of the existing landform and proposed development can change over the life of the proposed development.

Topography: Areas such as elevated intervening ridgelines can limit the extent to which the proposed development may be visible from surrounding viewpoints.

Contrast: The impact of the visual modification is also influenced by the type of changes that are visible from the viewpoint. These changes may include texture and colour of the proposed development in the context of the existing landform.

Visual sensitivity takes into account proximity of the viewer to the development and the perception or acceptance of potential changes to the landscape.

7.9.3 Viewing Points and Assessment Methodology

Investigations of the visual catchment of the proposed infrastructure on the site indicate that the proposed site has low visibility from the local road network and from surrounding properties. Using digital terrain information of the surrounding landform, site inspections and aerial photography, a number of transects representing views from the surrounding properties to the site have been developed. The location of these transects is shown on **Figure 7.6**. Visual transects have been developed for the following properties and locations:

- Walkers property which is located approximately 0.9 to 1.2 kilometres to the south south-west of the proposed 30 metre high winder building (**Figures 7.7** and **7.8**);

- Serradilla property which is located approximately 0.7 kilometres to the south of the proposed 30 metre high winder building (**Figures 7.9**);

- Holmes property which is located approximately 3.3 kilometres to the south-east of the proposed 30 metre high winder building (**Figures 7.10**);

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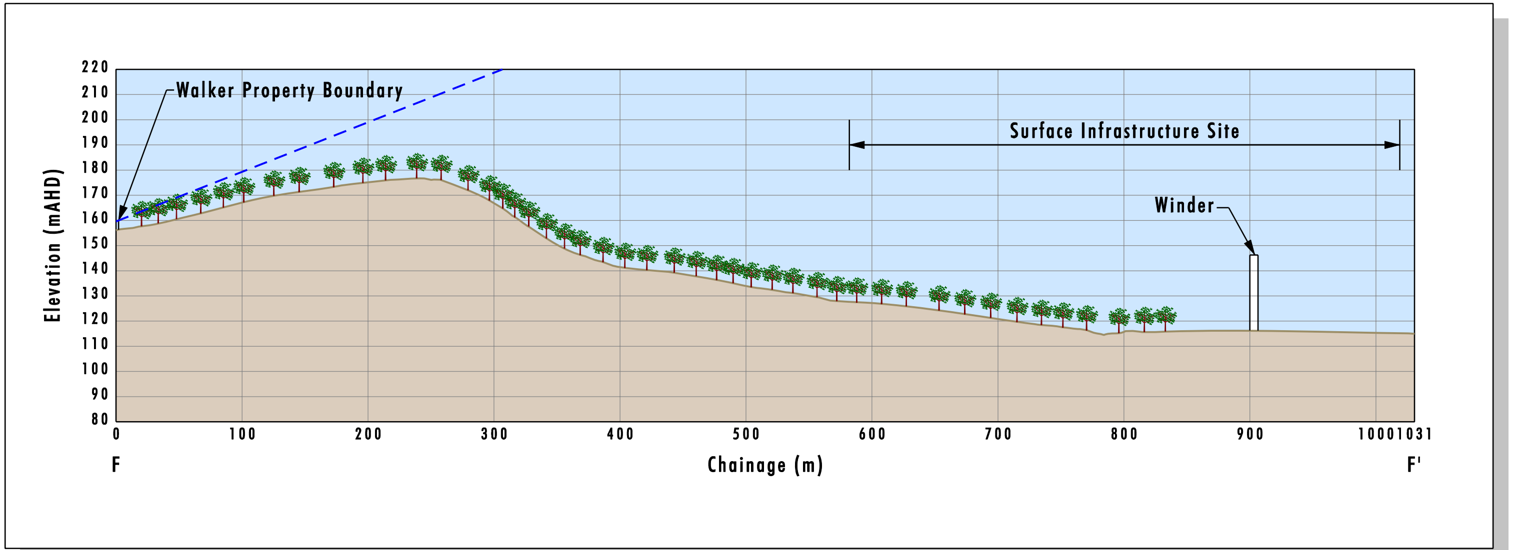
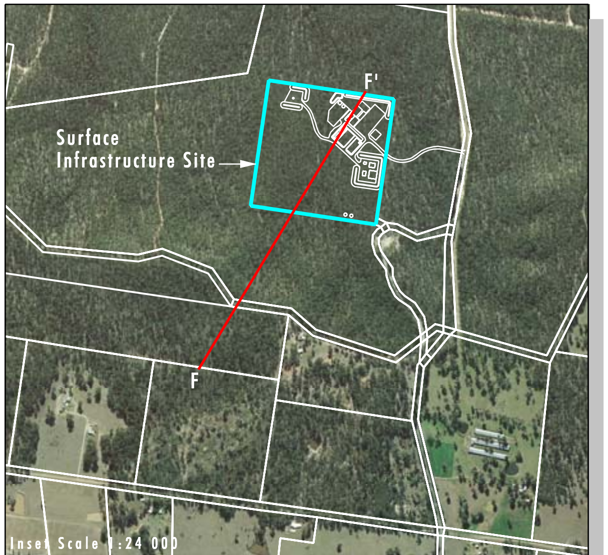


0 100 200 300m
Horizontal Scale 1:6 000

0 50 100 150m
Vertical Scale 1:3 000



Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

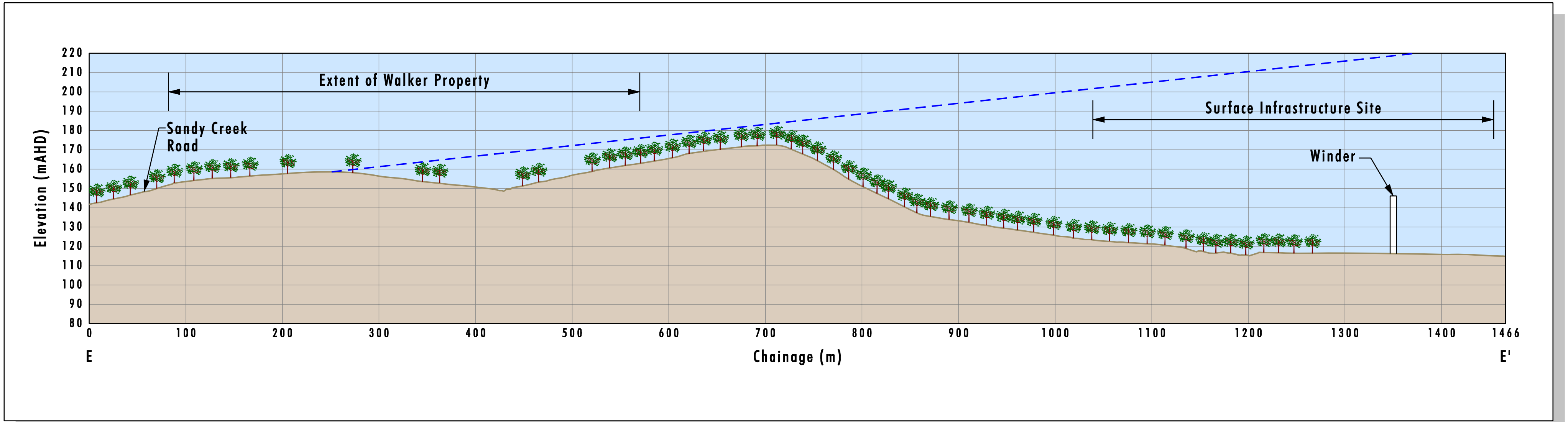
Existing Vegetation
Line of Sight

0 0.4 0.8 1.2km
Inset Scale 1:24 000

FIGURE 7.7

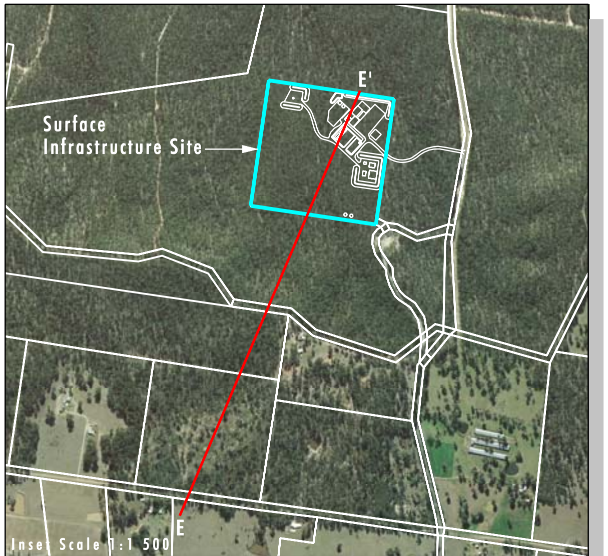
Visual Transect from highpoint within Walker Property to Surface Infrastructure Site

File Name (A4): R10_V1/2274_174.dgn



0 100 200 300m
Horizontal Scale 1:6 000

0 50 100 150m
Vertical Scale 1:3 000



Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

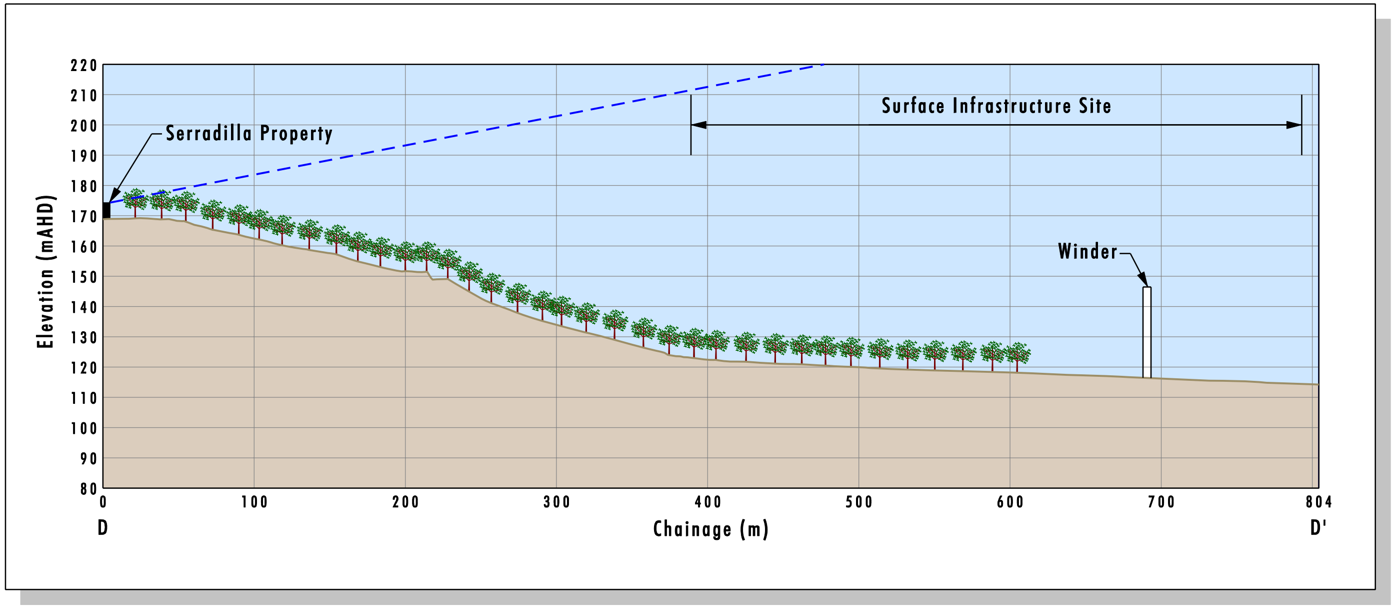
Legend

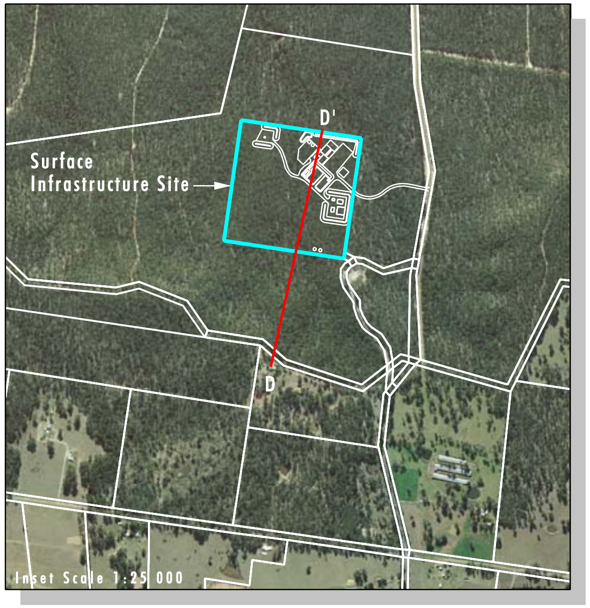
- Existing Vegetation
- Line of Sight

0 0.4 0.8 1.2km
Inset Scale 1:24 000

FIGURE 7.8

Visual Transect from Walker Property





0 100 200 250m
Horizontal Scale 1:5 000

0 50 100 125m
Vertical Scale 1:2 500

0 0.5 0.8 1.25km
Inset Scale 1:25 000

Source: Surface Infrastructure Site: Austar Coal Mine,
Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

