Section 2

Description of the Longwall Project

This section introduces the Proponent's objectives for the progression of the Narrabri Coal Mine from a 2.5Mtpa continuous miner operation (Stage 1) to an 8Mtpa longwall mining operation (Stage 2).

The local geology and coal resource within the Mine Site is described and the proposed Stage 2 longwall mining operations and sequence ("the Longwall Project") are described. This section also describes the proposed coal processing and product coal transport activities, hours of operation, infrastructure and services, safety management, waste management and progressive and final rehabilitation associated with the Project, with emphasis placed on any modification to the approved activities of Project Approval (PA) 05_0102.

The Longwall Project is described in sufficient detail to provide the reader with an overall understanding of the nature and extent of the activities proposed, how the various activities would be undertaken and to enable an assessment of the potential impacts on the surrounding environment. The boundaries of the various components described throughout this section are indicative. Where dimensional information is provided, it needs to be recognised as indicative only.

Details of the safeguards and management measures that the Proponent proposes to implement to minimise or negate the potential impacts on surface water, groundwater, soil, noise, air quality, Aboriginal heritage, flora and fauna and other components of the local environment are provided in Section 4B of this document.

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2.1 INTRODUCTION

2.1.1 Objectives

The Proponent's objectives for the proposed development and operation of the Stage 2 longwall mining project at the Narrabri Coal Mine are to:

i) develop and safely operate a productive longwall mine producing up to 8 million tonnes of low ash, thermal coal each year;

ii) progress to the elevated production levels, ie. greater than the approved 2.5Mtpa, at the earliest possible date to maintain the Proponent's coal production levels in the Gunnedah Basin;

iii) continue to supply international markets for the coal produced;

iv) develop and operate the mine in a manner that complies with all statutory requirements;

v) undertake all activities in an environmentally responsible manner, employing a level of control and integrating safeguards that would ensure compliance with appropriate criteria/goals and/or reasonable community expectations at all times;

vi) design and construct additional surface infrastructure that would minimise surface disturbance and would serve the mine for the foreseeable future;

vii) monitor and manage surface subsidence to ensure impacts on the local environment are minimised;

viii) monitor and manage mine ventilation to ensure a safe working environment is maintained and impacts on the local environment are minimised;

ix) maintain and increase the stimulus to the local economies of Narrabri, Boggabri and Gunnedah and their surrounding districts through employment and service supply opportunities related to the operation of the coal mine;

x) achieve the above objectives in a cost-effective manner and thereby ensure the ongoing viability of the proposed mining operation; and

xi) provide for ongoing monitoring of local environmental parameters such as groundwater, air quality and noise to ensure adverse impacts are minimised.

2.1.2 Overview of the Longwall Project

The Proponent proposes to convert the approved Narrabri Coal Mine from a continuous miner operation with an approved annual production rate of 2.5Mtpa to a longwall mining operation with a maximum annual production rate of 8Mtpa. **Figures 2.1** and **2.2** identify the critical surface and underground components of the proposed longwall mining operation. **Figures 2.1** and **2.2** differentiate between those activities or infrastructure already approved for the Stage 1 operations and those proposed for the Stage 2, longwall operations.

Longwall Mining

Longwall mining would involve the sequential development of sets of heading gate roads approximately 305m apart oriented north-south from the main mine headings ("West Mains") and developed for the full distance to the northern and southern boundaries of ML 1609 (up to 4.1km). Once each set of dual roadways are fully developed, the longwall equipment would be installed and the coal recovered as the longwall unit retreats back between the two sets of roadways towards the West Mains. All coal would be conveyed back to the Pit Bottom Area for transfer to the surface via the approved conveyor drift.

The longwall unit would recover 4.2m of coal from the lower part of the Hoskissons Coal Seam (leaving up to 5.2m of lesser quality coal in-situ) retreating at a rate of approximately 15m per day. At this rate, each longwall panel would take approximately 1 year to complete. Based on the proposed mining schedule, there could be up to three longwall panels being prepared (gate road development) or mined (longwall unit retreat) at any one time.

Mine Ventilation and Gas Drainage

The gas composition of the Hoskissons Coal Seam (which has a measured gas content range from $3.5m^3/t$ to $7.5m^3/t$) is predicted to vary considerably, however, for planning purposes and subject to further data becoming available, it is assumed to be an average of 90% CO_2 and 10% CH_4. The porous coarse grained sandstone floor of the Hoskissons Coal Seam would also be a source of gas within the underground workings.

Pre-drainage of the coal seam would need to be undertaken to reduce the gas content to less than $5.0m^3/t$ for the management of outbursts and rib emission prior to the development of each longwall panel. Pre-drainage would be undertaken using Surface to In-Seam boreholes drilled from the surface and / or conventional underground boreholes.

As the three mine drifts, dual gate road headings and longwall panels are developed, the mine ventilation system would be progressively upgraded to prevent gas build-up within the underground workings, thereby providing for safe working conditions and minimising the risk of outburst or spontaneous combustion.

As the longwall unit retreats, and the remaining section of the seam collapses, the gas accumulating in the goaf would also be drained. Goaf gas drainage would be completed either by re-using the SIS system used for pre-draining the gas from the panel to be developed, or by the development of additional bores from surface into the collapsed panel, with the gas drawn out the goaf by the installation and operation of a mobile vacuum plant at the top of each bore.

Mine Dewatering and Management

As groundwater seeps into the underground workings, it would be diverted to underground sumps from where it would be pumped to the surface into Dam A1 of the water management area within the rail loop (**Figure 2.2**). A proportion of this ‘raw’ groundwater, which is expected to be saline (Total Dissolved Solids (TDS) of up to 8 000mg/L), would be pumped from Dam A1 for use within the Pit Top Area, ie. coal washing and dust suppression. Water would also be required for use underground, ie. dust suppression and equipment cooling, with fresh water (TDS≤500mg/L) required for these activities. In order to improve the water quality for use underground, the approved Water Conditioning Plant (incorporating both micro-filtration and reverse osmosis processes) would be constructed and operated. Water discharged into Dam A1 would be pumped to the Water Conditioning Plant, with the treated water (“raffinate”) discharged to Dams C and D. The waste ‘brine’, which is expected to have a salinity approximating that of seawater, would be pumped to Dams A2, A3 and B for initial storage.

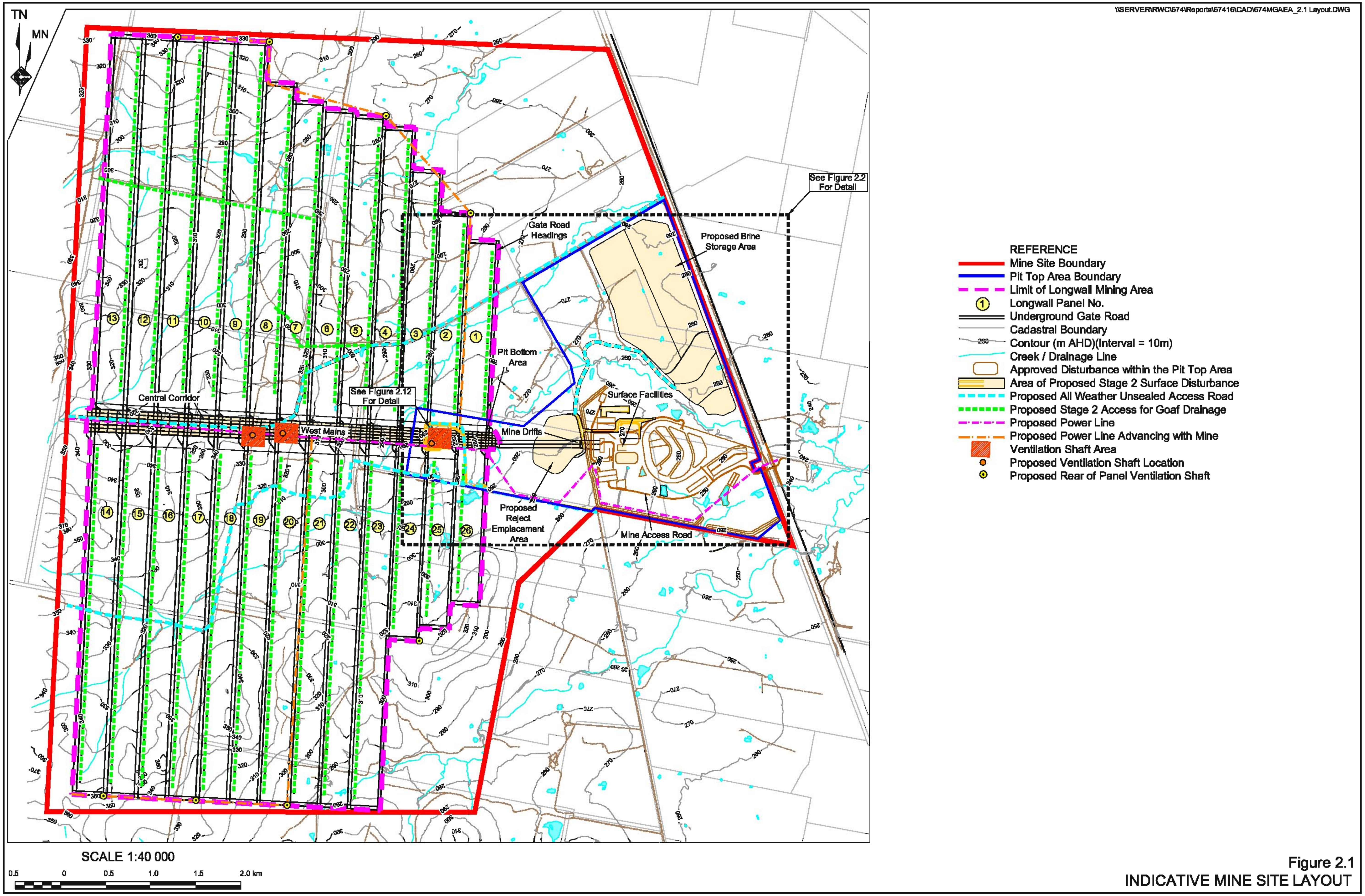

Figure 2.1
INDICATIVE MINE SITE LAYOUT

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\\SERVER\RWC\674\Reports\67416\CAD\674MGAEA_2.2 Pit Top.DWG