- Existing Vegetation
- Line of Sight

FIGURE 7.9

Visual Transect from Serradilla Property

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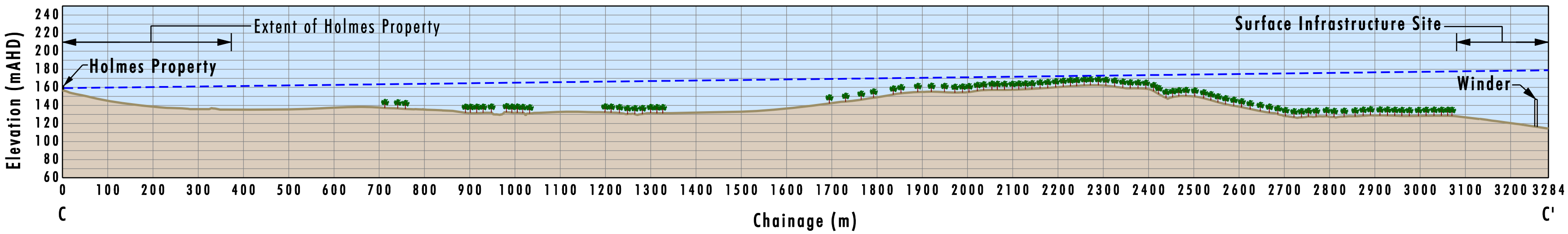
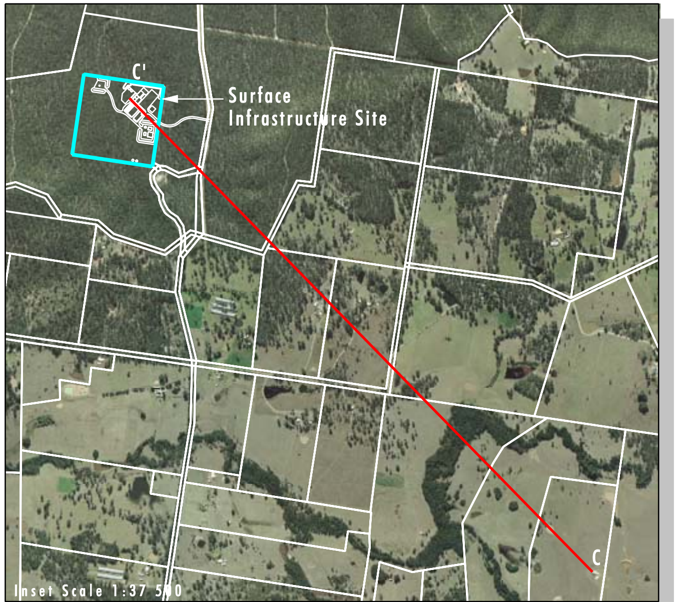


0 250 500 750m
Horizontal Scale 1:15 000

0 125 250 375m
Vertical Scale 1:7 500



Source: Surface Infrastructure Site: Austar Coal Mine,
Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

Existing Vegetation
Line of Sight

0 0.5 1.0 1.5km
Inset Scale 1:37 500

FIGURE 7.10

Visual Transect from Holmes Property

- Linton Penney property which is located approximately 1.1 kilometres to the east south-east of the proposed 30 metre high winder building (**Figures 7.11**); and
- Village of Kitchener which is located approximately 1.6 to 2.7 kilometres north proposed 30 metre high winder building (**Figures 7.12**).

7.9.4 Visual Impacts

As shown on **Figures 7.7** to **7.12**, analysis indicates that the proposed development will not be visible from surrounding residences other than the winder building, the very top of which may be visible from elevated sections of Kitchener. As shown on **Figure 7.12**, when viewed from Kitchener this elevated section of the winder building which will have a maximum elevation of approximately 145 mAHD will have a backdrop of forest vegetation located on the north facing slope of the Broken Back Range which extends from Pelton fire trail to the site. This forest vegetation backdrop extends up to an elevation of approximately 170 mAHD behind the winder building. As a result the winder building will not appear as a silhouette on the skyline however will be fully enclosed in a green backdrop of forest.

As a result it is considered that the visual modification of the landscape in the vicinity of the proposed Surface Infrastructure Site will be negligible, as the only potentially visible component of the development will be the 30 metre high winder building which will be green in colour and blend into the backdrop of surrounding green forest vegetation. The remainder of the infrastructure to be constructed on the site will be below the level of the surrounding trees and will not be visible from surrounding vantage points other than potentially a short section of Quorrobolong Road adjacent to the proposed access road.

As the mine operates 24 hours per day when working, there is a need for surface lighting of the facilities areas. To minimise light spill from the site, lights will positioned to shine into the Surface Infrastructure Site and light shields will be used where practicable.

Analysis indicates with these control measures in place, the proposed development will not have a significant visual impact or detract from the visual amenity of the surrounding area.

7.10 Traffic and Transport

7.10.1 Traffic Context

Construction and operation of the proposed Surface Infrastructure Site will result in changes in traffic movements in the local area. This is principally due to the relocation of staff from Ellalong Drift and Pit Top on Middle Road, Paxton to the proposed Surface Infrastructure Site off Quorrobolong Road. Coal will continue to be brought to the surface at the Ellalong Drift and Pit Top and major mine equipment will also continue to access underground workings at Ellalong Drift and Pit Top also.

A Traffic Study (see **Appendix 8**) has been prepared by GHD Pty Ltd to assess the projected impact of additional traffic during the construction and operational stages of the Surface Infrastructure Site off Quorrobolong Road.

The Traffic Study was developed in accordance with the requirements of Cessnock City Council and the *RTA Guide to Traffic Generating Developments* (October 2002) and includes:

- an assessment of existing road network and predicted traffic volumes in the area with and without the proposed development;

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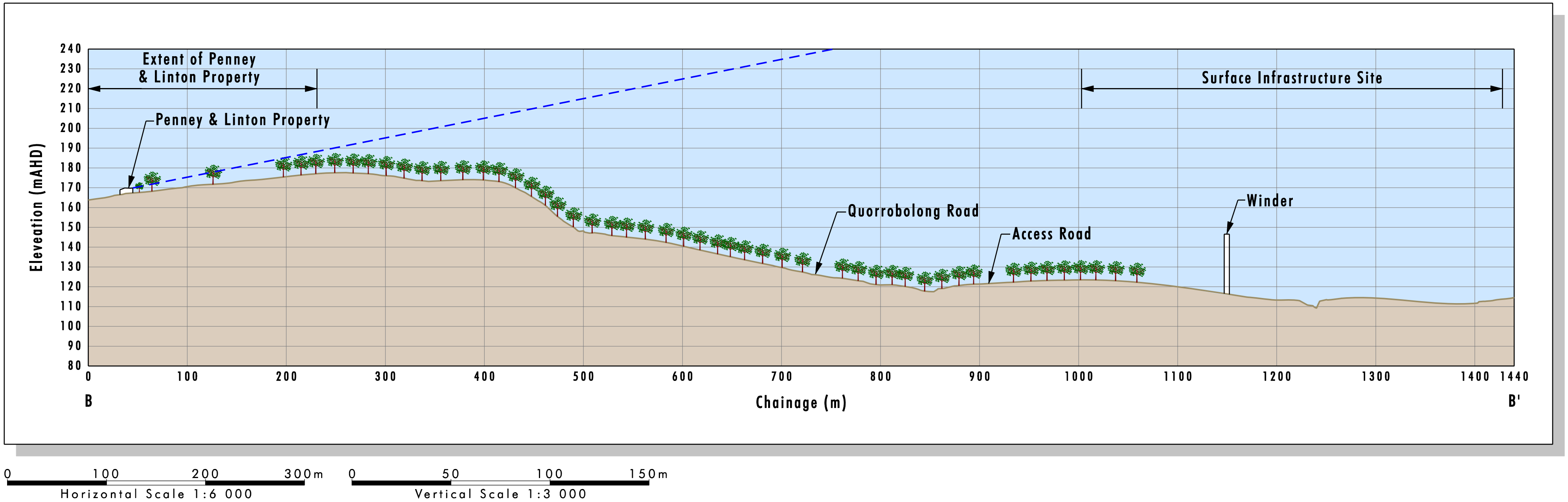

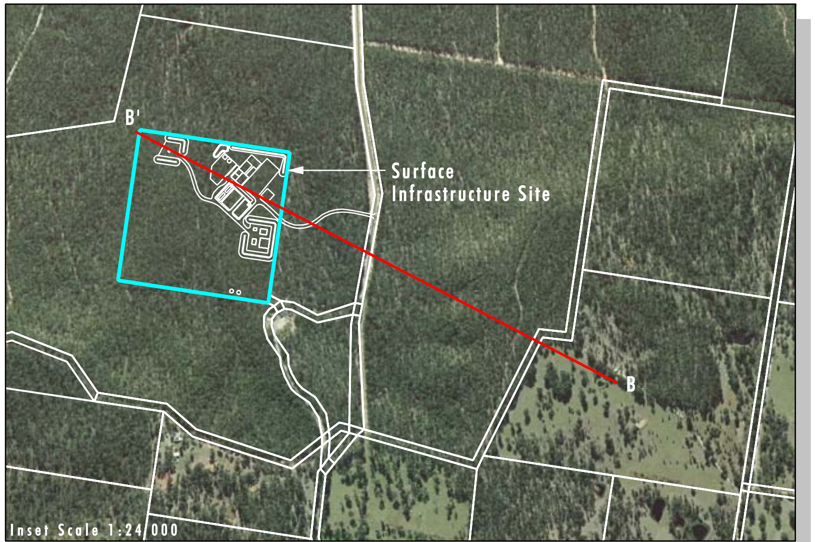

Source: Surface Infrastructure Site: Austar Coal Mine, Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

Existing Vegetation

Line of Sight

0 0.4 0.8 1.2km

Inset Scale 1:24 000

FIGURE 7.11

Visual Transect from Penney and Linton Property

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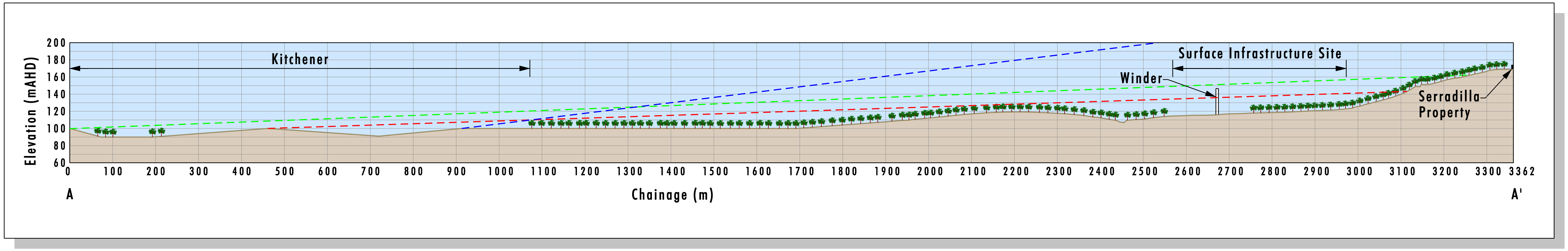
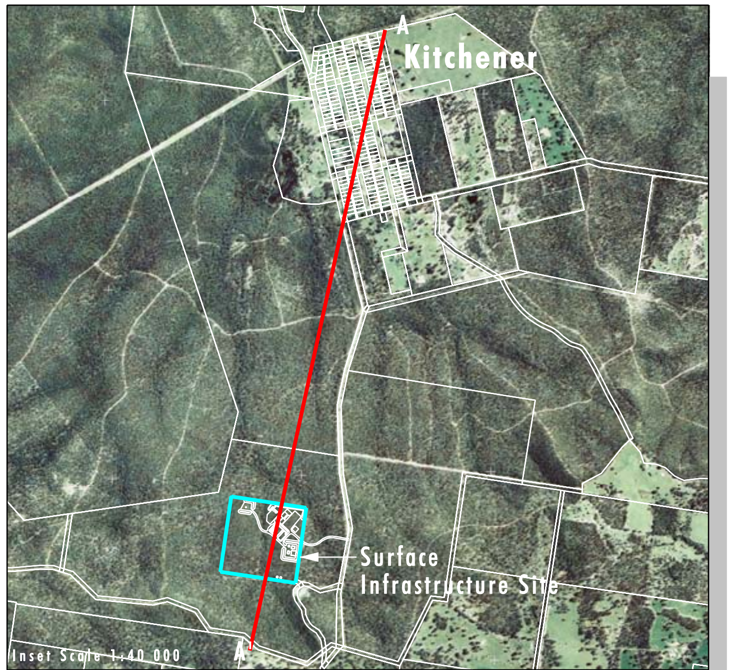


0 100 200 400m
Horizontal Scale 1:10 000

0 50 100 200m
Vertical Scale 1:5 000



0 0.4 0.8 1.2km
Inset Scale 1:40 000

Source: Surface Infrastructure Site: Austar Coal Mine,
Cadastre: LPI NSW, Aerial Photography: AAM Hatch 2006

Legend

- Existing Vegetation
- South Kitchener Line of Site
- Middle Kitchener Line of Site
- North Kitchener Line of Site

FIGURE 7.12

Visual Transect from Kitchener

- an assessment of existing and predicted intersection capacity in the area with and without the proposed development.
- a review of existing crash history for Quorrobolong Road;
- a review of the safety of the rail crossing at Vincent Street;
- assessment of intersection requirements for the proposed access off Quorrobolong Road;
- assessment of parking requirements at the proposed Surface Infrastructure Site; and
- assessment of construction traffic impacts.

7.10.2 Existing Traffic Conditions

The existing Local Road Network is described in **Section 5.9.** The key roads and intersections are indicated in **Figure 5.7**. There are currently no public transport services operating in the vicinity of the proposed development. Rover Coaches operate school buses on weekdays along Quorrobolong Road with one AM service and three PM services.

Intersection analysis undertaken as part of the Traffic Study (see **Appendix 8**) indicated:

- the Wollombi Road/West Avenue intersection currently operates at an unsatisfactory level of service (LOS F);
- the Aberdare Road/Vincent Street intersection currently operates with a satisfactory level of service (LOS C) and will continue to operate with this level of service in 2013; and
- the Sandy Creek Road/Quorrobolong Road intersection has a good level of service.

Analysis (see **Appendix 8**) of existing through traffic at Wollombi Road/West Avenue intersection, shows that the existing through traffic flow on Wollombi Road south-west approach is considerably impacted (LOS F) by the queued right turn movements (approximately 350 metres 95% back of queue). During the evening peak the intersection operates with an unsatisfactory level of service (LOS F), considerable vehicle delays (in particular on the Wollombi south-west approach) and is approaching capacity.

The morning and evening peak periods of the Aberdare Road/Vincent Street Intersection currently operate with a satisfactory level of service (LOS C), relatively minor vehicle delays and some spare capacity. Quorrobolong Road/Sandy Creek Road Intersection operates with a good level of service (LOS A/B), minor vehicle delays and significant spare capacity during the morning and evening peak periods the intersection currently.

A Stage 5: Existing Conditions Road Safety Audit Assessment was undertaken of the level crossing located between Baddeley Park (north side) and the intersection with Racecourse Road (south side) on Vincent Street. The Road Safety Audit determined that the existing road and rail traffic warrants an upgrade from the stop sign control to a Type F flashing light control (refer to **Appendix 8**).

As part of the Traffic Study (see **Appendix 8**), a crash history for the period beginning January 2001 to December 2006 for the local road network was obtained from the RTA. No crashes resulting in injuries were recorded within one kilometre of the proposed Surface Infrastructure Site access point. Of the crashes recorded on both Quorrobolong Road and Sandy Creek Road, the majority were single vehicle impact crashes.

7.10.3 Traffic Conditions from the Development

In regard to the proposed Surface Infrastructure Site an Austroads rural type AUR intersection layout (see **Appendix 8**) is recommended at the access point on Quorrobolong Road to accommodate the traffic from the Project. This will provide an auxiliary lane for vehicles to pass stationary vehicles decelerating or queuing to turn right into the Site. The provision of lighting at the intersection will also improve visibility for night shift entry. The Site will provide car parking for approximately 175 cars and a will be accessed by a two-way sealed driveway with mountable grass verges.

Sight distance at the proposed access intersection meets the minimum requirement in both directions, but is less than the desirable for northbound traffic travelling towards Kitchener. To address this GHD (2008) recommends that a left side road junction (W2-4) warning sign for northbound traffic be erected before the intersection to provide an early warning to northbound traffic of potential entering or turning traffic.

The Traffic Study indicates that each of the three key intersections is projected to operate with spare capacity from 2013 with only nominal impact from the proposed development. The performance of the three key intersections in terms of LOS, degree of saturation, average vehicle delay and 95% back of queue for the future year 2013 are detailed in **Appendix 8.** Analysis also indicates that with or without the development the road network will perform with a satisfactory level of service in 2013.

While the Wollombi Road/West Avenue Intersection is already approaching capacity, the impact of the proposed development will be minimal. Only an additional 3 vehicles in the morning and 21 vehicles in the evening are projected. The overall proportion of trips generated for the Aberdare Road/Vincent Street Intersection is projected to be 30 trips for the proposed development. This is considered to be nominal relative to total intersection volume. Even though the intersection is shown to be approaching capacity (LOS D) during the evening peak period this is still considered to be an acceptable level of service for peak hour operation.

The Quorrobolong Road/Sandy Creek Road Intersection is shown to operate with a good level of service (LOS A), minor vehicle delays and significant spare capacity during both the morning and evening peak periods.

The increase in traffic generated by the Project does not change the warrant for a Type F flashing light control required from the existing road and rail traffic.

7.10.4 Construction Traffic Impacts

A construction commencement date of January 2009 with completion by December 2012 is assumed. The impact to the capacity of the road network from heavy vehicles during the construction phase is expected to be low and dispersed relative to operational road network capacity impacts.

Some short-term influence is expected from the delivery of wide or high vehicles (such as, excavators, cranes, and tip trucks) to and from the Surface Infrastructure Site or concentrated delivery periods (such as large concrete pours). The routes available for heavy vehicles are limited by load restrictions on Sandy Creek Road and Duffie Drive and as a result the majority of heavy traffic will access the site from the north along Vincent Street and Quorrobolong Road.

7.10.5 Proposed Traffic Management Measures and Controls

As part of the Traffic Study GHD (2008) (see **Appendix 8**) made a number of recommendations relating to the existing road system, projected future traffic without the development and potential impacts of the proposed development. These recommendations were divided into management measures and controls required regardless of whether the development goes ahead or not and those that are specifically related to the development.

General Recommendations Based on Existing Traffic (not related to the development)

- Upgrade the Wollombi Road/West Avenue intersection to provide a designated right turn lane into West Avenue. Formalising this traffic movement may improve existing traffic problems associated with the right turn movement using the through lane and through vehicles passing in the bicycle lane/parking area.

- Install a type F flashing light control at the Vincent Street railway level crossing.

Development Specific Recommendations

- Construct an Austroads type AUR intersection treatment with an auxiliary passing lane for through traffic on Quorrobolong Road around right turning traffic at the proposed Surface Infrastructure Site access.

- Provide lighting at the proposed pit top facility access intersection on Quorrobolong Road.

- Erect a left side road junction (W2-4) warning sign for northbound traffic approaching the proposed Surface Infrastructure Site access intersection to compensate for less than desirable Safe Intersection Site Distance (SISD).

- Prepare a traffic management plan for oversize vehicle movements during construction of the Stage 3 development.

7.11 Site Rehabilitation and Decommissioning

Assuming that the mine is decommissioned at the end of the currently proposed development period (21 years), all buildings/workshops and associated hardstand and sealed areas will be removed and revegetated. In addition, upon decommissioning all access and ventilation shafts to the underground workings will be backfilled with soil from the acoustic bunds and sealed. The sediment dam will either remain in use as a farm dam after decommissioning or will be removed. If maintained, the capacity of the dam may be reduced. The proposed diversion drains and catch drains will remain as part of the final landform.

Any future development application for continued operations beyond 21 years will include a revision of the existing soil and water management system and decommissioning provisions.

8.0 Draft Statement of Commitments

The DGRs for the Underground Project require that the EA includes a Statement of Commitments which details the measures proposed by Austar Coal Mine for environmental mitigation, management and monitoring of the proposed Underground Project.

If approval is granted under Part 3A of the EP&A Act for the proposed Stage 3 Project, Austar Coal Mine will commit to the following controls:

8.1 Compliance with the EA

Operation of the Stage 3 development will be undertaken in accordance with the environmental controls and commitments as described in the EA.

8.2 Life of Stage 3 Concept Mine Plan

Project Life

8.2.1 The project approval life will be 21 years from the commencement of longwall mining. Closure and rehabilitation activities may continue beyond this 21 year period and will be undertaken in accordance with an approved Mining Operations Plan.

Production Limits

8.2.2 Underground mining in Stage 3 will produce up to 3.6 Mtpa ROM coal by LTCC methods. This coal will be conveyed, handled, processed and transported using Austar Mine Complex infrastructure.

Hours of Operation

8.2.3 Mining and associated activities for the Stage 3 Project may be undertaken 24 hours a day, seven days a week.

Refinement of Mine Plan

8.2.4 Any material changes to the concept mine plan outlined in this EA report will be detailed and assessed as part of Subsidence Management Plans (SMPs) and Mining Operations Plan (MOP) prepared by Austar Coal Mine.

8.2.5 Mining parameters for the proposed mine plan as detailed in the SMP will be designed to ensure that predicted systemic subsidence in terms of subsidence, tilt, tensile strain and compressive strain will comply with or be less than the Upper Bound predictions detailed in the EA. Those being:

- 3040 mm subsidence;
- 10 mm/m tilt;
- 1.2 mm/m tensile strain; and
- 3.0 mm/m compressive strain.

8.2.6 The locations of any minor surface infrastructure that may be required to implement the project will be detailed and assessed as part of MOPs prepared by Austar Coal Mine.

8.3 Subsidence

8.3.1 Austar Coal Mine will manage the impacts of mining subsidence as required by the conditions of the ML and other DPI conditions.

8.3.2 The Mine Plan submitted as part of the Subsidence Management Plan for longwall extraction will take into consideration monitoring results from previous Austar Mine Complex operations and will be designed to ensure that subsidence as a result of mining does not exceed Upper Bound predictions as set out in the EA for subsidence, tilt, tensile strain and compressive strain. Those being:

- **Maximum Upper Bound** subsidence ranges from approximately 425 mm for LWA7 to approximately 3040 mm for LWA17.
- **Maximum Upper Bound** tilt ranges from approximately 1.9 mm/m for LWA7 to approximately 10 mm/m for LWA17.
- **Maximum Upper Bound** tensile strain ranges from approximately 0.2 mm/m for LWA7 to approximately 1.2 mm/m for LWA17.
- **Maximum Upper Bound** compressive strain ranges from approximately 0.5 mm/m for LWA7 to approximately 3.0 mm/m for LWA17.

8.3.3 Where a potential subsidence impact is identified on private property, Austar Coal Mine will prepare in consultation with the property owner a Property Subsidence Management Plan (PSMP). These plans will clearly outline impacts of mining on the property and the management and remediation measures to be implemented.

8.3.4 Subsidence management measures to be implemented as part of the project will include:

- subsidence monitoring lines to be located as determined as part of the SMP process;
- visual assessment of all natural features and items of surface infrastructure before, during and following mining to detect subsidence impacts such as surface cracking, irregularities in the subsidence profile, erosion, damage to structures, changes in drainage patterns or loss of water from drainage structures;
- detailed subsidence monitoring in accordance with DPI requirements. This data will be utilised to regularly update the subsidence predictions for Stage 3;
- remediation and rehabilitation of subsidence impacts will be carried out, where required, as soon as practicable following subsidence using methods specified in SMPs and PSMPs;
- building structures located within the subsidence affectation area will be inspected by a structural engineer prior to and after undermining and appropriate management measures implemented;
- informing all relevant service providers of the potential impacts of mining subsidence on services;

- farm dams within the subsidence affectation area will be monitored during and following undermining to ensure they remain in a safe and serviceable condition. Remediation works will be undertaken as required;
- in the event of any significant loss of water from a privately-owned farm dam, Austar Coal Mine will provide an alternate source of water, as required, until the dam is repaired; and
- any privately-owned bores within the subsidence affectation area will be monitored during and following undermining. If the capacity of any utilised private bore is reduced to unacceptable level as a result of subsidence, Austar Coal Mine will provide an alternative supply of water until such time as the MSB re-establishes or replaces the bore.

8.3.5 Austar Coal Mine will, prior to undermining of Quorrobolong Road, Nash Lane and Coney Creek Lane prepare and implement a Traffic Management Plan to manage any subsidence impacts on the roads and associated culverts and bridges in consultation with Cessnock City Council and DPI and to the satisfaction of the Director-General.

8.3.6 Austar Coal Mine will prepare management plans in consultation with relevant service providers, for the protection of infrastructure and services within the potential Stage 3 mine subsidence area to ensure these remain in a safe and serviceable condition throughout the mining period. These plans will be submitted to the DPI for approval as part of the SMP prior to undermining of the services.

8.4 Ecology

8.4.1 Austar Coal Mine will establish and manage the proposed Biodiversity Offset Area (refer to **Figure 7.1**) to protect and enhance its ecological values in perpetuity, to the satisfaction of the Director-General.

8.4.2 A Weed Management Plan will be developed for the Surface Infrastructure Site.

8.4.3 The Austar bushfire management strategy will be revised to include the specific requirements of the Surface Infrastructure Site during the construction and operation phases.

8.4.4 Three months prior to the commencement of construction of the Surface Infrastructure Site, an Austar Mine Complex Ecological Management Plan which integrates management of ecological issues associated with construction of the Surface Infrastructure Site, Stage 3 underground mining and with the remainder of Austar Coal Mine operations will be submitted to the Director-General for approval. This will include:

- clearing procedures for establishment of the Surface Infrastructure Site and associated access road/services easement;
- replacement of arboreal habitat within surrounding areas or within the Biodiversity Offset Area, should the removal of any hollow-bearing trees be required; and
- extension of the existing Austar Coal Mine ecological monitoring program to include monitoring of vegetation condition within subsidence affected areas.

8.4.5 Clearing of vegetation will be restricted to the minimum area necessary to construct the proposed infrastructure and provide adequate fire protection and will be undertaken in accordance with the tree felling procedure outlined in **Section 7.5.3**.