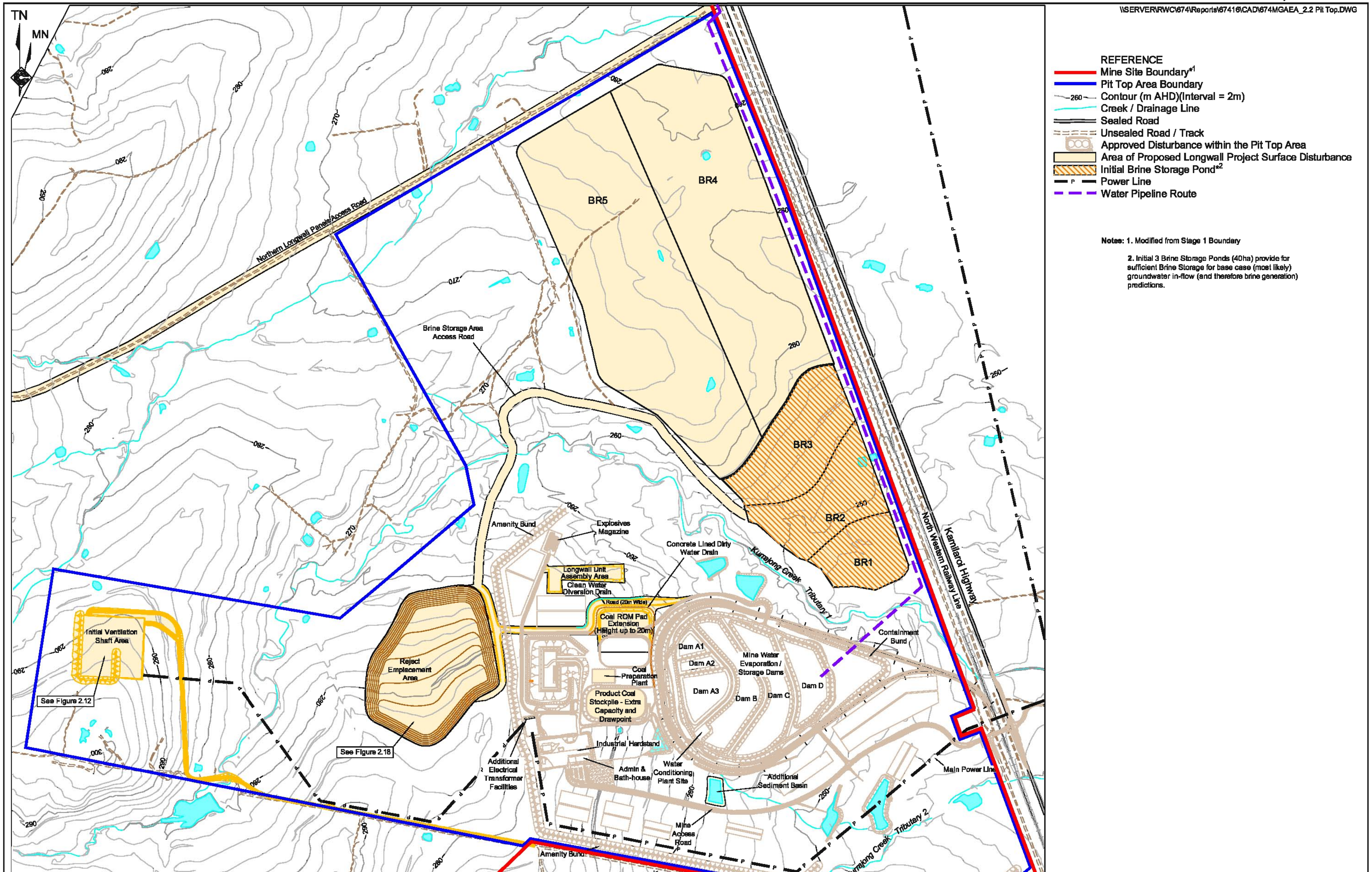

Figure 2.2
PIT TOP AREA LONGWALL PROJECT COMPONENTS

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The Proponent would process all dewatered groundwater not required for Pit Top Area activities through the Water Conditioning Plant. It is proposed to discharge the excess raffinate to the Namoi River although as indicated above investigations are proceeding into other potential uses. The additional brine, in excess of that which can be stored within Dams A2, A3 and B, would be pumped to and stored within an additional storage facility to be constructed (progressively) to the north of Kurrajong Creek Tributary 2 (Brine Storage Area) (see **Figures 2.1** and **2.2**). The Brine Storage Area would incorporate a series of ponds, which would be constructed as required throughout the life of the Longwall Project. The initial three ponds (BR1, BR2 and BR3 which cover an area of 40ha) have sufficient capacity to store brine generated by the predicted base case (most likely) dewatering requirements of the Longwall Project. The additional area of the Brine Storage Area (BR4 and BR5), would provide additional storage capacity in the event that dewatering requirements exceed those predicted by base case groundwater modelling.

Additionally, it was identified that as the volume of groundwater to be dewatered increased in the initial years of the mine's operation there was insufficient water make to meet the operational requirements of the mine. The Proponent proposes to source additional sources of water from water licences acquired from the Namoi River, Namoi alluvium and/or the Great Artesian Basin.

At the completion of underground mining, the stored brine would be pumped back into the goaf areas and remaining gate roads of the completed longwall panels and the Brine Storage Area rehabilitated. The Proponent is also investigating the potential to progressively pump the brine into the completed goaf areas of the mine as the direction of mining progresses up-dip (west to east, ie. LW14 to LW26). This would target the transfer of all brine underground by the cessation of mining in approximately 30 years.

Coal Transfer to Surface and Processing

Transportation of the mined coal to the ROM coal stockpile would continue to be via the conveyor drift from the Pit Bottom Area to the box cut within the Pit Top Area. From the box cut excavation, the ROM coal would be transported to the ROM coal stockpile area by conveyor from where it would be sent to the Coal Preparation Plant.

Coal Processing and Reject Management

The ROM coal would be drawn from the ROM coal stockpiles via one of two reclaim valves and tunnels from where it would be fed to a rotary breaker for size reduction. The broken coal would then be transferred to a dry screen with the <16mm coal transferred directly to the product coal stockpile area and the remainder transferred to the Coal Preparation Plant where the coal would be washed and coarse and fine reject screened off. The fine and ultra-fine reject would be dewatered to produce a filter cake which would be disposed of in combination with the coarse coal reject. The washed coal would be transferred to the product coal stockpile area from where it would ultimately be loaded into train wagons for transport from the Mine Site.

The Coal Preparation Plant is expected to remove up to 5% of the total ROM feed as reject, which would be predominantly rock from the floor of the mine workings. Approximately 90% of the reject would be coarse reject and the remainder comprising the filter cake, with both reject streams stockpiled within a reject pile. From the reject pile, the consolidated reject would be transferred to a Reject Emplacement Area on the north-facing side of a low ridge immediately to the west of the box cut. The proposed maximum footprint of the Reject Emplacement Area is approximately 25ha, however, it would be constructed progressively as a series of elongated (north-south oriented) cells in a westerly direction. The emplacement would be constructed against the slope of the ridge, rising to a maximum of 15m above the natural surface level.

Transportation

The product coal would be drawn from stockpiles via three reclaim valves and tunnels and conveyed to the train load-out bin. The loading of product coal via the drawdown valves and train load-out bin would be fully automated with batches drawn from the stockpiles and loaded into train wagons on the Narrabri Coal Rail Siding.

Rehabilitation

Rehabilitation of the Mine Site would involve activities in five distinct areas.

1. Pit Top Area infrastructure.

   All surface infrastructure, with the exception of the mine access road and rail infrastructure, would be decommissioned, dismantled and removed from the Mine Site. The disturbed areas of the Pit Top Area would be backfilled where appropriate, eg. box cut and underground water storage dams (after dam lining and saline material is removed), profiled, covered with available topsoil and revegetated with either pasture grass species or native tree, shrub and grass species (depending on final landform and land use requirements).

2. Reject Emplacement Area.

   As the permanent 14^{o} batters of each cell of the Reject Emplacement Area are formed, they would be progressively capped with the previously stripped subsoil and topsoil. On completion of each cell to the nominated 15m height, the top surface would be profiled and revegetated with a fast growing cover crop.

3. Water and brine storage ponds.

   Following dewatering of the ponds, the plastic liner of each pond would be removed and transported to a waste disposal facility. Following testing to confirm there have been no breaches in the liner the ponds would be backfilled, profiled, re-topsoiled and revegetated with pasture species to create a landform comparable with the surrounding topography.

4. Ventilation and gas drainage infrastructure.

   The ventilation and gas drainage infrastructure would be rehabilitated in much the same fashion as the Pit Top Area, albeit on a smaller and more widespread scale. When facilities are no longer required, they would be progressively rehabilitated.

5. Surface cracking caused by subsidence.

   The disturbance resultant from any surface cracking caused by subsidence would be progressively rehabilitated. For smaller width cracking, the surface would simply be ripped to allow the cracks to be filled in. In some instances, the surface cracking may be too wide to be effectively in-filled by surface ripping and in these instances, material excavated from within the footprint of the Reject Emplacement Area would be used to in-fill the cracks prior to ripping and revegetation.

In addition to these principal activities, the mine would continue to be operated with comprehensive systems to manage groundwater, surface water, noise, air quality and visibility. These systems are detailed in Section 4B.

As noted in Section 1.1, some components of the Stage 2 Longwall Project are intended to commence prior to other Stage 2 components in order to maintain schedules for coal production from the Narrabri Coal Mine. The Stage 2 components to be brought forward include the following.

- The construction (but not operation of) the coal processing plant.
- The construction and use of a ventilation shaft (the West Mains ventilation shaft) and associated surface infrastructure.
- Development of the rear of panel ventilation shaft.
- Development and operation of gas (and potentially water) pre-drainage infrastructure involving drilling into and along the coal seam from the surface within longwall panels LW1 to LW3.

Approval to bring forward the commencement of these components is the subject of an application to modify the Stage 1 Project Approval.

2.1.3 Mine Site Layout

Figures 2.1 and **2.2** presents the Mine Site layout and identifies the following components with the new components associated with the Longwall Project separately distinguished. The Mine Site boundary coincides with the boundary of ML 1609.

- The Pit Top Area[1].
- The box cut for the transport and conveyor drift portals.
- Surface buildings (including the Coal Processing Plant).
- The Reject Emplacement Area.
- Approved rail loop.
- Water Conditioning Plant.
- Storage Dams A1 to D within the rail loop for the storage of dewatered groundwater and the products of the Water Conditioning Plant, ie. raffinate (fresh water) and brine.
- The Brine Storage Area.
- The initial ventilation shaft area.

[1] For the purposes of describing the proposed activities, the Pit Top Area encompasses all surface infrastructure except for the various ventilation shafts and disturbance associated with mine ventilation and gas drainage. This includes the Mine Access Road, the rail loop, the ROM and product coal pads, coal preparation plant, Reject Emplacement Area, box cut and drift portals, and all surface buildings and service infrastructure.