8.4.6 An appropriate speed limit on access roads will be implemented to minimise the risk of vehicle collision with ground-dwelling fauna dispersing between adjacent habitats.

8.4.7 An appropriately designed nest box will be erected (either within remaining bushland areas or within the Biodiversity Offset Area) for the compensation of each tree hollow removed as a result of clearing required for construction of the proposed Surface Infrastructure Site.

8.4.8 Any outbreaks of invasive weeds observed on the property boundary will be appropriately controlled to avoid their escape into the surrounding Werakata State Conservation Area and subsequently competing with threatened flora species. Early detection will ensure the management required is not extensively onerous.

8.4.9 Any landscaping undertaken around infrastructure areas will use only locally occurring native plant species to reduce the risk of invasive plant species escaping into the adjacent reserve and competing with threatened flora species. Particular care will be taken to avoid planting species which are known to escape and naturalise into native bushland.

8.5 Heritage

8.5.1 An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared for the Austar Mine Complex to outline all Aboriginal heritage management strategies for the project, responsibilities of all parties and the timeframe for required heritage works.

8.5.2 Austar will make a monetary contribution of $100,000 to an Aboriginal project or program (to be decided by Aboriginal stakeholders) as an offset for any subsidence impacts that affect the grinding groove site. Austar will make this contribution when all necessary government approvals for the Project have been obtained.

8.5.3 No Aboriginal archaeological site be visited, or have works done there, without Aboriginal stakeholders in attendance.

8.5.4 Known sites on accessible properties will be included in a monitoring program. This will involve recording each site before and after subsidence to identify any impacts. This will be done by an archaeologist and Aboriginal stakeholders.

8.5.5 Aboriginal stakeholders (and an archaeologist if requested by Aboriginal stakeholders) provide relevant Austar personnel with a cultural heritage awareness training session.

8.5.6 If any additional sites are found within the Project area, these will be inspected by an archaeologist and Aboriginal stakeholders to assess the site and decide on how it should be managed.

8.5.7 If remediation works are required on any of the creeklines within the Stage 3 area, an archaeological survey with Aboriginal stakeholders will be undertaken prior to commencement of any works.

8.5.8 Historic Heritage Management Plan incorporating all of Austar Mine Complex will be developed.

8.6 Surface Water and Drainage

8.6.1 Austar will develop a detailed Soil and Water Management Plan for the Surface Infrastructure Site prior to commencement of construction.

8.6.2 Erosion and sediment control measures will be designed and implemented for construction of surface infrastructure to a standard consistent with Managing Urban Stormwater: Soils and Construction (NSW Landcom 2004) (the Blue Book) and Guidelines for Establishing Drainage Lines on Rehabilitated Minesites (Draft) (DLWC, 1999).

8.6.3 Any subsidence impacts on drainage lines will be effectively remediated such that there is no significant impact on downstream water users and environmental flows. Drainage line monitoring and remediation protocols will be developed as part of the SMP process, and in consultation with DWE, to guide the management of subsidence impacts and drainage line remediation works on surface water systems. The drainage line monitoring and remediation protocols will include:

- detailed monitoring protocols;
- a program to complete drainage remediation works in a timely manner post-subsidence to limit the potential for surface water capture;
- details of the design of drainage line remediation works such that the rehabilitated drainage lines maintain a similar channel form and sinuosity to the pre-mining environment, to ensure that the overall erosive power of the creek system is consistent with that existing pre-mining;
- assessment of the viability and benefits of applying proactive measures such as the installation of liners or geo-fabrics in drainage lines prior to subsidence; and
- the existing Austar Site Water Management Plan will be extended to include the Surface Infrastructure Site and Stage 3 underground mining. The plan will be updated in consultation with DWE and DPI and submitted to the Director-General prior to the commencement of construction of the Surface Infrastructure Site.

8.6.4 Surface water monitoring results will be reported annually in the Annual Environmental Management Report.

8.7 Groundwater

8.7.1 A groundwater monitoring program will be implemented for the project as outlined in **Appendix 14**, or as otherwise agreed by the Director-General in consultation with the DWE.

8.7.2 The results of groundwater monitoring and a comparison of measured and predicted impacts will be reported annually in the Annual Environmental Management Report.

8.7.3 Impacts on privately-owned bores will be assessed by monitoring and in the event that any utilised privately-owned bore is significantly affected, an alternative water supply will be provided by Austar Coal Mine until such time as the bore is re-established or replaced.

8.7.4 An annual analysis of surface and groundwater monitoring data will be undertaken and will include:

- comparison of groundwater levels with rainfall information;
- identification of any changes or long-term trends in groundwater levels; and
- visual inspection of creeks and drainage lines

8.7.5 The monitoring results and analysis findings will be reported in the Annual Environmental Management Report.

8.8 Noise and Blasting

8.8.1 Unless otherwise agreed with the landowner, Austar Coal Mine will manage operations associated with the Stage 3 underground mining and Surface Infrastructure Site such that the noise emissions from these activities comply with the noise criteria included in **Table 8.1** at surrounding residences.

Table 8.1 – Project Specific Noise Criteria

Location	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$	Amenity Criteria $L_{Aeq(Period)}$	Project Specific Noise Criteria $L_{Aeq(15minute)}$
Kitchener Residences	Day	38 dBA	50 dBA	38 dBA
	Evening	35 dBA	45 dBA	35 dBA
	Night	35 dBA	40 dBA*	35 dBA
Serradilla Residence, Kauter Residence, Penney and Linton Property	Day	37 dBA	50 dBA	37 dBA
	Evening	37 dBA	45 dBA	37 dBA
	Night	35 dBA	40 dBA	35 dBA

8.8.2 Unless otherwise agreed with the landowner, Austar Coal Mine will manage the construction phase of the Surface Infrastructure Site such that the noise emissions from these activities comply with the noise criteria included in **Table 8.2** at surrounding residences between the hours of 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1 .00 pm Saturdays. For all other times including Sundays and Public Holidays construction work will be managed to be inaudible at the identified receivers.

Table 8.2 – Construction Noise Design Goals

Location	Acceptable L_{A10} Noise Level (4 weeks and under)	Acceptable L_{A10} Noise Level (between 4 and 26 weeks)	Acceptable L_{A10} Noise Level (> than 26 weeks)
Kitchener Residences	53	43	38
Serradilla Residence	52	42	37

8.8.3 Acoustic bunding will be constructed to a height of 3.5 metres above ground level along the northern boundary adjacent to the car park and bathhouse.

8.8.4 The ventilation fan outlet will be directed to the west.

8.8.5 Man and materials winder and second egress winder motors will be enclosed.

8.8.6 Blasting will generally take place only once per day and will be undertaken between the hours of 9.00 am to 5.00 pm Monday to Saturday with no blasting on Sundays or Public Holidays.

8.8.7 Airblast overpressure from blasting associated with shaft development at the Surface Infrastructure Site when measured at residences not associated with the development will not exceed a maximum of 120 dBL Linear Peak at any time and will not exceed 115 dBL for more than 5% of blasts over a 12 month period.

8.8.8 Peak particle velocity from blasting associated with shaft development at the Surface Infrastructure Site when measured at residences not associated with the development will not exceed a maximum of 10 mm/s at any time and will not exceed 5 mm/s for more than 5% of blasts over a 12 month period.

8.9 Air Quality

8.9.1 Austar Coal Mine will manage operations associated with the operation of the Surface Infrastructure Site so that dust deposition as a result of the development does not exceed levels set out in **Table 8.3** at nearest non-project related residences.

Table 8.3 - Dust Deposition Criteria

Pollutant	Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

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

8.9.2 Austar Coal Mine will expand the existing dust monitoring network to include dust deposition gauges at locations to the south and north of the proposed Surface Infrastructure Site. Dust monitoring findings relating to the Surface Infrastructure Site will be reported annually in the Annual Environmental Management Report.

8.10 Energy and Greenhouse Gas

8.10.1 Austar Coal Mine will develop and maintain an internal energy and GHG management plan for Stage 3 operations in accordance with Austar Coal Mine requirements. This will include reviewing:

- energy efficiency in plant and equipment procurement, consideration be given to the life cycle costs advantages obtained by using energy efficient components;

- the opportunity to install additional sub-metering for offices, workshops and winders;
- operational initiatives such as turning off idling plant equipment;
- control and temperature settings for air conditioning units in offices and switchrooms;
- automatic control of external and internal lighting;
- potential energy efficiency opportunities in water pumping and dust suppression systems (for example, variable speed drive pumps);
- review changes in power consumption with installation of new equipment and install power factor correction equipment to suit; and
- review workshop and bathhouse lighting and office and high bay lighting.

8.11 Visual

8.11.1 Austar Coal Mine will implement the following visual controls to screen or reduce the visual impact from views of the Surface Infrastructure Site from residential areas and public road locations:

- Maintain a vegetative screen along the edges of the access road to the Surface Infrastructure Site.
- Limit clearing on the Surface Infrastructure Site to that required for construction and bushfire protection purposes.
- Use appropriate natural tones on the winder building to ensure that it blends into the backdrop of native forest when viewed from Kitchener and sections of Quorrobolong Road.
- Direct night-time security lights into the site and ensure that all lighting is located and directed so as to not directly impact on residential or road locations. Lighting will be designed to minimise excessive night glow in a manner consistent with AS 4282 Control of the Obtrusive Effects of Outdoor Lighting.
- All buildings potentially visible to the public to be coloured in suitable natural tones.

8.12 Transport

8.12.1 To mitigate potential traffic impacts associated with the development of the Surface Infrastructure Site, Austar Coal Mine will:

- Construct an Austroads type AUR intersection treatment with an auxiliary passing lane for through traffic on Quorrobolong Road around right turning traffic at the proposed Surface Infrastructure Site access.
- Provide lighting at the proposed pit top facility access intersection on Quorrobolong Road.

- Erect a left side road junction (W2-4) warning sign for northbound traffic approaching the proposed Surface Infrastructure Site access intersection to compensate for less than desirable Safe Intersection Site Distance (SISD).
- Prepare a traffic management plan for oversize vehicle movements during construction of the Stage 3 development.

8.13 Community

8.13.1 Austar Coal Mine will work with Cessnock City Council, DoP and Community Consultative Committee to incorporate representatives from the Stage 3 Project area. Austar Coal Mine will provide the Community Consultative Committee with regular information regarding the environmental management performance of the Stage 3 Project and any relevant matters regarding community relations.

8.13.2 Maintain a 24 hour per day community information and complaint line.

8.13.3 Provide regular updates of mine development and monitoring on the Austar Coal Mine website.

8.13.4 Austar Coal Mine will in consultation with Cessnock City Council contribute to the upgrade of the Wollombi Road/West Avenue intersection to provide a designated right turn lane into West Avenue to formalise traffic movements in this area and improve existing traffic problems associated with the right turn movement using the through lane and through vehicles passing in the bicycle lane/parking area.

8.13.5 Install a type F flashing light control at the Vincent Street railway level crossing.

8.13.6 Provide support to Kitchener Public School through the provision of sporting equipment and contributions to school/community projects.

8.13.7 Contribute to the ongoing maintenance of Poppet Head Reserve, Kitchener.

8.14 Decommissioning and Rehabilitation

8.14.1 A decommissioning plan will be prepared for the Surface Infrastructure Site as part of the MOP process and submitted to the DPI for approval approximately five years prior to the commencement of decommissioning works.

8.15 Continuous Improvement of Existing Operations

8.15.1 Austar Coal Mine will review and extend its current Site Water Management Plan for Austar Mine Complex to include Stage 3 operations and operation of the Surface Infrastructure Site. The water performance of the water management system will be reported in the Annual Environmental Management Report.

8.15.2 Activities within Austar Mine complex will be undertaken in accordance with approved Mining Operation Plan that will be reviewed and updated at least every seven years.

8.15.3 Austar Coal Mine will continue to implement the voluntary Noise Pollution Reduction Program for Pelton CHPP in consultation with DECC.

8.15.4 Austar Coal Mine will commit to a Noise Management Plan that incorporates current noise monitoring, the voluntary Noise Pollution Reduction Program and associated noise management for Austar Mine Complex operations and will investigate reasonable and feasible noise mitigation strategies where appropriate.

8.15.5 Austar Coal Mine will investigate opportunities for reduction in energy use and greenhouse gas emissions from the Austar Mine Complex. This will include:

- ongoing review of emissions monitoring and management technology;
- review of coal operations and potential for improvement as part of producing clean coal through coal preparation to reduce moisture and ash content, sulphur, nitrogen and other contaminants. This results in reduced emissions of greenhouse gases and other pollutants when the coal is used; and
- consider the application of the in-force National Greenhouse and Energy Reporting System (NGERS) and the Carbon Pollution Reduction System (CPRS) on Austar operations.

8.16 Environmental Management, Monitoring, Auditing and Reporting

8.16.1 Austar Coal Mine incorporate the Stage 3 Project into the Annual Environmental Management Report for Austar Mine Complex.

8.16.2 Three years after commencement of the Stage 3 Project, and every three years thereafter, Austar Coal Mine will commission and pay the full cost of an Independent Environmental Audit of the project in consultation with the Director-General of DoP. A copy of the audit report will be provided to the Director-General of DoP and DPI, DECC, Cessnock City Council, DWE and members of the Community Consultative Committee for the Stage 3 Project. This audit may be combined with other independent environmental audits required by the Director-General of DoP.

9.0 Justification and Alternatives

9.1 Austar Coal Mine Operational Context

The development of the proposed Stage 3 underground mining operations is essential to continued mining at the Austar Mine Complex beyond 2011 and will provide access to approximately 45.3 Mt of coal. Austar is currently completing mining in Stage 1 with longwall mining in Stage 2 planned to commence in January 2009. Mining within Stage 2 area predicted to finish at the end of 2011 with longwall mining in Stage 3 planned to commence in the start of 2012 if consent is granted. Construction of the proposed Surface Infrastructure Site is programmed to commence in mid 2009 to allow sufficient time for ventilation shaft construction to provide for ongoing ventilation of the mine.

Coal extracted from the proposed Stage 3 area will be handled and processed utilising existing infrastructure and facilities as part of the Austar Mine Complex. This provides for considerable efficiency and significant economies-of-scale in processing coal. As a result only minimal construction and hence utilisation of new resources is required to facilitate the proposed Stage 3 operations.

An approved Mining Operations Plan (MOP) (Austar 2008) detailing the established environmental and operational controls for the continued operation of the existing Austar Mine Complex infrastructure and facilities is in place.

The proposed Stage 3 development will provide for the extraction of approximately 45.3 Mt of ROM coal from the Stage 3 area over a 16 to 21 year period. This will enable continued production of up to 3 million tonnes per year of product coal from the Pelton CHPP. Approximately 87% of the indicated and inferred coal resource is within CML2. The remaining 13% of the coal resource is located to the east and north of CML2 and would be otherwise sterilised if not mined as part of Stage 3 due to geological constraints to the north and east of these coal resources.

Continued use of LTCC as proposed provides for efficient extraction of the full seam which is up to 7.0 metres thick in Stage 3. This ensures that valuable coal resources are fully utilised and not sterilised by the use of a mining method that cannot extract the full seam thickness at depths of in excess of 700 metres.

The conventional longwall mining equipment that was used at the mine prior to LTCC was capable of mining up to a height of 3.5 metres. As a result, where the coal seam is 7 metres thick, up to a 3.5 metre thickness of coal would be left in the ground and sterilised from future extraction. Based on an average seam thickness across the proposed Stage 3 area of 6 metres, use of LTCC will yield approximately 16 Mt more coal than would be extracted using the former conventional longwall mining equipment.

Use of LTCC technology allows up to 63% more coal to be extracted from the seam face than conventional longwall mining techniques and uses only approximately 5% more energy. As a result use of LTCC technology substantially reduces the energy required to mine coal and the associated GHG emissions.

The Greta Coal Seam at the Austar site also has naturally very low coal seam methane characteristics. Continued operations will ensure maximum resource extraction for minimal additional energy consumption and GHG emissions.

Austar will also assess and consider where feasible the implementation of GHG, energy management and mitigation initiatives during the Project. These mitigation measures will largely be focussed on energy management, energy efficiency and the potential reduction in energy consumption.

The ongoing use of LTCC technology provides for increased resource extraction and energy efficiency and the opportunity for Australia to further participate in the development of this highly efficient form of longwall resource extraction in an environmentally acceptable manner.

The high quality bituminous coal that remains in the southern margins of the Greta Coal Seam is a highly valuable resource and has superior GHG emission characteristics to lesser quality coals that may otherwise be used to supply global coal demands. Austar plans to utilise the significant Stage 3 coal resource and to maximise resource extraction within Mining Lease (CML2). Mining within Stage 3 will continue to contribute to employment opportunities and revenue generation within the community, Cessnock LGA, Hunter region, the State and the Nation.

The potential savings and efficiencies achieved by utilising existing and approved infrastructure and operations instead of establishing extensive new development on a Greenfield site are significant.

9.2 Economic Contribution

The Austar Coal Mine is the sole remaining coal mine within the Cessnock LGA and has a long and productive history as part of the Cessnock community. Over the past 90 years the mine has, contributed significantly to the prosperity, employment and security of the local and surrounding areas. Austar currently employs approximately 200 people from the following LGAs:

- Cessnock/Singleton – 50%
- Lake Macquarie – 28%
- Newcastle – 9%
- Maitland – 13%

During Stage 3 Austar will continue to provide employment for 200 people with employment rising to approximately 275 people at full production of 3 Mtpa. The Stage 3 coal resource (based on 2007 coal prices) has an estimated export value of approximately $5.6 billion. Approximately 16 Mt of this coal is accessible due to the use LTCC mining equipment and would not be accessible if conventional longwall mining equipment was used. It is estimated that based on 2007 coal prices, this additional 16 Mt of coal is worth approximately $1.95 billion in export earnings.

At 2007 production levels of approximately 1.6 Mtpa of product coal, Austar Coal Mine generates approximately $200 million per year in revenue with this expected to increase to approximately $400 million per year (based on 2007 coal prices) at full production of 3 Mtpa.

A significant component of this revenue is expended in the local, regional and state economies. This expenditure includes approximately:

- $31.5 million per year in wages and salaries with this expected to increase to approximately $46 million per year (2007 prices) at full production;

- $6.3 million per year in contractors and consultants with this expected to increase to approximately $11.6 million per year (2007 prices) at full production;
- $17.3 million per year in repairs and maintenance with this expected to increase to approximately $32.4 million per year (2007 prices) at full production;
- $15 million per year in electricity and consumables with this expected to increase to approximately $28.1 million per year (2007 prices) at full production;
- $3.8 million per year in plant hire with this expected to increase to approximately $7.1 million per year (2007 prices) at full production; and
- $8 million per year in Local and State government charges and royalties with this expected to increase to in excess of $15 million per year at full production.

Access to coal resources in Stage 3 will have a significant economic benefit to the Cessnock LGA and the region through ongoing:

- local employment;
- purchase of goods and services;
- local Austar expenditure; and
- local employee earnings expenditure.

Approval to mine Stage 3 will also enable the continued utilisation and therefore benefit from significant existing infrastructure that has been established at Austar Mine Complex over the 90 year life of the mine. This infrastructure has an estimated replacement value of approximately $800 million and includes:

- Ellalong Drift and Pit Top, associated underground and above coal conveyance infrastructure and roadways;
- the overland conveyor system to Pelton CHPP;
- air ventilation infrastructure;
- coal handling, preparation, stockpiling at Pelton CHPP and associated rail loading infrastructure;
- Austar water management and dewatering infrastructure;
- reject emplacement areas at Pelton CHPP and Aberdare Extended; and
- Austar Branch Line.

Access to Stage 3 will also provide for the continued utilisation of South Maitland Railway which is currently used solely to haul coal from Austar Coal Mine. This infrastructure is also of significant value and represents a significant investment that current and future generations will benefit from, if Stage 3 is approved.

As set out above, the continuation and extension of the Austar Mine Complex into the proposed Stage 3 mining area will provide considerable social and economic benefits for the Cessnock area, the State of New South Wales and Australia.

9.3 Ecologically Sustainable Development

For the purposes of this EA, the definition of Ecologically Sustainable Development (ESD) as set out in Section 6(2) of the *Protection of the Environment Administration Act, 1991* and adopted by the EP&A Act, has been used. ESD requires the integration of economic and environmental considerations in decision making processes. The following ESD principles are integral to the Stage 3 Project:

a) the precautionary principle;
b) inter-generational equity;
c) conservation of biological diversity and ecological integrity; and
d) improved valuation, pricing and incentive mechanisms.

These principles which are discussed further in **Sections 9.3.1** to **9.3.4**, have been incorporated into planning and assessment of the Stage 3 Project through:

- incorporation of risk assessment and analysis within the environmental assessment and decision-making processes for the project;

- adoption of environmental assessment and management procedures that are cautious, well understood, predictable and result in high standards for environmental and occupational health and safety performance. This includes site specific calibration of the subsidence prediction model using in excess of two years of subsidence data derived from subsidence measurements specific to the Greta Coal Seam and Branxton Formation and commissioning a peer review of subsidence predictions;

- ongoing consultation with regulatory authorities and community stakeholders since 2005 when Austar purchased the mine and through the subsequent modifications to development consent for Stage 1 and Stage 2, development of associated Subsidence Management Plans and Property Subsidence Management Plans and consultation with government agencies, Aboriginal stakeholders, land holders and community stakeholders for the Stage 3 project;

- optimisation of resource utilisation and the economic benefits to the State and community arising from the development of the Project through:

  - reconfiguration of the 1996 conceptual mine plan for coal resources in the Stage 3 area to optimise coal extraction within the geological features such as dykes and faults that constrain the coal resource and to include coal resources to the east of CML2 that would be otherwise sterilised if not extracted as part of Stage 3 underground mining;
  - limiting the width of longwall panels to extraction widths over which the overlying massive Branxton Formation can span as a beam, minimising overall subsidence and differential subsidence across the land surface as a result of mining and hence minimising surface impacts;
  - use of LTCC equipment that enables the full coal seam thickness of up to 7 metres to be extracted increasing the amount of coal that can be mined in the Stage 3 area to be by approximately 16.2 Mt more than would have been accessible if the former conventional longwall mining equipment was utilised;
  - use of LTCC equipment enables up to 64% more coal to be extracted from the proposed Stage 3 area than by conventional longwall mining equipment whilst requiring only 5% more energy to achieve this increased extraction;

- continued utilisation of existing Austar Mine Complex Infrastructure and associated established environmental controls to handle, process and transport coal from Stage 3 underground mining area and hence maximise the benefit derived from this existing infrastructure. It is estimated that the replacement value of this infrastructure is approximately $800 million;

- designing the proposed development to have minimal short term and long term impacts though an iterative process involving:
  - assessing these potential impacts through consideration of land use, water management, cultural heritage, transport, ecology (flora and fauna), noise emissions, air quality emissions (including greenhouse emissions), rehabilitation, socio-economics, land resources and visual amenity;
  - developing environmental control measures to mitigate adverse impacts and monitor the performance of the development; and
  - developing contingency measures that can be implemented if unforeseen or unpredicted impacts occur.

Environmental assessment undertaken as part of the proposed Stage 3 Project indicates that the construction and operational phases of the development can be undertaken in accordance with ESD principles through the application of identified mitigation and management measures to minimise environmental impacts.

9.3.1 The Precautionary Principle

Environmental assessment involves the prediction of potential environmental outcomes of a development. The precautionary principle reinforces the need to take risk and uncertainty into account, especially in relation to threats of irreversible environmental damage. A comprehensive definition of the precautionary principle is as follows:

> that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and an assessment of the risk-weighted consequences of various options.

A Preliminary Environmental Assessment (PEA) including a review of potential risks was undertaken as part of the initial stage of the EA process and has been revisited and revised as a greater understanding of the proposed development and its potential impacts has been developed. These assessments were conducted and revisited to identify risks and potential environmental impacts and to assist in the development of appropriate mitigation measures and strategies. The Precautionary Principle has been applied to the assessment of the Stage 3 Project.

Key components of the EA to minimise the potential for serious irreversible environmental damage include:

- careful design and review of the project;

- development of management, reduction and mitigation measures that are designed to address the potential environmental impacts of the project;

- implementation of monitoring and reporting mechanisms for the life of the project;

- identification of potential risks and consequences of those risks; and
- development of contingency measures that could be implemented in the case of unforeseen or unpredicted impacts as a result of the Project.

A range of mitigation measures have been incorporated into the proposed development to minimise the potential for serious irreversible damage to the environment, including the development of environmental management and monitoring measures and an Biodiversity Offset Strategy that will be implemented upon the construction of the Surface Infrastructure Site. Where residual risks are identified, contingency controls have been considered and will be further refined during subsequent preparation of Subsidence Management Plans and Property Subsidence Management Plans.

9.3.2 Intergenerational Equity

Intergenerational equity is based on the principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. Intragenerational equity is applied within the same generation. The principles of generational equity are addressed by the proposed development through:

- continued utilisation of approximately $800 million worth of coal handling, processing and transporting infrastructure that prior to the reopening of Austar Coal Mine was a $14 million liability to NSW;
- assessment of the potential social impacts of the Stage 3 Project, including the distribution of impacts between stakeholders;
- consideration of methods to minimise energy usage and GHG emissions generated by the Stage 3 Project and maximise use of existing resources and infrastructure;
- implementation of environmental management and monitoring measures to minimise potential environmental impacts, including the Austar Mining Operation Plan, Annual Environmental Management Reports and updating of the Site Water Management Plan for Austar Mine Complex;
- mitigation and compensation measures for any potential impacts on Aboriginal Cultural Heritage will also be implemented. This includes the contribution of $100,000 to Aboriginal stakeholders for an agreed project as compensation for possible impacts on an axe grinding groove located above the proposed longwalls; and
- implementation of a Biodiversity Offset Strategy during the life of the Stage 3 Project to offset for potential ecological impacts resulting from the construction of the Surface Infrastructure Site.

As stated, and most significantly the Project will benefit current and future generations through ensuring that the mine operations transform from a former significant liability (as the mine was prior to being purchased by Austar) to an operation that has the ability to generate and maintain employment for up to approximately 275 people when the Project is fully operational. It is estimated that at a production level of 3 million tonnes per year, Austar Coal Mine will generate approximately $400 million per year (based on 2007 coal pricing) in revenue with significant flow-on effects to the local area, region, State and National economies.