- A Central Corridor within which additional ventilation shafts and installation of power lines to supply these would be constructed. The Central Corridor would also provide a single access path for all other access tracks required for the installation and management of Surface to In-seam (SIS) pre-drainage, goaf gas drainage and any surface cracking caused by subsidence.
- The underground mine workings including:
  - the Pit Bottom Area and conveyor, transport and ventilation drifts;
  - West Mains: up to seven east-west oriented headings from which the main north-south gate road headings and longwall panels would be developed;
  - gate road headings: developed from the West Mains to define the extent of the longwall panel (two gate roads on each side of each longwall panel);
  - Longwall Panels: the mining areas defined by the gate road headings.
- The proposed location of additional ventilation shafts and fans, power lines, internal roads and goaf drainage corridors.

2.1.4 Approvals Required

The Longwall Project would be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. As such, the Minister for Planning is the approval authority for the issue of a project approval. The initial application for project approval for the Stage 2 Longwall Project was made on 9 October 2008 (application number MP 08_0144). A modified application was made on 18 August 2009 to reflect the inclusion of additional project components and an increase in the project's capital investment value. The Proponent intends to lodge an application in accordance with the provisions of Section 75W of the *Environmental Planning and Assessment Act 1979* to allow the early commencement of those components outlined in Section 2.1.2.

The following licences and leases, additional to those encompassed by the project approval process, would be required for the Longwall Project.

Environment Protection Licence 12789 – Department of Environment and Climate Change.
The Proponent holds Environment Protection Licence No. 12789 for the Narrabri Coal Mine and this would require variation under Section 58 of the *Protection of the Environment Operations Act 1997* should the Longwall Project be approved.

Mining Lease – Department of Primary Industries (Mineral Resources)
The Proponent holds Mining Lease (ML) No. 1609 which entitles the Proponent to recover coal from the Hoskissons Coal Seam. A small variation to ML 1609 would be required to extend the area without surface restriction to enable the construction of the Reject Emplacement Area and Brine Storage Area and use of selected areas of the surface above the underground mining area for gas drainage purposes.

Water Licence – Department of Water and Energy
A licence is required under Section 116 of the *Water Act 1912* to permit the extraction of groundwater during mining activities. Additionally, water licences would be required for water supplies during the initial years of operation of the mine.

A licence is also required under the *Water Management Act 2000* should the Longwall Project result in any loss in water within aquifers for which a Water Sharing Plan is current. The Proponent currently holds WAL AL811436 for 248MLpa within the Intake Beds of the Great Artesian Basin Groundwater Source, as well as a 818ML Licence granted under the *Water Act 1912* (No. 90BL254679)

Further approvals and notifications would be required in accordance with the *Coal Mines Health and Safety Act 2002*, relating to the commencement of longwall mining operations.

The Proponent would ensure all additional buildings constructed on the Mine Site are approved and/or certified by Narrabri Shire Council.

2.1.5 Longwall Project Timetable

Table 2.1 provides an indicative Longwall Project timetable currently being followed by the Proponent, from the submission of an application for project approval in October 2008, through to the commencement of longwall mining in January 2011.

Table 2.1
Indicative Timetable for Longwall Project Progression

Activity	Indicative Timing
Submission of the Proponent's application for project approval	9 October 2008
Planning Focus Meeting	2 September 2008
Receive Director-General's Requirements.	7 October 2008
Complete Community Consultation	15 May 2009
Submit *Environmental Assessment* for adequacy assessment	31 August 2009
Submit *Environmental Assessment* for public exhibition	17 November 2009
Environmental Assessment exhibition period	18 November 2009 to 6 January 2010
Narrabri Coal Project Stage 1 surface facilities completed	November 2009
Narrabri Coal Mine Pit Bottom established	November 2009
Narrabri Coal Mine Stage 1 coal production commences	December 2009
Compilation of submissions and preparation of response	January 2010
Lodgement of final Statement of Commitments and Preferred Project Report (if necessary)	February 2010
Compilation of Director-General's Environmental Assessment Report	February 2010
Longwall Project Approval Determination	March 2010
Longwall unit brought onto Mine Site and assembled	October 2010
Roadways for Longwall Panel 1 completed	December 2010
Longwall mining commences	January 2011

2.2 GEOLOGICAL AND RESOURCE ASSESSMENT

2.2.1 Regional Geology

An overview of the regional geological setting is provided as background for both:

i) the resource assessment of Section 2.2.5; and

ii) to introduce the various rock units above and below the coal seam to be mined and which are referred to in the hydrogeological assessment of the Stage 2 Longwall Project.

The Narrabri Coal Mine is located within the Permo-Triassic Gunnedah Basin, which forms the central part of the north-south elongate Sydney-Gunnedah-Bowen Basin system. The Narrabri Coal Mine is located in the near the northwestern boundary of the Gunnedah Basin and the eastern margin of the Surat Basin, a sub-basin of the larger Great Artesian Basin. Hence, the rocks and sediments beneath and surrounding the Mine Site can be grouped into:

- undifferentiated Quaternary sediments;
- Jurassic Surat Basin sequence; and
- the Gunnedah Basin sequence.

The Boggabri Ridge, comprising Early Permian volcanic rocks, forms the basement of the Gunnedah Basin and divides the basin into two parts, the Maules Creek sub-basin to the east, and the Mullaley Sub-basin to the west (see **Figure 2.3**).

The Mine Site is located within the Mullaley Sub-basin which contains Permian and Triassic sedimentary and volcanic rocks. The rocks strike approximately north-south and dip to the west at an angle of less than 10°. In the area of ML 1609, adjacent to the Boggabri Ridge, there is a local angular unconformity between the Late Permian Black Jack Group and the overlying Triassic Digby Formation.

The western part of ML 1609 is unconformably overlain by Jurassic sedimentary and volcanic rocks along the eastern margin of the Oxley Embayment, a part of the Surat Basin.

2.2.2 Local Geology and Stratigraphy

The rocks throughout ML 1609 strike north-south and dip gently to the west. Minor variations to the north-south strike may be the result of variable thickness and compaction of the sedimentary units being draped over the faulted and uneven surface on the underlying Boggabri Volcanics. To the east of ML 1609, the Boggabri Volcanics have been uplifted and faulted along a north-south trending anticlinal structure, the Boggabri Ridge. The proximity of ML 1609 to the Boggabri Ridge is a major control on the outcrop and structure of the local geology. **Figure 2.4** presents an east-west cross-section through ML 1609, based on the DMR 1:100 000 Gunnedah Basin Northern Sheet map, and illustrates the stratigraphic sequence. Each unit in the sequence is described in the following text.

Quaternary Sediments

Undifferentiated Quaternary alluvial gravel, sand silt and clay overly the Jurassic and Triassic rocks. These sediments are present in the east and northeast of the Mine Site associated with the Namoi River.

Surat Basin (Great Artesian Basin) Sequence (Jurassic)

The Pilliga Sandstone crops out along the western margin of ML 1609. It is up to 60m thick, (DME Narrabri DDH-30), and consists of medium bedded, cross-bedded, well sorted, fine to coarse grained quartz sandstone.