9.3.3 Conservation of Biological Diversity

A comprehensive and detailed assessment of the ecology and biodiversity of the landform above the proposed Stage 3 underground mining area and of the proposed Surface Infrastructure Site has been undertaken for this EA. The majority of the Stage 3 Project will be conducted underground with negligible detrimental impact to the land surface.

In accordance with ESD principles, the proposed Stage 3 Project addresses the conservation of biodiversity and ecological integrity by proposing an environmental management framework designed to conserve ecological values where possible and provide a Biodiversity Offset Area for the proposed development of the Surface Infrastructure Site where ecological values will be disturbed. In addition to the provision of a Biodiversity Offset Area as proposed, the proposed disturbance of the Surface Infrastructure Site has been as far as possible restricted to the northern part of the site to minimise impacts on the existing environment where practicable. Protocols for clearing, site disturbance, sediment and erosion control and water management have been developed for the construction phase to minimise on-site and off-site impacts on ecological values.

The potential for environmental degradation in the longer term, will also be minimised through appropriate landscaping works using native species, development of a weed management program, training of personnel, environmental auditing and the development and implementation of contingency plans in case of an emergency which is likely to impact on the environment. Environmental monitoring will be undertaken to determine whether the environmental control measures are operating effectively.

9.3.4 Valuation and Pricing of Resources

The efficient and non-wasteful management of resources to maximise the welfare of society, both now and for future generations is central to ESD. The proposed Stage 3 Project maximises the efficient use and management of resources through the following factors:

- maximising resource utilisation though reconfiguring the mine plan to include coal resources at the eastern boundary of CML2 that would be otherwise sterilised;

- use of LTCC mining equipment that enables the full coal seam thickness in Stage 3 underground mining area of up to 7 metres to be extracted. Prior to 2006, longwall equipment used at Austar mine was limited to an extraction height of 3.5 metres. In a panel by panel comparison, this would equate to a recovery of only 64% of the coal resource that could otherwise be extracted by LTCC technology based on an average seam thickness of 6.2 metres;

- use of LTCC mining equipment will enable approximately 16.2 Mt more of high quality coal to be extracted than would have been achievable if the former conventional longwall mining equipment used by the mine was used for Stage 3. This additional 16.2 Mt of coal has a 2007 export value of approximately $2.11 billion and represents approximately 36% of the total coal resource to be extracted from Stage 3;

- minimisation of energy usage in coal extraction through the utilisation of LTCC technology which within the proposed Stage 3 area will allow up to 64% more coal to be extracted compared to conventional longwall mining for only a 5% increase in energy usage; and

- minimising the resources and energy required to handle, process and transport coal from Stage 3 through continued utilisation of the existing Austar Mine Complex infrastructure that operates within an established and controlled environmental management framework.

9.4 Site Suitability and Ability to Control Potential Impacts

9.4.1 Site Suitability

The Stage 3 underground mining operation proposes to access approximately 45.3 Mt of high quality coal resource from the Greta Coal Seam worth approximately $5.6 billion in exports based on 2007 coal prices. The mine during its various ownerships has been accessing the Greta seam and the overlying Pelton seam since approximately 1916 with mining progressing downdip from the seam outcrop to depths of in excess of 550 metres. Over the life of the mine, a range of mining techniques including bord and pillar, continuous miner, longwall mining and more recently LTCC have been used. As a result of these activities over nearly the past century there is an extensive site specific knowledge base of subsidence characteristics, potential subsidence impacts and the interactions of these impacts with structures on the landform above the mining area, service infrastructure, geology, ecology, land use, surface drainage, groundwater.

The proposed Stage 3 development, which seeks to mine coal from the Greta seam at depths of 450 to 740 metres below the surface, has been developed within the context of this site specific knowledge base, taking into account specific characteristics of the coal resource, the overlying geology, significant natural features, land use and improvements. Landform characteristics of the site have been recorded using Aerial Laser Survey techniques which provide an accurate, high level of definition of not only the land surface but also includes definition of structures on the surface such as buildings and roads and of the vegetation canopy.

Detailed investigation of the site geology and potential geological anomalies such as faults and dykes in the vicinity of the proposed Stage 3 area has been undertaken (see **Figure 3.1**) to enable a conceptual mine plan to be developed. Geological investigation and experience from previous mining within the Greta coal seam and Branxton Formation indicate that the Branxton Formation is sufficiently massive to be strong enough to span longwall panel void widths of approximately 227 metres as proposed without collapsing or undergoing significant sagging. As a result, it is expected that the subsidence profile that will result from the proposed mining of Stage 3 will be controlled by the compression of the chain pillars that are left between each longwall. With subsidence being controlled by compression of the chain pillars, the whole of the landform above the Stage 3 longwalls will subside in a relatively uniform manner and as a result the only areas of relative change in landform will be around the perimeter of the group of longwall panels. As a result, no significant changes to the visual characteristics or visual amenity of the area are predicted as a result of proposed Stage 3 mining.

Subsidence predictions have been undertaken by MSEC (2008) based on Maximum Predicted Subsidence which represents the maximum level of subsidence using the subsidence model that has been calibrated using measured subsidence specific to the Greta seam and Branxton Formation geology. As a risk management tool, a very conservative Upper Bound estimate of subsidence has been derived by MSEC (2008) based on subsidence being equal to 65% of the effective extracted seam thickness. A peer review of MSEC (2008) subsidence predictions undertaken by Seedsman Geotechnics (2008) found that the Upper Bound subsidence estimate was ‘needlessly conservative’. MSEC (2008) has stated that based on the height of chain pillar, the longwall void configuration and the massive nature of the Branxton Formation that maximum subsidence is unlikely to be more than 50% of the effective extracted seam thickness rather than the 65% that has been adopted by MSEC (2008).

Analysis of the Maximum Predicted and Upper Bound subsidence predictions using high definition digital terrain models derived from the Aerial Laser Survey data indicate that creeklines and drainage lines within the area will remain free draining even at Upper Bound subsidence levels. As a result subsidence remediation works along creek lines are not expected to be required. Consequently there is unlikely to be any significant disturbance or loss of riparian vegetation or Aboriginal archaeological heritage in proximity to creek lines.

Geological drilling indicates that the Branxton Formation which is massive, extends from the Greta Coal Seam to the surface within the Stage 3 area. In addition, the geomorphology of the area has resulted in broad and relatively shallow valleys and exhibits no confined gorges and deep valleys as are evident in the Southern Coalfield. As a result upsidence and valley closure impacts as a result of mining that have been observed in the Southern Coalfield are unlikely to have a significant impact on the Stage 3 area.

Hydrogeological assessment of the Stage 3 area undertaken by Connell Wagner (2007) indicates that there is unlikely to be any significant loss of shallow groundwater resources due to upsidence or valley closure impacts. This assessment is consistent with the findings of MSEC (2008) and Seedsman Geotechnics (2008).

Analysis of subsidence impacts on dwellings, buildings and structures undertaken by MSEC (2008) indicates that even at Upper Bound levels of subsidence, all buildings and structures will remain Safe Serviceable and repairable during and following Stage 3 underground mining. Similarly, subsidence predictions indicate that mining will not have a significant impact on land use in the area. Subsidence Management Plans and Property Subsidence Management Plans providing details of specific management and monitoring activities on a property by property basis will be prepared in consultation with relevant government agencies and land holders prior to longwall extraction.

Taking the above characteristics and potential impacts into account, the ability to control and management these impacts, it is considered that the proposed Stage 3 development site is suitable for underground mining as proposed.

The proposed Surface Infrastructure Site is on a 16 hectare parcel of land that is owned by Austar. The proposed development of the site will disturb approximately 8 to 10 hectares of this site. Environmental assessment and analysis indicates that, with the implementation of control measures as proposed, the site can be developed without having a significant impact on the surrounding Werakata State Conservation Area. Development of the site will result in disturbance of two threatened species and small sections of Endangered Ecological Communities. A Biodiversity Offset Area of similar or greater ecological value has been identified on land that is also owned by Austar and abuts Werakata State Conservation Area. Conservation of the proposed Biodiversity Offset Area will offset ecological impacts of developing the proposed Surface Infrastructure Site.

The site can be adequately serviced in terms of potable water, sewer, electricity and telecommunications. Access to the site will be via a new road that will be constructed between the site and Quorrobolong Road. An In holding Access Agreement with DECC will be required for that section of the road between the Surface Infrastructure Site and Quorrobolong Road. Traffic assessment undertaken by GHD (2008) indicates that with the provision of warning signs on the southern approach to the intersection and street lighting at the intersection, the intersection will comply with relevant design and safety standards.

The site contains soils that are potentially erosive when disturbed. A series of soil and water management controls have been designed for the construction phase and for ongoing use of the site to ensure that the site can be developed in an acceptable manner. Soil and water management controls along with landscaping and weed management measures will be incorporated into the development to minimise potential long term impacts on the surrounding Werakata State Conservation Area.

The proposed Surface Infrastructure Site is visually screened from surrounding areas and is sufficiently acoustically distant from residential receivers to ensure that the development (with the incorporation of appropriate mitigation measures) can be undertaken without having a significant adverse impact on the amenity of the surrounding area. The site was chosen specifically for this purpose and is intentionally removed, remote and screened from residential areas and rural properties so as to provide for minimal impact from the construction and operation of the Site.

Geological assessment and mining planning indicates that the site can provide appropriate access to the proposed Stage 3 underground workings for men and materials and can be used to adequately ventilate the underground mine.

Taking the above matters into account, it is considered that the site is suitable for the development of the proposed Surface Infrastructure Site.

9.4.2 Assessment and Control of Potential Impacts

In preparing this environmental assessment a Preliminary Risk Assessment (Umwelt, 2008a) was undertaken in the initial stages of the Project to identify key issues, risks and consequences of the proposed development. This Preliminary Risk Assessment formed the basis for discussions with relevant government agencies and stakeholders. Following these discussions which included a Planning Focus Meeting with relevant government agencies, the Director-General of Planning issued DGRs setting out the key environmental issues to be addressed in this environmental assessment. These are set out in **Section 5.2.1**. Each of these issues have been considered and explored through targeted surveys undertaken specifically for the project and through detailed assessment based on site specific data and best practice assessment methods. This has included:

Subsidence

As set out in **Section 6.1** and **Appendix 11**, a detailed subsidence impact assessment for the project has been undertaken by MSEC (2008). The assessment has been based on an Incremental Profile Method (IPM) model that has been calibrated using site specific subsidence information recorded from former mining of the Greta coal seam in the Branxton Formation. This data set spans several decades of subsidence monitoring. The modelling and subsidence predictions were peer reviewed by Seedsman Geotechnics (see **Appendix 12**). IPM modelling by MSEC (2008) has produced subsidence predictions for the Maximum Predicted subsidence and Upper Bound subsidence. Maximum Predicted subsidence predictions are based on monitored subsidence levels from previous and current mining in the Greta coal seam. The Upper Bound subsidence predictions have been developed for risk assessment purposes and are based on subsidence being equivalent to 65% of the effective extracted seam thickness which Seedsman Geotechnics found to be needlessly conservative.

Potential subsidence impacts have been assessed against both Maximum Predicted and Upper Bound subsidence levels. This assessment has found that subsidence even at Upper Bound subsidence levels can be acceptably controlled with all buildings and dwellings remaining Safe, Serviceable and Repairable during and subsequent to mining.

Surface and Groundwater

As set out in **Section 6.2** and **Appendix 13**, potential changes to surface flows above the proposed Stage 3 mining area as a result of mining have been assessed for the Maximum Predicted and Upper Bound predicted levels of subsidence. This assessment has been undertaken using a detailed two dimensional hydrodynamic model (RMA-2) that has been developed for the Quorrobolong Valley using topographic information derived from detailed Aerial Laser Survey data combined with site specific information on the hydraulic properties of the valley derived from site inspection and interpretation of aerial photography. The two dimensional hydrodynamic model has been calibrated to known flood levels for the February 1990 and June 2007 major storm events both of which had Average Recurrence Intervals of approximately 100 years.

Results of the modelling indicate that:

- Creeks and drainage lines will remain free draining with no significant increase in instream velocities predicted for the Maximum Predicted and Upper Bound subsidence cases.

- The alignment of creeks channels and drainage lines or delineation of catchment boundaries are not expected to significantly change as a result of subsidence for the Maximum Predicted and Upper Bound subsidence cases.

- Flood depths will not increase at any existing dwellings nor will flood hazard categories change at dwellings or on access tracks as a result of the proposed Stage 3 mining for the Maximum Predicted and Upper Bound subsidence cases.

- The duration of inundation during flooding events will generally not increase as a result of the proposed Stage 3 mining except at the junction of Cony Creek and Sandy Creek at the western edge of the proposed mining area. At this location the predicted increase in the time the land is flooded is not of sufficient duration to adversely impact on riparian vegetation or grasses in the area.

It is considered that potential surface water impacts above the proposed Stage 3 underground mining area are predictable and controllable.