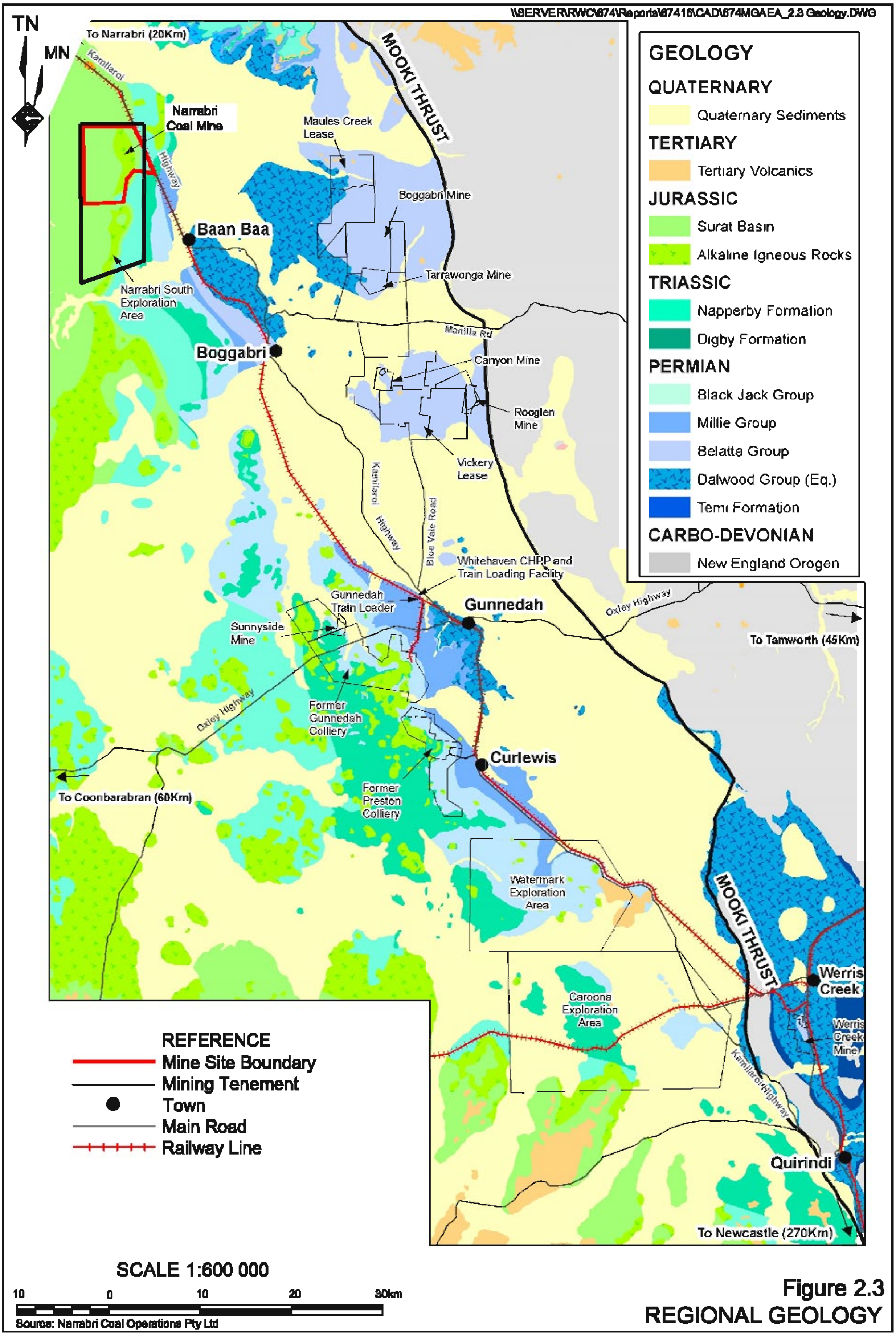


Figure 2.3
REGIONAL GEOLOGY

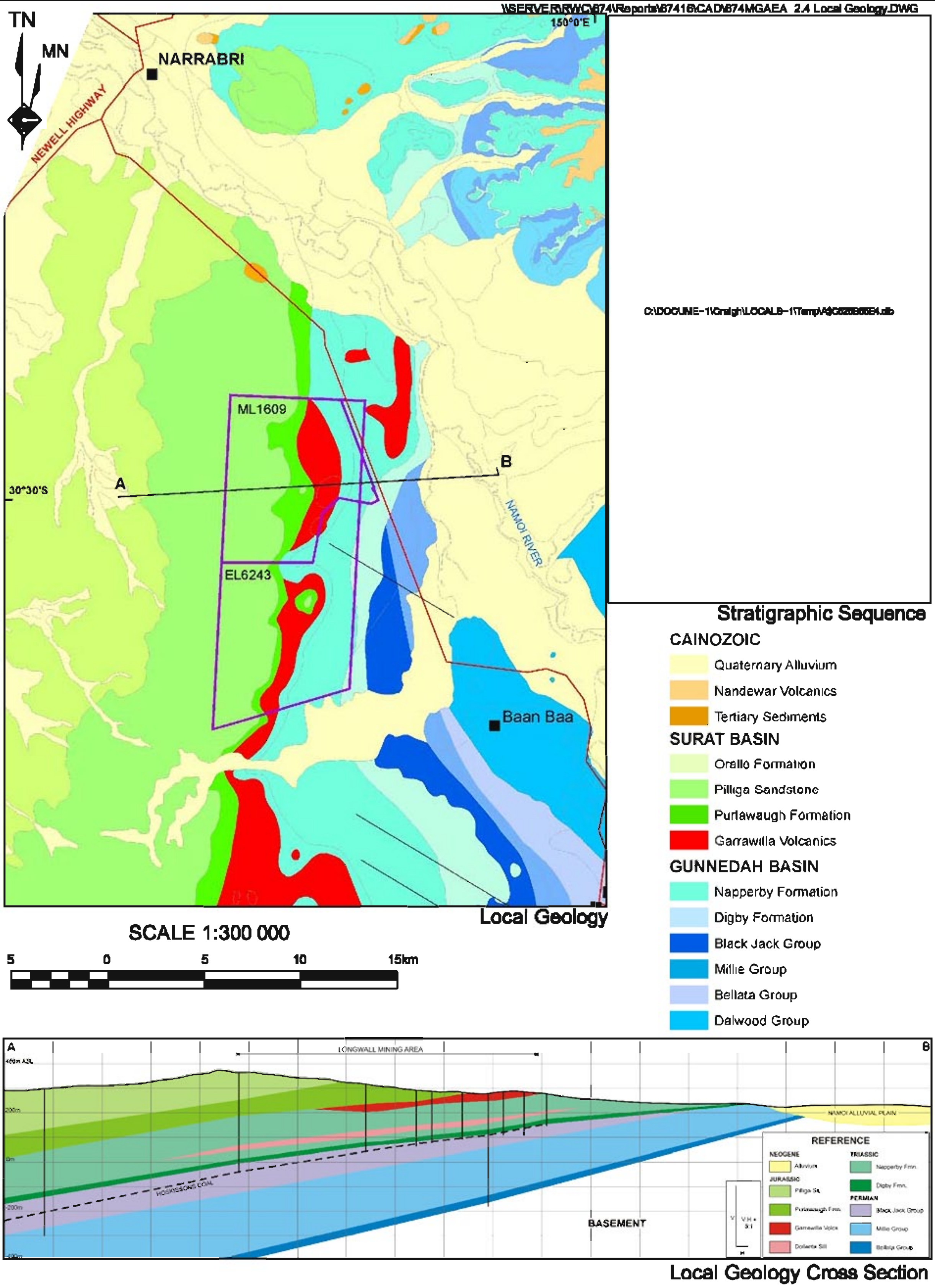


Figure 2.4
LOCAL GEOLOGY AND STRATIGRAPHY

Source: Narrabri Coal Operations Pty Ltd

The Purlawaugh Formation is up to 140m thick and crops out over the western half of ML 1609. It consists of thinly bedded, generally fine grained, silty lithic sandstone, siltstone and minor claystone. Thin stony coal seams are present in the lower part of the unit.

The Garrawilla Volcanics unconformably overlie the Triassic Napperby Formation or the Deriah Formation where it is present. The volcanics consist mainly of alkali basalt flows with very minor intervening mudstone and clastic rocks. The Garrawilla Volcanics are up to 40m thick.

Gunnedah Basin Sequence (Permian to Triassic)

The Napperby Formation is up to 140m thick. It consists of a coarsening-up sequence of siltstone, sandstone / siltstone laminite, and fine to medium grained quartz-lithic sandstone.

An intrusive Basalt Sill is present in the lower part of the Napperby Formation in ML 1609. It varies in thickness from 0 to 30m but is typically 15m to 20m thick. It occurs approximately 30m to 35m above the base of the Napperby Formation. It is dark green alkali basalt and is almost certainly related to the Garrawilla Volcanics. The basalt typically has strongly developed sub-vertical fractures infilled with secondary chlorite and zeolite minerals. The fractures do not continue into the enclosing rocks and may be related to cooling shrinkage.

The Digby Formation is divided into two units, the lower Digby Conglomerate and the overlying Ulinda Sandstone. The Ulinda Sandstone is either not present in ML 1609 or the boundary between these units is not clear with interbedded conglomerate and sandstone common in the top of the conglomerate. Consequently, the whole unit is referred to as the Digby Conglomerate in this area.

The Digby Conglomerate unconformably overlies the coal-bearing Black Jack Group. The unit consists mainly of thickly bedded, polymictic, lithic, pebble conglomerate with clasts of volcanic, meta-sediment and jasper in a lithic rich matrix. Minor finely to medium bedded, lithic sandstone beds are present towards the top of the unit. The Digby Formation is typically 15m to 20m thick in ML 1609. The boundary with the underlying Black Jack Group is an angular unconformity. In the east of ML 1609, it cuts the Hoskissons Coal Seam at a depth of approximately 130m to 160m below the land surface. In the west, over a distance of approximately 5km, there is up to 20m of the Black Jack Group remaining above the Hoskissons Coal Seam.

The Black Jack Group consists of lithic sandstone, siltstone, claystone and coal with minor tuff. It is up to 70m thick in the western part of the ML 1609 but is less than 40m thick in the east due to the low angle unconformity with the overlying Digby Formation. The Hoskissons Coal Seam and the Melville Coal Seam are present within ML 1609. Thickness and quality characteristics are such that only the Hoskissons Coal Seam is currently considered to contain coal resources with mining potential.

Throughout ML 1609, the Black Jack Formation includes the following strata.

- Benelabri Formation – lithic sandstone, siltstone with minor coal. Increases in thickness towards the west away from the unconformity.
- Hoskissons Coal Seam – dull lustrous coal. Coal consists of a low ash working section (basal 4.2m) and a high ash coal with claystone bands (upper 5.2m).

- Arkarula Formation – quartzose sandstone and siltstone. Typically the upper 10m of the Black Jack Formation over the Mine Site.
- Brigalow Formation – coarse sandstone and conglomerate interbedded with the coal seam and grades laterally into the Arkarula Formation, thickening to the west across the Mine Site from 2m to 19m.
- Pamboola Formation – lithic sandstone, siltstone, claystone and coal. Continuous over the Mine Site below the Arkarula Formation and Brigalow Formation with a thickness of between 55m and 75m.

2.2.3 Geological Structure and Geotechnical Attributes

Located on the eastern side of the Mullaley Sub-basin adjacent to the north-south trending Boggabri Ridge, the major structural elements of the geology with the Mine Site are strongly influenced by the proximity to the Boggabri Ridge. The rocks overlying the Boggabri Ridge strike north-south and dip gently to the west.

Interpretation of regional aeromagnetic data identified a strong northwest structural trend with several northwest-trending fault blocks in the basement. The overlying sedimentary units are draped over this fault topography but are not apparently faulted at the level of the coal measures. No faults that would seriously affect the continuity of underground longwall mining operations have been identified by the exploration program. **Table 2.2** records the geotechnical attributes of the various overlying units, the seam and the seam floor and identifies relevant issues associated with each unit.

Table 2.2
Geotechnical Attributes of the Mine Stratigraphy

Page 1 of 2

Unit	Description	Comments
Napperby Formation	Comprises mudstones, siltstones, sandstones and sandstone/siltstone laminites. Some units very weak, particularly along bedding planes and laminae.	This unit is not significant operationally. However, the drifts and ventilation shaft would pass through the formation for the majority of their length. Excavation would be easy but some sections would require high density support and in these areas the depth of cut before supporting would be restricted.
Dolerite Sill	Basalt sill 40m to 60m above the coal seam which is very strong.	Operational impact expected to be slight due to amount of interburden between it and the seam. May require blasting during construction of exhaust shafts.
Digby Formation	Weakly cemented conglomerate with high matrix to pebble ratio. Strength tests indicate moderate strength.	Operational impact is not expected to be as severe as other NSW conglomerates but the unit would behave massively, possibly more like a massive sandstone. Consequently, difficulty in achieving first cave and periodic weighting should be anticipated. Stress tests indicate it is highly stressed relative to strength which should help the unit to cave following mining.
Benelabri Formation	These sandstone, sandstone/siltstone layers are not always present. They increase in thickness towards the west, separating the coal from the conglomerate. Moderate strength.	As significant thickness of roof coal is to be carried, these layers are not of great importance in terms of roof behaviour. However, by increasing the separation between the working section and the base of the conglomerate at the face start positions in the west, they would positively influence the potential for windblasts.

Table 2.2 (Cont'd)
Geotechnical Attributes of the Mine Stratigraphy

Page 2 of 2

Unit	Description	Comments
Roof Coal	Generally, greater than 1m of clean coal in immediate roof.	The roof coal is expected to form a good roof with low stress such that roof support densities on development and during retreat would be towards the lower end of those commonly found in other coal regions.
Working Section	Not heavily cleated. Extent of jointing not known.	The actual rib support required can only be determined once the seam is accessed. At this stage, rib support is expected to be similar that generally used within the industry.
Arkarula Formation/ Brigalow Formation	Tests indicate moderate strength floor with no slaking tendency.	Floor problems are not anticipated. This is a positive outcome as there are significantly fewer effective strategies for dealing with weak floors than there are for weak roofs.

2.2.4 Exploration

Exploration Licence (EL) 6243 (see **Figure 2.5**) was granted to Narrabri Coal Pty Ltd in May 2004 and covers an area of 113km^2. The area incorporating EL 6243 was initially explored by Pacific Power in the 1980s using widely spaced drilling.

The Proponent would continue its exploration activities in the southern half of EL 6243 over the next few years. Any coal mining proposal within that area would depend upon the quantity and quality of coal identified, technical and economic factors and environmental constraints. In any event, any proposal would be the subject of a separate application for project approval.

Coal exploration commenced in July 2004 and has, to date, entailed:

- drilling of in excess of 190 drill holes, 120 of which have been cored, and the majority of which have been geophysically logged (**Figure 2.5**);
- ply-by-ply quality analysis of a number of the 120 cores recovered from the coal seam;
- Uniaxial Compressive Strength (UCS) determination for roof and floor strata;
- slake durability testing of floor strata;
- specialist analysis of regional aeromagnetic data and data from a high resolution (low height) aeromagnetic survey of the EL area which was conducted in September 2005;
- specialist assessment of gas make and nature particularly in the initial longwall area;
- specialist "televiewer" reports on 25 deep holes for evidence of stress-related breakout;
- specialist assessment permeability and porosity of strata;
- geotechnical review of data with emphasis on assessment of likely mining conditions; and
- specialist investigations of the coal for spontaneous combustion.

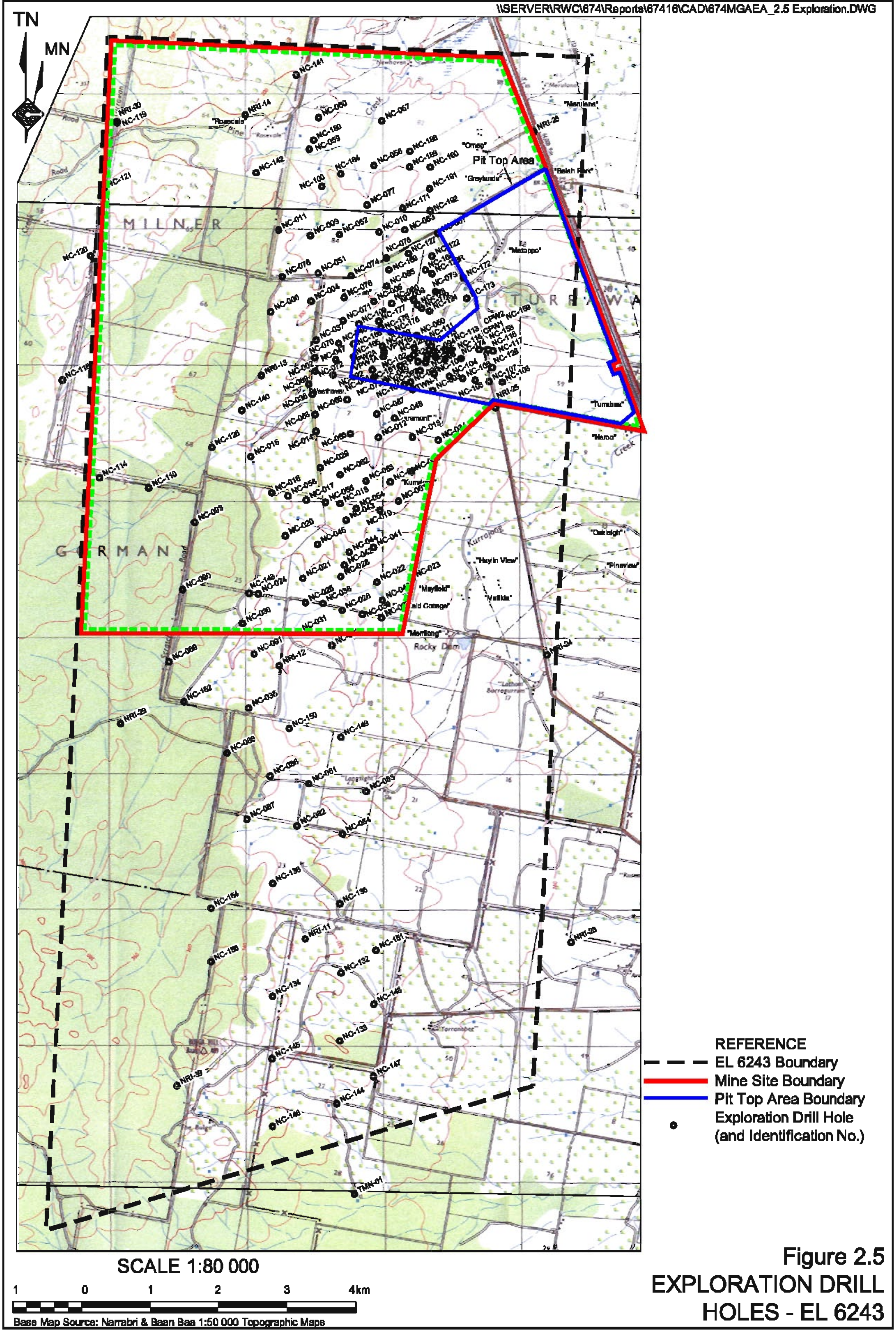


Figure 2.5
EXPLORATION DRILL HOLES - EL 6243

2.2.5 Coal Resources and Reserves

The coal resource of the Narrabri Coal Mine is contained within the Hoskissons Coal Seam and the results of the exploration activity have confirmed seam characteristics of the Hoskissons Coal Seam within ML 1609 as follows.

- The Hoskissons Coal Seam is between 8m and 10m thick over the western half of ML 1609.
- In the eastern half of ML 1609, the seam is cut off at a depth of approximately 160m by a low angle unconformity between the coal seam and the overlying Digby Formation.
- The coal seam strikes generally north-south, and dips gently to the west.
- The levels of the floor of the coal seam below surface and the variations in overall seam thickness are displayed in **Figure 2.6**.

The Hoskissons Coal Seam comprises two plies, (referred to as the **H**oskissons **C**oal Seam Ply **1** (HC1) and Ply **2** (HC2). The lower part of the Hoskissons Coal Seam, the HC2 ply, contains low ash coal suitable for thermal applications and therefore is suitable for recovery by underground mining methods. The lower approximately 4.0m to 4.2m of HC2 is the targeted working section for longwall mining. A working section height of approximately 4.2m is the optimum limit for safe, productive continuous miner operations and is towards the upper end of single-pass longwall technology. The upper section of the seam, the HC1 ply, contains high ash stony coal and tuffaceous claystone bands that would remain in the roof where the seam thickness exceeds 4.2m.

Based on an average working section of 4.2m, it has been calculated that 230 million tonnes of coal occurs within the lower HC2 ply, ie. the in-situ coal of the Narrabri Coal Mine within ML 1609. An assessment of the recoverable coal resources of the Mine Site conducted by SRK Consulting (SRK) established that 65.5% of the coal or approximately 150 million tonnes could be recovered by a longwall mining operation.

Table 2.3 provides a summary of the measured, indicated and inferred coal resources within ML 1609 drawn from the Joint Ore Resources Code (JORC) assessment conducted by SRK Consulting.

Table 2.4 provides a summary of the current coal reserves within ML 1609 drawn from the Joint Ore Resources Code (JORC) assessment conducted by Minarco – Mineconsult during 2007. This reserve does not include areas of inferred coal resources in the western part of the lease and thus, would increase to the 150Mt as assessed by SRK subject to further drilling.

Table 2.3
Coal Resources within ML 1609

Coal Ply	Resource Category	Seam Thickness (m)	Coal Tonnage (Mt)
HC2	Measured	4.11	88.64
	Indicated	4.12	81
	Inferred	4.13	60
	Total		**229.64**

Source: SRK (2007)

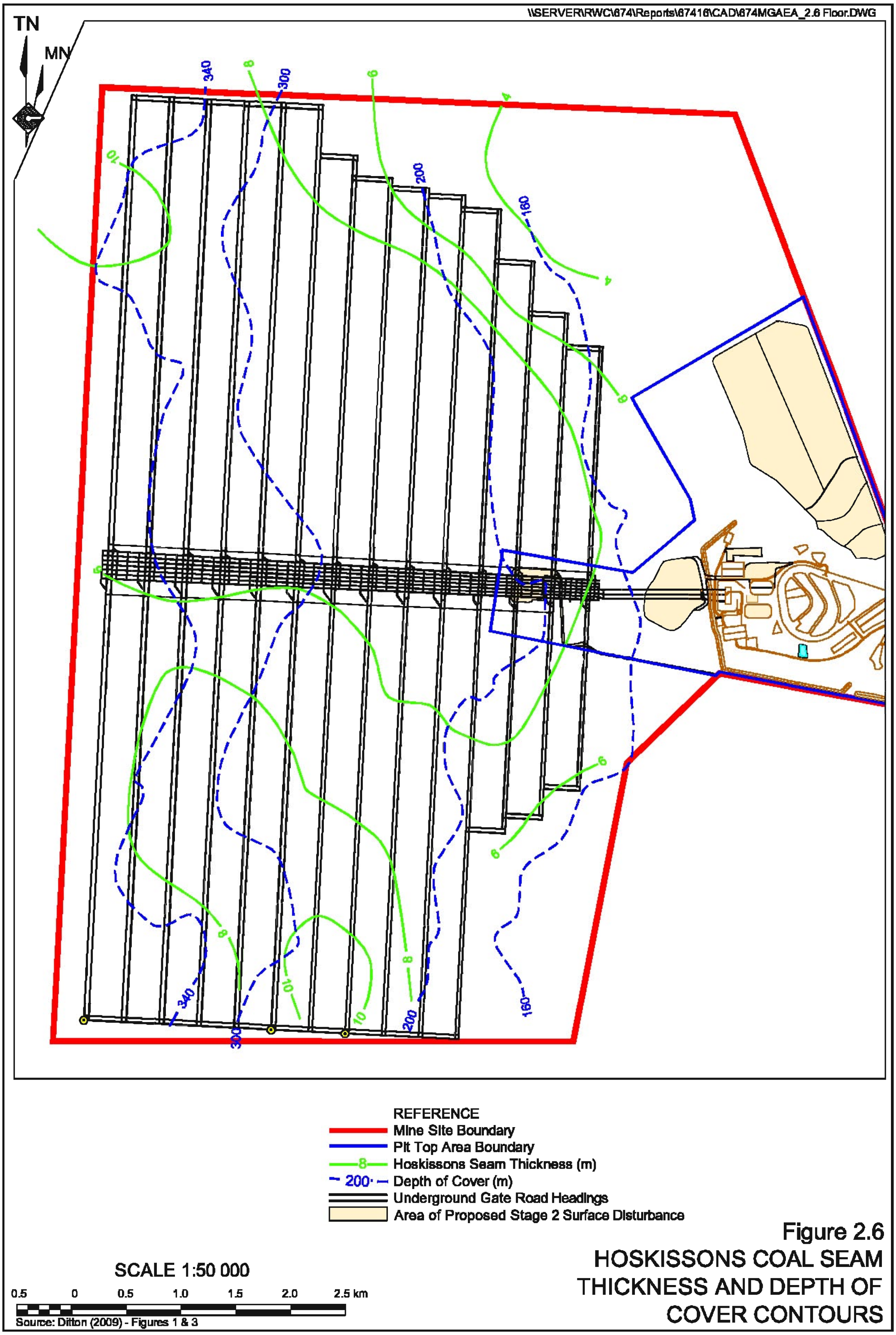


Figure 2.6
HOSKISSONS COAL SEAM THICKNESS AND DEPTH OF COVER CONTOURS

Table 2.4
Coal Reserves within ML 1609

Coal Reserves (Mt)	Marketable Reserves (Mt)		
Proved+Probable	Proved	Probable	**Total**
112.0	51.1	51.6	102.7

Table 2.5 lists various parameters contributing to the assessment of coal quality. Invariably, there is considerable similarity between the results for the measured, indicated and inferred resources.