In regard to groundwater, analysis of the existing groundwater regime and geology of the area as discussed in **Section 6.3** and **Appendix 14**, indicate that the potential for vertically interconnected cracking to extend from the mining goaf resulting from longwall extraction to the surface is negligible. Due to the geomorphology of the valley and the massive structure of the Branxton Formation that extends from the Greta Coal seam to the surface, the potential for upsidence or valley closure impacts to adversely impact on groundwater in the shallow alluvium is also considered to be negligible. As a result, it is considered that the proposed Stage 3 underground mining will not adversely impact on groundwater resources in the area.

A detailed groundwater monitoring program is proposed to record groundwater levels in the alluvium and underlying strata to monitor for any unexpected impacts. It is considered that potential groundwater impacts as a result of the proposed Stage 3 underground mining are predictable and controllable.

Soil and water management requirements for the proposed Surface infrastructure Site have been identified as set out in **Section 7.5** and **Appendix 15**. Potential impacts on soil and water resources at the Surface Infrastructure Site are predictable and controllable. A Soil and Water Management Plan providing detailed design of the soil and water management controls to be implemented, will be developed prior to commencement of construction of the site.

Flora and Fauna

As set out in **Section 6.6** and **Appendix 5**, flora and fauna assessments of the landform above the proposed Stage 3 underground mining area indicate that potential impacts on ecological values as a result of subsidence are likely to be low and will be controllable and manageable. An ongoing monitoring program of riparian habitats above the proposed Stage 3 mining area is proposed to document the condition of these habitats throughout the life of the proposed mining development.

The construction of the proposed Surface Infrastructure Site will result in loss of habitat for threatened flora species, Endangered Ecological Communities and native fauna. These impacts and potential consequences for native fauna and flora species are well understood and controllable as discussed in **Section 7.2** and **Appendix 5**. To minimise and offset this impact a series of clearing controls and requirements for habitat re-establishment in the form of the provision of nest boxes, have been developed. In addition a 17 hectare Bio-diversity Offset Area that is of equivalent or greater ecological value to the Surface Infrastructure Site has been identified on land that is owned by Austar and is contiguous with Werakata State Conservation Area.

Air Quality

Construction of the Surface Infrastructure Site and establishment of ventilation shafts at the site to ventilate the underground mine has the potential to impact on air quality of the immediately surrounding area. As set out in **Section 7.8** and **Appendix 17**, this potential impact is negligible and readily controlled.

Greenhouse Gas

A detailed Greenhouse Gas (GHG) and Energy assessment has been undertaken for the proposed Stage 3 development as set out in **Section 5.11** and **Appendix 10**. This assessment indicates that the energy value of the coal from the Greta seam to be mined is high (28 GJ/t) and as a result is likely to produce less GHG per unit of energy derived when burnt than other lower energy value coals. Analysis indicates that based on 2005 world coal production figures, combustion of coal from Stage 3 at full production of 3 Mtpa would produce approximately 0.0006% of the world's annual GHG emissions from the consumption of coal.

Greta seam coal in the proposed Stage 3 has low in-seam gas levels and as a result fugitive GHG emissions from the coal seam during extraction will be relatively low.

Analysis indicates that mining of coal using the LTCC equipment can extract approximately 61% more coal per unit of energy used than could be extracted using conventional longwall mining equipment that was previously used at the mine. As a result the LTCC process is highly energy efficient and results in less GHG being emitted per tonne of coal extracted.

As part of the proposed development, Austar will develop and maintain an internal energy and GHG management plan for Stage 3 operations with the focus on further reducing energy usage and GHG emissions over the life of the project.

Noise and Vibration

As set out in **Section 7.7** and **Appendix 16**, a detailed noise and vibration assessment has been undertaken for the construction and operation of the proposed Surface Infrastructure Site. This assessment indicates that noise and vibration aspects of the proposed development are well understood and controllable and that with the implementation of some minor noise and vibration controls will not have an adverse impact on surrounding residences.

Traffic and Transport

Construction and operation of the proposed Surface Infrastructure Site will effectively redirect mine traffic that is currently accessing Austar Coal Mine's Ellalong Drift and Pit Top off Middle Road, Paxton to Quorrobolong Road, Kitchener. As a result, the proposed development will not increase regional traffic. The potential impacts of this redirecting of traffic are well understood and predictable. Traffic impact assessment (GHD 2008) undertaken for the project as described in **Section 7.10** and **Appendix 10** indicates that traffic impacts are controllable and with the implementation of standard specified control measures will not have an adverse impact on traffic flows or traffic safety.

The development traffic using Quorrobolong Road to access the proposed Surface Infrastructure Site will be predominantly passenger vehicles transporting workers to and from the site with only a small number of heavy vehicles per day required for deliveries. As a result the proposed development is not expected to have a significant adverse impact on the structural capacity of the road pavements.

The GHD (2008) traffic assessment indicated that the intersection of Wollombi Road and West Avenue in Cessnock has an existing traffic problem that could be improved through some intersection works. Austar has undertaken to make a contribution to these works.

Aboriginal and Non-Aboriginal Heritage

Aboriginal (see **Appendix 6**) and non-Aboriginal (see **Appendix 7**) heritage surveys of the surface of the proposed Stage 3 underground mining area and the proposed Surface Infrastructure Site were undertaken as part of the environmental assessment for the proposed development. The surveys and assessment indicated that other than one axe grinding groove site, there were no heritage sites that were likely to be adversely affected by the proposed development.

Careful consideration and analysis of the axe grinding groove site and the rock strata on which it is located indicated that there is a potential that site could be cracked as a result of subsidence. In consultation with Aboriginal stakeholders and representatives of DECC it was agreed that any of the potential mitigation measures identified may not successfully prevent the grinding groove site from cracking.

Following further consultation it was agreed that once all relevant approvals were obtained for mining, Austar would contribute $100,000 to an Aboriginal project or program to be decided by Aboriginal stakeholders. In addition, Austar has committed to the development of Aboriginal Cultural Heritage Management Plan that sets out ongoing management and monitoring requirements for the Austar Mine Complex. A series of management and monitoring recommendations have also been developed for items of historic heritage. It is considered that with these controls and management measures in place the proposed development can be undertaken without having a significant adverse impact on the heritage of the area.

Visual Amenity

Analysis indicates that subsidence above the proposed Stage 3 underground mining area will tend to be relatively uniform and within the natural slope variability that currently exists in the area even at Upper Bound levels of subsidence predictions. Similarly analysis indicates that predicted subsidence is unlikely to significantly impact on vegetation or ecological habitats above the proposed mining area. As a result it is concluded that underground mining as proposed will not significantly change the visual amenity of the proposed Stage 3 mining area.

Visual assessment undertaken for the proposed Surface Infrastructure Site (see **Section 7.9**), has included the use of radial analysis and visual transects to identify potential vantage points in the surrounding area that may have views of the proposed Surface Infrastructure Site. Analysis indicates that only the winding tower which will be approximately 30 metres high will be visible from the north and is unlikely to be visible from any other direction due to the extensive visual screening that is provided by the forested areas surrounding the development site. When viewed from the north, the winder tower will be seen against a backdrop of green forested vegetation which it will be painted with an appropriate colour to blend into.

Security lighting and night lighting will be required at the site as it will operate 24 hours per day seven days be week. To minimise the potential for light spill it is proposed to keep lighting to the minimum height necessary to provide sufficient light and to direct all lighting into the Surface Infrastructure Site.

With these control measures in place, it is considered that the proposed construction and operation of the Surface Infrastructure Site will not adversely impact on the visual amenity of the surrounding area.

Social and Economic

The potential social and economic impacts and benefits of the proposed development have been considered throughout the environmental assessment process. This has included ongoing discussion with government agencies and the community since the mine was purchased by Austar in 2005. This consultation process has included briefings, meetings, one on one discussion with land holders, the provision of information material in the form of flyers and website material. This consultation process in conjunction with risk identification and assessment has been used to understand the potential socio-economic impacts of the proposed development.

Consultation with land holders, community and government agency representatives will be ongoing throughout the life of the mine and will include liaison with and through the Community Consultative Committee. Consultation will also occur through the ongoing development of Subsidence Management Plans and Property Subsidence Management Plans that will be developed in consultation with land holders and relevant government agencies. These Plans will detail control and mitigation measures to be implemented on a property by property basis.

As the proposed development is effectively an extension of the existing Austar mining operations and will effectively involve a relocation of workers from the Ellalong Drift and Pit Top to the proposed Surface Infrastructure Site, it is unlikely that the proposed development will result in an increased demand for infrastructure and services in the region. The proposed development will require the extension of water, sewerage, electricity and telecommunications to the proposed infrastructure site. These works will be funded by the project and are not expected to place an increased demand on community resources.

The proposed development will make a significant contribution to the local and regional economy through the ongoing direct employment of 200 to 275 people, annual turn over of $200 million to $400 million and generation of approximately $5.6 million in export revenue.

Southern Coalfield Inquiry

In exploring the potential risks and controls required for the proposed development, the findings of the Southern Coalfield Inquiry have also been taken into consideration. These have included:

- Establishing an envelope of acceptable subsidence impacts within which the Subsidence Management Plans will be developed to ensure that the risk of impacts remains within the envelope assessed and approved.

- Detailed consideration of potential subsidence impacts on natural features such as creek lines and identification of geological anomalies to help guide these considerations.

- Environmental assessments in regard to subsidence effects, impacts and consequences including:

  - extensive baseline subsidence monitoring data to guide assessment of impacts on significant natural features;
  - examination of subsidence effects, subsidence impacts and environmental consequences;
  - detailed and transparent explanation of subsidence impact assessment methods including quantification of anticipated subsidence impacts and consequences;
  - extensive discussion between subsidence engineers and archaeologists, ecologists, hydrologists and geomorphologists in assessing potential impacts;
  - peer review of subsidence predictions;
  - assessment of socio-economic benefits of the project;
  - provision of a Biodiversity Offset Area and an axe grinding groove offset strategy to address potential impacts that can’t be otherwise mitigated;
  - ongoing consultation with key government agencies and community stakeholders since the mine recommenced in 2005;
  - review of the acceptability of impacts in a risk-based decision making framework which includes environmental, economic and social framework and includes consideration of sustainability issues.

- Development and implementation of contingency plans to manage unpredicted impacts on significant natural features.

The environmental assessment undertaken for the proposed Stage 3 development has taken into consideration the matters set out in the DGRs and the relevant recommendations from the Southern Coalfield Inquiry. This assessment indicates that the proposed development can be undertaken in a predictable and controllable manner without having a significant adverse impact on the environment or surrounding community. Economic analysis indicates that the proposed development, if approved will continue to make a significant contribution to the local area, region and State economies.

9.5 Alternatives

9.5.1 Alternative of Not Proceeding

The alternative of not proceeding would result in the following not being realised:

- ongoing employment of 185 to 275 people for the life of Stage 3;
- ongoing benefit from the utilisation of existing Austar Mine Complex infrastructure;
- potential to extract 45.3 Mt of high quality/high energy coal worth in excess of $5.6 billion in a resource and energy efficient manner;
- annual revenue generation of approximately $200 million to $400 million per year with a significant component of this revenue being expended as operating costs for the mine which has significant local and regional direct and indirect flow on effects;
- ongoing benefit from use of approximately $800 million of existing rail infrastructure including Ellalong Drift and Pit Top, Pelton CHPP and Austar Branch Line. Ongoing benefit will also be derived through the continued use of South Maitland Railway; and
- ongoing management of groundwater levels in old workings to prevent the discharge of acid mine water from abandoned workings in the area surrounding Austar Mine Complex.

If Stage 3 does not proceed, the coal that would have been supplied to overseas export markets from Austar Coal Mine will be replaced with other coal resources that are likely to be of lower quality, require more energy to extract and result in greater GHG emissions in a global context.

Analysis of potential environmental risks and impacts as set out in **Sections 5**, **6** and **7** along with Austar commitments as set out **Section 8** indicate that the proposed Stage 3 development can be undertaken in a controlled and predictable manner without having a significant adverse impact on the surrounding area. Analysis also indicates that the proposed development will, if approved make a significant contribution to the local and regional economies. As a result, it is considered that the alternative of not proceeding is not preferred or warranted.

9.5.2 Alternative Mine Plan and Mining Technique

As outlined, the mine plan has been designed to optimise resource recovery. The geology of the area, and particularly the known fault zones that bound proposed Stage 3, has ultimately determined the conceptual mine layout for Stage 3 as shown on **Figure 1.3**. The mine plan as shown has been specifically and intentionally designed to maximise mine safety and resource extraction within the geological and physical constraints that bound the resource.

An alternative mine was that considered as part of the Bellbird South Extension (HLA 1995) which was approved by the Minister in 1996. This plan involved coal extraction to a maximum thickness of 4.5 metres which would leave up to 2.5 metres of high quality coal resource sterilised and not available for future extraction. In addition the Bellbird South Extension mine plan did not include the coal resource to the east of CML2 where the Greta Seam splits. Geological constraints to the east of the proposed Stage 3 mining area are such that if this coal is not extracted as part of the proposed Stage 3 it would also be sterilised as it would be uneconomic to mine this resource separately to Stage 3 due to the short length that the longwall panels would need to be to fit within the geological constraints.

As a result, adoption of the mine plan formerly proposed for the Bellbird South extension would result in a significant high quality coal resource being sterilised. Consequently the conceptual mine plan for Stage 3 as shown on **Figure 1.3**, which seeks to efficiently extract all the identified viable coal resource is preferred.

Additional coal resource also exists to the south of proposed Longwall 17 where the resource extends under Sandy Creek Road. Coal in this area is at a depth of approximately 700 metres and is at the limit of what is currently considered to be an extractable depth using currently available technology. Better understanding of mining requirements and improvements to technology are likely to occur over the life of the proposed Stage 3 mining operation and as a result mining at depths of greater than 700 metres is likely to be feasible in the future. The proposed mine plan will not sterilise future access to this further coal resource.

9.5.3 Alternative to Proposed Surface Infrastructure Site

New upcast and downcast shafts will be required to provide for the ventilation needs of Stage 3 as the locations of current ventilation shafts are such that only Stage 2 operations can be adequately ventilated using the existing system. The possible locations of the new shafts are restricted to coinciding with the location of main headings to ensure that adequate ventilation can be achieved. An alternative would be to only construct the ventilation shafts at the proposed Surface Infrastructure Site and continue to access the proposed Stage 3 mining area from Ellalong Drift and Pit Top.

This alternative could be undertaken but would result in increased underground travel times for miners of up to 2 hours per shift with the proposed Stage 3 area approximately 14 kilometres travel distance from Ellalong Drift and Pit Top. This would mean that the effective work time per shift would be reduced significantly impacting on the efficiency of the underground mining operation. It would also result in greater time required to evacuate workers from underground should the need arise. From an energy perspective, it would mean that vehicles used to transport workers underground would also travel greater distances and use more energy per tonne of coal mined increasing energy usage and resultant GHG emissions. For these reasons continued access from Ellalong Drift and Pit Top to service the proposed Stage 3 underground mining is not preferred.

Another alternative to the proposal for the Surface Infrastructure Site would be to bring coal to the surface at this site rather than continuing to convey coal underground and then bringing it to the surface at Ellalong Drift and Pit Top. Bring coal to the surface at the proposed Surface Infrastructure Site would reduce the distance that coal need to be transported underground but would require the construction of a new CHPP and coal transport facilities. This would require substantially greater development footprint on the site and significant investment in terms of coal handling and preparation equipment and rail transport infrastructure. Given the above considerations and proximity of the site to Werakata State Conservation Area, bringing coal to the surface at the proposed Surface Infrastructure Site is not preferred and not considered to be feasible.

The proposed Surface Infrastructure Site is located over the main headings, the location of which is controlled by geological faults and is on land owned by Austar Coal Mine. The site has been identified as a potential infrastructure site for Austar Coal Mining operations for many years. No alternate sites that would provide appropriate ventilation and access to proposed Stage 3 workings have been identified. The site is relatively close to necessary services including road access, sewer, water and electricity infrastructure, all of which can be provided without substantial disturbance or impact.

The site is remote and screened from surrounding residential areas and rural properties and as a consequence can be constructed and operated with minimal impact on surrounding areas. The scale of the proposed development on the Surface Infrastructure Site is such that adequate buffers can be maintained to the surrounding Werakata State Conservation Area and the development can be implemented without having a significant impact on EECs, threatened species or drainage lines.

As stated, the preferred option is to construct the Surface Infrastructure Site as proposed. This will enable the existing coal handling, processing and transport infrastructure at Austar Mine Complex to continue to be utilised whilst providing adequate ventilation and safe and efficient access to Stage 3 underground workings for employees and materials

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11.0 Abbreviations and Glossary

11.1 Abbreviations

μS/cm	microseimens per centimetre
ACHMP	Aboriginal Cultural Heritage Management Plan
ACM	Austar Coal Mine
ADO	automotive diesel oil
AEMR	Annual Environmental Management Report
AFC	armoured face conveyor
AHD	Australian height datum
AHIMS	Aboriginal Heritage Information Management System
ALS	aerial laser survey
AR&R	Australian Rainfall and Runoff
ARI	average recurrence interval
Austar	Austar Coal Mine
BMP	Bushfire Management Plan
BoM	Bureau of Meteorology
CCO	Chemical Control Order
CHPP	coal handling and preparation plant
CMHS Act	Coal Mine Health and Safety Act 2002
CMHS Regulation	Coal Mine Health and Safety Regulation 2006
CML2	Consolidated Mining Lease 2
CPRS	Carbon Pollution Reduction System
CSCP	Cessnock Social and Community Plan November 2004 to November 2009
CWSS	Cessnock City Wide Settlement Strategy 2004
DA	Development Application
DCP	Development Control Plan

DECC	Department of Environment and Climate Change
DEWHA	Department of Environment, Water, Heritage and the Arts
DEWR	Department of Environment and Water Resources
DGRs	Director-General's Requirements
DoP	Department of Planning
DPI	Department of Primary Industries
DTM	digital terrain model
DUAP	Department of Urban Affairs and Planning (former, now Department of Planning)
DWE	Department of Water and Energy
EA	environmental assessment
EECs	endangered ecological communities
EF	emission factors
EHC Act	Environmentally Hazardous Chemicals Act 1985
EIS	environmental impact statement
EMP	Environmental Monitoring Program
ENM	environmental noise model
EPA	Environment Protection Authority of NSW (former, now DECC)
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)
EPL	Environment Protection Licence
ESD	ecologically sustainable development
FM Act	Fisheries Management Act 1994 (NSW)
GHG	greenhouse gas
GHGEA	Greenhouse Gas and Energy Assessment
GTK	gross tonnes per kilometre
ha	hectares
HREP	Hunter Regional Environmental Plan 1989

HVAS	high volume air sampler
IBRA	Interim Biogeographic Regionalisation for Australia
ICOMOS	International Council for Monuments and Sites
ILUA	Indigenous Land Use Agreement
INP	Industrial Noise Policy
IPM	Incremental Profile Method
KTP	key threatening process
kV	kilovolt (1000 volts)
L/sec	litres per second
LEP	Local Environment Plan
LHRCP	Lower Hunter Regional Conservation Plan 2006
LHRS	Lower Hunter Regional Strategy 2006
LGA	Local Government Area
LTCC	Longwall Top Coal Caving
LW	longwall
m	metres
m^2	metres squared
m/s	metre per second
ML	Mining Lease
mm	millimetres
mm/m	millimetres per metre
MOP	Mining Operations Plan
MSB	Mine Subsidence Board
MSEC	Mine Subsidence Engineering Consultants Pty Ltd
Mt	mega tonne (one million tonnes)
Mtpa	million tonnes per annum
MVA	Megavolt ampere
NGERS	National Greenhouse and Energy Reporting System

NMVOCs	non-methane volatile organic compounds
NNTR	National Native Title Register
NPE Bill	National Park Estate (Lower Hunter Region Reservations) Bill 2006
NPWS	National Parks and Wildlife Service
NT Act	Native Title Act 1993
OTDR	Optical Time Domain Reflector
PEA	Preliminary Environmental Assessment
PoEO Act	Protection of the Environment Operations Act 1997 (NSW)
PRP	Pollution Reduction Program
PSMP	Property Subsidence Management Plan
RCP	Regional Conservation Plan
RL	reduced level
ROM	run of mine
ROTAP	rare or threatened Australian plant
RTA	Roads and Traffic Authority
SCA	State Conservation Area
SCT	SCT Operations Pty Ltd
SEPP	State Environmental Planning Policy
SISD	Safe Intersection Site Distance
SMP	Subsidence Management Plan
SRA	State Rail Authority (NSW)
SWMP	Site Water Management Plan
tpa	tonnes per annum
TSC Act	Threatened Species Conservation Act 1995 (NSW)
Umwelt	Umwelt (Australia) Pty Limited
UNFCCC	United Nations Framework Convention on Climate Change
WMA	Water Management Act 2000 (NSW)
Yancoal	Yancoal Australia Pty Limited

Yanzhou	Yanzhou Coal Mining Company Limited

11.2 Glossary

AHD:	Australian Height Datum.
Alluvium:	Sediment deposited by a flowing stream, e.g., clay, silt, sand, etc.
Amenities:	Lunch room, showers, toilets.
Amenity:	An agreeable feature, facility or service which makes for a comfortable and pleasant life.
Aquifer:	A water-bearing rock formation.
Arboreal:	Adapted for living and moving around in trees.
Archaeological:	Pertaining to the study of culture and description of its remains.
Average Recurrence Interval (ARI):	The statistically calculated interval likely to be exceeded once in a given period of time. A term used in hydrology, also known as return period.
Background Noise:	Existing noise in the absence of the sound under investigation and all other extraneous sounds.
Catchment Area:	The area from which a river or stream receives its water.
Coal Reserves:	Those parts of the Coal Resources for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken.
Coal Resources:	All of the potentially useable coal in a defined area, based on geological data at certain points and extrapolations from these points.
Conglomerate:	A rock type comprising greater than 50 per cent rounded water-worn fragments (>2 mm in size) of rock or pebbles cemented together by another mineral substance.
Conservation:	The management of natural resources in a way that will preserve them for the benefit of both present and future generations.
Cumulative Subsidence	The accumulated subsidence, tilts, curvatures and strains which occur due to the extraction of all longwalls within a single seam.
dB (Decibel)	A unit for expressing the relative intensity of sounds on a logarithmic scale from zero (for average least perceptible sound) to about 130 (for the average pain level).
dBA	A modified decibel scale which is weighted to take account of the frequency response of the normal human ear.
Dip:	The direction in which rock strata is inclined.

Drift	A tunnel used to access coal resources.
Ecology:	The science dealing with the relationships between organisms and their environment.
Ecosystem:	Organisms of a community together with its non-living components through which energy and matter flow.
Effluent:	The liquid waste of sewage and industrial processes.
Electrical Conductivity:	The measure of electrical conduction through water or a soil-water suspension generally measured in millisiemens per centimetre or microsiemens per centimetre. An approximate measure of soil or water salinity.
Environmental Planning and Assessment Act 1979:	NSW Government Act to provide for the orderly development of land in NSW.
Environment Protection and Biodiversity Conservation Act 1999:	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.
Fault:	A fracture or fracture zone along which there has been displacement of the sides relative to one another. Displacement can be vertical and/or horizontal.
Fauna:	All vertebrate animal life of a given time and place.
Floodplain:	Large flat area of land adjacent to a stream which is inundated during times of high flow.
Flora:	All vascular plant life of a given time and place.
Geology:	Science relating to the earth, the rocks of which it is composed and the changes it undergoes.
Geotechnical:	Relates to the form, arrangement and structure of geology.
Groundwater:	Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table.
Habitat:	The environment in which a plant or animal lives; often described in terms of geography and climate.
Indigenous:	Native to, or originating in, a particular region or country.
kV (Kilo Volt):	One thousand volts.
L_{A1} Noise Level:	The noise level exceeded for one per cent of the time. It is used in assessment of sleep disturbance.

L_{A10} Noise Level: The noise level, measured in dB(A), which is exceeded for 10 per cent of the time, which is approximately the average of the maximum noise levels.

L_{A90} Noise Level: The noise level, measured in dB(A), exceeded for 90 per cent of the time, which is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.

L_{Aeq} Noise Level: The average noise energy, measured in dB(A), during a measurement period.

L_{AMax} Noise Level: The maximum noise energy, measured in dB(A), during a measurement period.

Landform: Sections of the earth's surface which have a definable appearance (e.g. cliff, valley, mountain range, plain, etc).

Mean: The average value of a particular set of numbers.

Megalitre (ML): One million litres.

Meteorology: Science dealing with atmospheric phenomena and weather.

Mitigate: To lessen in force, intensity or harshness. To moderate in severity.

Native: Belonging to the natural flora or fauna in a region.

Outcrop: Bedrock exposed at the ground surface.

Particulates: Fine solid particles which remain individually dispersed in gases.

Peak Discharge: Maximum discharge down a stream following a storm event.

pH: Scale used to express acidity and alkalinity. Values range from 0-14 with seven representing neutrality. Numbers from seven to zero represent increasing acidity whilst seven to fourteen represent increasing alkalinity.

Piezometer: A small diameter bore lined with a slotted tube used for determining the standing water level of groundwaters.

Protection of the Environment Operations Act 1997: NSW legislation administered by DEC that regulates discharges to land, air and water.

Rehabilitation: The process of restoring to a condition of usefulness. In regard to quarrying, relates to restoration of land from a degraded or quarried condition to a stable and vegetated landform.

Revegetation: The process of re-establishing vegetation cover.

Run of mine (ROM): Bulk material extracted from a mine, before it is processed in any way.

Salinity: A measure of the concentration of dissolved solids in water.

Seam: An identifiable discrete coal unit.

Sedimentation: Deposition or settling of materials by means of water, ice or wind action.

Sediment Dam: A dam built to retard dirty runoff to allow sediment to settle out before allowing clean water discharge.

Socio-economic: Combination of social and economic factors.

Sound Power Level: The total sound energy radiated per unit time measured as 10 times a logarithmic scale, the reference power being 12 picowatts.

Spontaneous Combustion: Spontaneous ignition of some or all of a combustible material.

Surface Infrastructure: Any man made object, facility or structure on the surface of the land.

Tailings: Fine residual waste material separated in the coal preparation process.

Topography: Description of all the physical features of an area of land and their relative positions, either in words or by way of a map.

Total Suspended Particulates (TSP): A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre ($\mu g/m^3$) for air.

Woodland: Land covered by trees that do not form a closed canopy.