Table 2.5
Coal Quality

Resource Category	Seam Thickness (m)	Inherent Moisture	Volatile Matter	Ash	Sulphur	Specific Energy	Relative Density
Measured	4.11	4.3	28.3	9.7	0.36	29.0	1.42
Indicated	4.12	4.3	27.9	10.7	0.36	29.1	1.43
Inferred	4.13	4.4	27.7	11.0	0.36	29.1	1.44
Total	**4.12**	**4.33**	**28.0**	**10.5**	**0.36**	**29.1**	**1.43**
Source: SRK (2007)							

2.2.6 Spontaneous Combustion Potential

A spontaneous combustion assessment completed for the Hoskissons Coal Seam by Dr Basil Beamish, whilst not providing quantitative data on the heating characteristics of the coal, provided an analysis of the spontaneous combustion potential of the coal to be mined. The similarity of Hoskissons Coal Seam to that of Dartbrook Colliery's Wynn Seam was noted. Standard laboratory testing of core samples by Uniquest indicated that the Hoskissons Coal Seam has a moderate to high propensity to spontaneous combustion and confirmed the similarity to the Wynn Seam at Dartbrook (which displays the following properties).

- An R70 rate of 2°C to 5°C per hour.
- A cross-over temperature range of 130°C to 150°C.
- A self-heating temperature of 86°C to 90°C.
- Low rank/high volatile coal.

Based on the properties described above, and the mining method to be implemented which would leave up to 5m of inter-bedded low quality broken coal in the goaf, spontaneous combustion has been identified as a medium to high risk at the Narrabri Coal Mine.

Section 2.4.7 provides a description of how the spontaneous combustion risk is to be managed.

2.3 MINE PLANNING

2.3.1 Introduction

From the outset of mine planning for the Stage 1 operation, it was recognised the coal resource may be suitable for extraction by longwall mining methods, however, given the absence of any experience with longwall mining in the Narrabri area, the Proponent favoured a staged approach to enable further assessment of ground, mining and groundwater conditions. Mine planning for Stage 2 commenced almost immediately following the granting of PA 05_0102, considering economic, geological, geotechnical and environmental issues. The reasons for accelerating the planning for Stage 2 have previously been discussed in Section 1.4.4. Details of the various considerations are set out in the following subsections followed by an overview of the staged approach to mining the defined coal reserve.

2.3.2 Economic Considerations

In assessing the economic issues relevant to the design of the Longwall Project, the Proponent has drawn on experience gained by an associated company, Namoi Mining Pty Ltd, which mined the Hoskissons Coal Seam with continuous miners at Gunnedah Colliery from 1996 to early 2000. This experience has provided a high level of confidence with respect to productivity levels that can be expected from the proposed longwall mining operations within similar seam conditions.

Although the Mine Site is 382km from Port Newcastle and the cost of rail freight would be significantly higher than that for miners in the Hunter Valley, a number of economic considerations offset this disadvantage.

The low ash, low sulphur quality of in-situ coal in the proposed 4.2m thick working section would minimise the proportion of coal requiring washing to produce thermal coal products for sale into the export market. The high quality ensures that there would be a ready market for the coal.

ML 1609 is located in close proximity to the North Western Branch Railway Line, which limited the length of track work required to construct the Mine Site rail loop.

Finally, the Proponent has an existing rail allocation for the North Western Branch Railway Line and Main Northern Railway Line, ensuring that the coal produced is able to be transported to Port Newcastle for export.

2.3.3 Geological Considerations

The exploration results identified that the coal resource includes large areas which appear to be free of major structural disturbance and accordingly these areas would support a high production longwall mining operation. The longwall panels of the underground have been defined to correspond with the limit of where the coal seam thickness is at least 4m or greater (see **Figure 2.6**).

The geological data compiled enabled the eastern-most and shallowest area where the Hoskissons Coal Seam is present to be defined. This area then contributed to defining the locations of the box cut and portals for the transport drift and conveyor drift, ie. based on a 1:8 (V:H) gradient and the need to locate the base of the drifts (the Pit Bottom Area) centrally within the resource area.

2.3.4 Geotechnical Considerations

A range of geotechnical studies have been undertaken to assist in the design of the longwall mining operations. These studies have provided important information used in the planning of both the Stage 1 continuous miner operation (initially) and more recently the proposed longwall mining operation and include the following.

- Geophysical logging of drill holes by GroundSearch Australia.
- Detailed regional aeromagnetic survey by SRK Consultants.
- Geological modelling by JB Mining Services to assess structural, stratigraphic and coal seam data.
- Geotechnical testing of the rocks / strata which overly the coal seam by Australia Soil Laboratories.
- Stress direction testing by Sigra Pty Ltd.
- Coal seam gas analysis by Earth Data Geological Consultants.
- A geotechnical assessment of the Stage 1 Narrabri Coal Project completed by Mining Geotechnical Services Pty Limited in October 2006.
- Assessment of the spontaneous combustion potential of the Hoskissons Coal Seam (Beamish, 2006).
- Assessment and design of pillars completed by Pacific International Mining Solutions in January 2009.
- Subsidence Assessment by Ditton Geotechnical Services Pty Ltd (DGS, 2009).

The critical geotechnical parameter influencing the design and development of the longwall mining operations, as opposed to the approved Stage 1 continuous miner operations, was the predicted subsidence and possible impacts of this subsidence both underground and at surface. The complete report of Ditton Geotechnical Services Pty Ltd (DGS, 2009) is provided as Part 1 of the *Specialist Consultant Studies Compendium* that accompanies this *Environmental Assessment*, with a detailed summary of the predicted subsidence levels and impacts included as Section 4B.1. The following provides a brief description of the causes and effects of subsidence, local conditions with the potential to affect subsidence and impacts on the proposed longwall mining plans.

In most cases immediately after extraction in a longwall panel, the immediate mine roof usually collapses into the void left in the seam behind the roof supports. The overlying strata or overburden then sags down onto the collapsed material, resulting in settlement of the surface. The maximum subsidence occurs in the middle of the extracted panel and is dependent on the following.

- The height of extraction in the longwall panel: which determines the height of the initial collapse. The longwall panels extraction height would be 4.2m while the gate road headings and chain pillars between the panels would be 3.5m in height.
- The depth below surface of longwall panel: with the influence of rock fracture, swelling and bridging reducing the effect of the initial collapse with height. Cover depths range from 160m up to 380m with a single row of chain pillars to be left between the extracted longwall blocks. The widths of the chain pillars would increase with cover depth from 24.6m to 37.6m.

- The geological properties of the strata above the collapse including any massive structures above the longwall panel: influencing the bulking characteristics of the collapsed strata as well as any 'bridging' by the massive units over collapsed rock beneath it. Three geological units above the coal seam have been assessed for their potential for bridging behaviour. DGS (2009) has determined, based on strength testing, empirical data base and an analytical Voussoir Beam model, that only the Garrawilla Volcanics have the potential to reduce subsidence.
- Features of surface geology and topography: which may exacerbate the impacts of surface subsidence through cracking or impacts on structurally vulnerable features such as creeks, caves, overhangs etc. The terrain is generally flat in the east with two low-level ridges with moderate slopes in the west. The ephemeral watercourses of Pine and Kurrajong Creeks and their tributaries drain the Mine Site towards the north-east.

Modelling completed by DGS (2009) has predicted that subsidence of up to 2.44m would be experienced, resulting in:

- surface cracking of between 20mm and 190mm;
- altered surface gradients of up to 6% (3^{o}) along creeks;
- potential ponding depths of between 0.5m and 1.5m within the watercourses in the flatter areas of the site; and
- possible impacts on subsurface aquifers within 110m to 180m above the proposed panels as a result of direct hydraulic connection to the workings.

Based on the above assessment of potential subsidence, the impacts would be limited to the Mine Site, the majority of which is owned by the Proponent. The impacts of up to 2.44m of subsidence have been considered by each of the specialist consultants commissioned as part of the *Environmental Assessment*, with the recommended amelioration and/or mitigation measures to be implemented by the Proponent. Any impact on ground or surface water availability has also been carefully evaluated with appropriate licences and contingency strategies developed to address any impacts should they occur.

2.3.5 Environmental Considerations

The Narrabri Coal Mine would continue to operate as an underground operation. The primary environmental considerations have therefore revolved around any additional surface disturbance required for the Stage 2 longwall operations, subsidence-related impacts on the surface and potential impacts on local ground and surface water resources. The following provides a summary of the main environmental issues considered during the design of the Longwall Project.

- <u>Vegetated Land / Agricultural Land</u>

  The Longwall Project would require the establishment of Reject Emplacement Area to the immediate west of the Pit Top Area (see **Figure 2.2**). While the exact area covered by the Reject Emplacement Area would be dependent on the coal quality, ie. proportion of stone and/or oversize material within the ROM coal, as well as the amount of coal to be washed, the Proponent has allocated an area of

25ha based on the assumption that the quantity of waste represents 5% of the ROM coal feed. Notably, initial waste stream calculations completed following the completion of coal washability tests on selected coal samples calculated waste would be 2.2% of ROM coal feed. Therefore, the allocated area may be at least double the required size, catering for increased volumes of waste should coal quality decrease as the underground is developed to the west and south where coal quality data is more limited.

The impact of the Reject Emplacement Area on current and future land capability and land use is the subject of a Soil and Land Capability Assessment for the Longwall Project undertaken by Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC). The complete report of GCNRC (2009b) is provided as Part 9b of the *Specialist Consultant Studies Compendium* that accompanies this *Environmental Assessment*, with a detailed summary of the predicted subsidence levels and impacts included as Section 4B.9.

- Ecological Considerations

  In order to install the proposed ventilation and gas drainage system for the Longwall Project, access roads, power lines and drill sites would be constructed along the alignment above the West Mains and goaf drainage access roads displayed on **Figure 2.1**. Underground communication (PED) lines would also be installed along the same corridor. These access tracks, drill sites and shaft construction sites would be aligned over both cleared agricultural lands, as well as within woodland vegetation located across the western portion of the Mine Site. The Proponent, in consultation with Ecotone Ecological Consultants Pty Ltd (Ecotone), has committed to aligning these surface activities to minimise disturbance to the remnant vegetation and the preparation of a flora and fauna management plan or strategy to provide for regular re-assessment of the ecological value(s) of the areas to be disturbed and management practices to minimise any impacts.

  Subsidence also has the potential to impact on the flora and fauna of the Mine Site, primarily as a result of surface cracking and/or changes to local drainage. An ecological assessment completed by Ecotone (2009), which is provided as Part 4 of the *Specialist Consultant Studies Compendium*, has determined that the proposed surface disturbance and predicted subsidence is unlikely to have a detrimental impact on local ecology. Section 4B.4 provides a summary of the assessment and conclusions of Ecotone (2009).

- Aboriginal Heritage

  Similar to the potential impacts on local ecological values, the surface disturbance associated with the installation of the mine ventilation and gas drainage systems and mine subsidence has the potential to impact on sites or artefacts of Aboriginal heritage significance that may occur throughout ML 1609. In recognition of this potential impact, an archaeologist from Archaeological Surveys and Reports Pty Limited (ASR) and representatives of the local Aboriginal community undertook surveys of the proposed and likely areas of impact.

  An initial detailed survey of the proposed disturbance corridors above Longwall Panels 1 to 7 (which would take approximately 7 years to complete) identified

43 Indigenous sites and/or artefacts. These sites and artefacts were found almost exclusively within 25m of the creeks and creek tributaries which traverse the Mine Site. The Proponent has committed to avoiding the four sites identified as having scientific significance. The Proponent would also avoid the remaining identified sites unless this is impracticable for mine safety reasons. Notably, the alignment of proposed surface disturbing activities has been modified, where possible, to avoid a number of the sites identified by ASR and the Aboriginal community as being of greatest significance. In the event that a site cannot be avoided, the artefact(s) would be salvaged in accordance with a site salvage protocol currently being developed in consultation with the registered Aboriginal stakeholders.

A further reconnaissance survey of the remaining Mining Area (Longwall Panels 8 to 26) has also been completed over those areas considered as having the highest probability for site occurrence and discovery, eg. creek tributaries, rock shelfs and overhangs. The findings of this survey were very similar (with respect to site type and distribution) to those of the detailed Panels 1 to 7 Survey Area survey and indicated that the cumulative impact of the proposed Longwall Project on the archaeological record would be minimal and would not constrain the conversion of the mine to a longwall operation.

The Proponent would also abide by the provisions of the *National Parks and Wildlife Act 1974* in relation to the identification of additional Indigenous archaeological sites following the approval and commencement of the Longwall Project. Section 4B.5 and Part 5 of the *Specialist Consultant Studies Compendium* provide further detail on the type, location and management of the identified sites.

- Water Resources

The groundwater that would be encountered by the underground workings is saline with an average total dissolved solids concentration of between 6 000mg/L and 8 000mg/L (depending on the sample size used). Based on groundwater modelling undertaken by Aquaterra Consulting Pty Ltd (see Part 2 of the *Specialist Consultant Studies Compendium*), it is predicted that dewatering requirements of the Longwall Project would steadily increase (by adopting the base case) from 0.2ML/day (78MLpa) in the first year of longwall mining to 3.89ML/day (1 419MLpa) after approximately 18 years before decreasing over the remaining life of the remaining life of the Longwall Project (as a significant volume of the inflowing water can be retained in completed goaf areas which are down-dip of the active panels). Section 4B.2 considers the impact of the proposed dewatering on the local groundwater aquifers, as well as any impacts (if any) on the availability of this water to local groundwater users.

Due to the saline nature of the groundwater, it would require storage and segregation from natural surface water drainage on the Mine Site. The surface water storage structures designed and constructed for Stage 1 would be retained, with treatment of this water by ultra-filtration and reverse osmosis already approved should the volume dewatered from the underground workings approach 0.88ML/day. The treated water would be re-used underground for dust suppression and equipment cooling purposes, or if surplus to operational requirements discharged from the Pit Top Area to the Namoi River. A by-product of the water treatment would be the generation of significant volumes of brine, ie. saline water, with approximately 20ML generated for every 100ML of raw water treated. The current proposal for managing this brine is to store it at surface for the life of the mine before progressively pumping it back into the goaf and retained gate roads of the underground workings. Section 4B.3 and Part 3 of the *Specialist Consultant Studies Compendium* (WRM, 2009) provide further detail on the management of water resources (including brine) at surface for the development and operations of the Longwall Project.

In addition to the above, progression to a longwall mining operation would increase the operational demand for water by up to approximately 1.7ML/day (Section 2.7.2 provides further detail on the annual water requirements of the Longwall Project). Section 4B.3 and Part 3 of the *Specialist Consultant Studies Compendium* (WRM, 2009) also provide a detailed review of the daily and annual water requirements of the Mine Site and available sources.

- <u>Noise</u>

  Monitoring of noise levels during the Stage 1 construction period has identified that inversion conditions much stronger than originally anticipated occur during winter mornings near the Mine Site and these inversions have resulted in elevated noise levels being received at some residences surrounding the Pit Top Area.

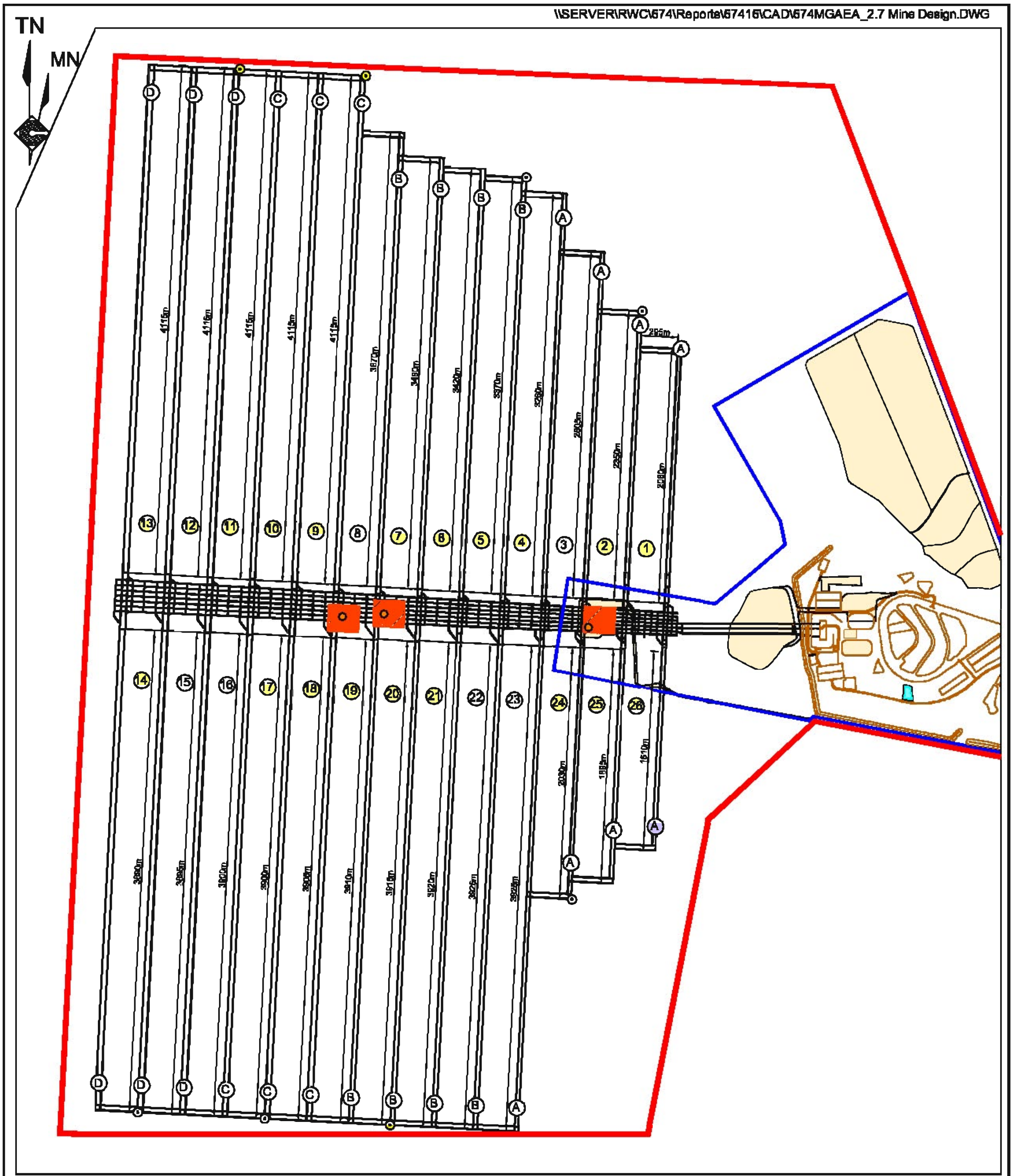
  These local conditions are now better understood and have been incorporated into a revised noise modelling study for the proposed longwall mining operations conducted by Spectrum Acoustics (Spectrum, 2009). In order to comply with noise criteria nominated in accordance with the DECCW's Industrial Noise Policy (INP), there would be some restrictions placed on construction activities within the Pit Top Area and during the excavation of the ventilation shafts and other infrastructure within the central corridor. Section 4B.7 presents these restrictions, based on the recommendations of Spectrum Acoustics (2009), which is provided as Part 6 of the *Specialist Consultant Studies Compendium*.

2.4 LONGWALL MINING OPERATION

2.4.1 Mine Design and Mining Method

Mining would involve the sequential development of gate road headings approximately 305m apart and oriented north-south from the West Mains to define a total of 26 longwall panels (LW1 to LW26) (see **Figure 2.7**). Two gate road headings would be developed by continuous miner to the north initially (to develop LW1 to LW13) and then south (to develop LW14 to LW26) to a point set back from the lease boundary or the Hoskissons Coal Seam where it is at least 4.0m thick (see **Figure 2.6**). The width of the retained chain pillar between the longwall panels would increase from 24.6m for LW1 to LW4, to 29.6m (for LW5 to LW8), then 34.6m (for LW9 to LW10) and finally 37.6m (for LW11 to LW13) (see **Figure 2.7**). The chain pillar width of LW14 to LW26 would reflect that of the corresponding panel to the north of the West Mains, eg. LW14 corresponds with LW13, LW19 corresponds with LW8, etc.

Once the two gate road headings are established on both sides of each longwall panel, the longwall equipment would be installed within an installation road driven between the main and tailgate roads and the coal recovered as the longwall unit retreats back towards the West Mains. All coal would be conveyed back to the Pit Bottom Area for transfer to the surface via the conveyor drift.



REFERENCE

- Mine Site Boundary
- Pit Top Area Boundary
- Approved Disturbance within the Pit Top Area
- Area of Proposed Stage 2 Surface Disturbance
- Longwall Panel No.
- Proposed Ventilation Shaft Location
- Ventilation Shaft Area
- Proposed Stage 2 Tailgate Ventilation Intake or Exhaust Shaft
- (A) Retained Chain Pillar Width = 24.6m
- (B) Retained Chain Pillar Width = 29.6m
- (C) Retained Chain Pillar Width = 34.6m
- (D) Retained Chain Pillar Width = 37.6m

SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Figure 2.7
UNDERGROUND MINE DESIGN

Figure 2.7 illustrates the mine design of the proposed Stage 2 of the Narrabri Coal Mine, including the following design features.

- The longwall panels would progressively increase in length in from approximately 2.1km (LW1) to 4.1km (LW9 to LW18) and would generally be 295m in width (total void width would increase to approximately 305m once the gate road either side of the panel is incorporated as the longwall unit retreats).
- The longwall panels are located at depths increasing from approximately 160m below surface over the eastern section of the Mine Site to 380m below surface as the Hoskissons Coal Seam dips to the west (see **Figure 2.6**).
- Thirteen panels (LW1 to LW13) would be formed towards the north from centrally located main headings and thirteen panels (LW14 to LW26) would be formed towards the south from the mains.
- The longwall panels would have an average face extraction height of 4.2m taken from the floor of the seam (which is between 4.6m to 10m thick). The face height would be ramped back to the gate roads at a height of 3.5m at the maingate and tailgate ends.
- The single chain pillar formed between each longwall panel would be 3.5m high with the pillar widths increasing as noted above.
- The longwall panel width to height (W/H) ratio for the proposed mining layout would range from 0.80 to 1.91. The chain pillar W/H ratio would increase from 7.0 to 10.7.

Plate 2.1 presents an artist's impression of the main components of the proposed longwall mining operation at the Narrabri Coal Mine.

2.4.2 Equipment

The longwall design would be based on proven technology with an emphasis on reliability of equipment. The principal components of the system would include:

- double-ended ranging drum shearer rated at 3 000tph with full horizon control (**Plate 2.2**);
- an armoured face conveyor rated at 3 000tph with provision for single tailgate drive and dual maingate drives (**Plate 2.2**);
- Beam Stage Loader rated at 3 500tph; and
- high capacity two leg chocks (**Plate 2.2**) shields with shearer initiation, base lift and high set functions.

Additional underground mining equipment to be used in association with the longwall mining unit is listed in **Table 2.6**.

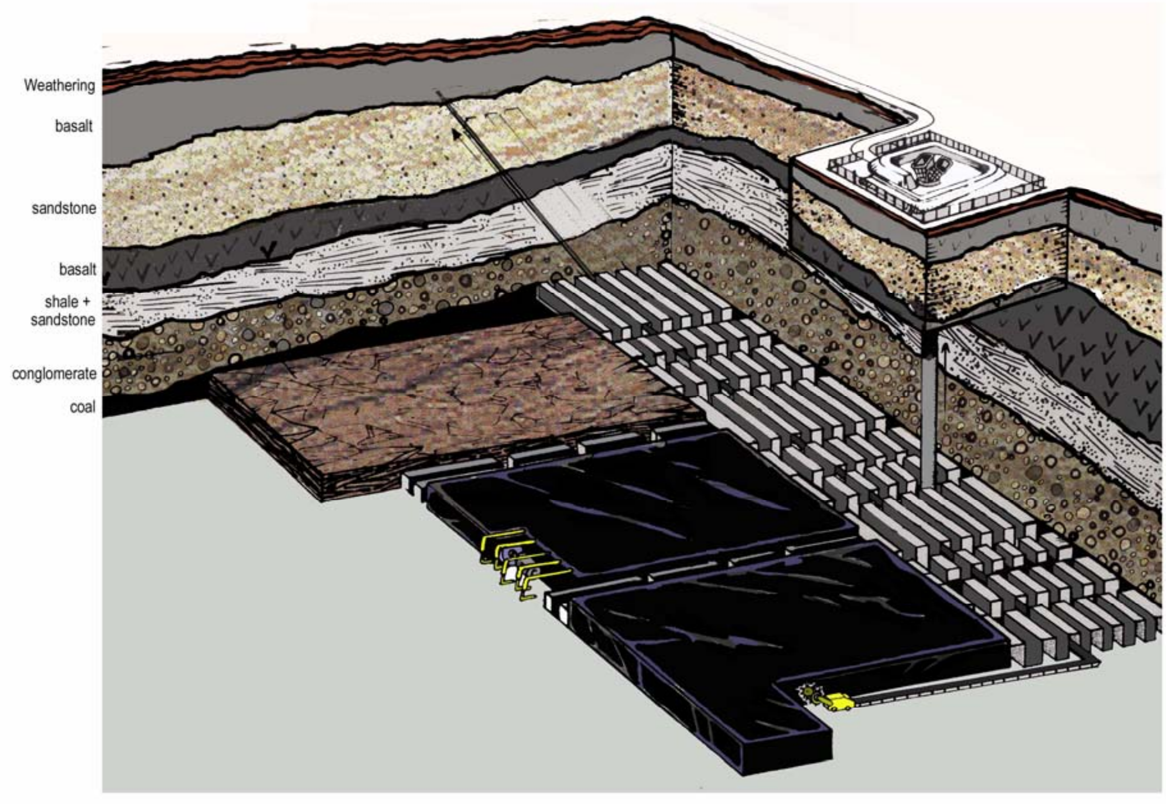


Plate 2.1
Artist's Impression of Longwall Mining Operation

Plate 2.2
Thick Seam Longwall Coal Mining Operation

With respect to the underground equipment, there would be regular movements of the man transport vehicles between the surface and underground, while the Load / Haul / Dump (LHD) vehicles would be on the surface at various times intermittently during operations for loading and unloading. The remaining equipment listed in **Table 2.6** would remain underground at all times unless major maintenance is required.

Table 2.6
Indicative Underground Operational Equipment

Indicative Equipment	No.	Use
Continuous miner	3	Underground primary and secondary mining
Shuttle cars	6	Transfer of coal from continuous miner to breaker feeder
Breaker Feeder	3	Breaking of coal
LHD vehicle	6	Material transport
Man transport vehicle	7	Personnel transport
Roof bolting machine	3	Roof bolting
Panel conveyor belt	3	Transfer of coal from breaker feeder to transport drift conveyor
Source: Narrabri Coal Operations Pty Ltd		

2.4.3 Mining Sequence

The Proponent intends to adopt the following indicative mining sequence for the Stage 2 longwall operations presented in **Figure 2.7**. The panels have been numbered LW1 to LW26 to illustrate the sequence of development, ie. LW1 would be developed and mine initially followed by LW2, then LW3 and so on.

The initial mining sequence would be the same as for the approved Stage 1 operations, ie. following the connection of the drifts to the coal seam, a continuous miner unit would be deployed to form the Pit Bottom Area and then commence driveage of the headings within the West Mains towards the west. At the same time, the first ventilation shaft would be constructed from surface and would be completed prior to the development of mains headings to this point to enable the headings of the West Mains to intersect the completed shaft.

Once the Pit Bottom has been established, a second and third continuous miner would be deployed to develop the gate road headings from the West Mains to the extent shown for LW1. Once each set of gate road headings are fully developed, the longwall equipment would be installed and the coal recovered as the longwall unit retreats back towards the West Mains. All coal would be conveyed back to the Pit Bottom Area for transfer to the surface via the conveyor drift.

Additional small scale (approximately 1.5m to 2m diameter) ventilation shafts would be constructed at the limit of every third or fourth longwall panel and would act as either in-take or exhaust points from the underground mine (see **Figure 2.7**). **Figure 2.7** also identifies the proposed location of the three primary ventilation shafts to be constructed from surface into the West Mains. While the exact location of these would be determined by the ventilation requirements of the mine, based on a conservative assessment of ventilation requirements, it is anticipated that ventilation shafts would be constructed adjacent to Maingates 2, 7 and 8.

2.4.4 Mining Rate

The headings of the West Mains would be developed by the continuous miners at a rate of approximately 140m per week, with the gate road headings developed at a rate of approximately 200m per week. On completion of the gate road headings, it would take approximately 6 weeks to install the longwall unit within LW1 or move the longwall unit from one panel to the next. With a nameplate capacity of 3 000tph and once fully operational, the longwall mining rate is forecast to be approximately 140 000 tonnes per week (up to a maximum daily rate of 50 000 tonnes). The maximum annual mining rate would not exceed 8Mt.

The indicative coal production schedule for the life of the mine is displayed in **Table 2.7**.

Table 2.7
Indicative Coal Production Schedule

Year	Development*	Longwall	Total
1	61 000	-	61 000
2	590 000	-	590 000
3	478 000	6 160 000	6 638 000
4	465 000	6 160 000	6 625 000
5	457 000	6 160 000	6 617 000
6	457 000	6 160 000	6 617 000
7	457 000	6 160 000	6 617 000
8	457 000	6 160 000	6 617 000
9	299 000	6 238 000	6 537 000
10	267 000	6 921 000	7 188 000
11	266 000	6 160 000	6 426 000
12	272 000	6 160 000	6 432 000
13	266 000	6 160 000	6 426 000
14	480 000	6 160 000	6 640 000
15	312 000	6 160 000	6 472 000
16	266 000	6 806 000	7 072 000
17	267 000	6 353 000	6 620 000
18	266 000	6 160 000	6 426 000
19	266 000	6 160 000	6 426 000
20	266 000	6 160 000	6 426 000
21	266 000	6 160 000	6 426 000
22	266 000	6 160 000	6 426 000
23	266 000	6 160 000	6 426 000
24	272 000	6 799 000	7 071 000
25	261 000	6 360 000	6 621 000
26	187 000	6 160 000	6 347 000
27	-	5 320 000	5 320 000
28	-	6 132 000	6 132 000
Total	**8 433 000t**	**161 809 000t**	**170 242 000t**
Modified after Palaris Mining			* Using Continuous Miners

2.4.5 Mine Ventilation and Gas Drainage

2.4.5.1 Introduction

Gas emissions during longwall extraction and ventilation / gas drainage requirements would be dependent on the size of the gas reservoir contained in coal seams and porous interburden adjacent to the working section, the gas composition of the reservoir and the desorption rate of the reservoir.

Tests conducted by Geogas Pty Ltd established that while gas compositions within the Hoskissons Coal Seam vary considerably, the predominant gas is CO_2 (~90%) with concentrations of CH_4 and N_2 also present in varying proportions. The results of gas desorption tests established the total desorbable gas content within the mine would vary from 3.87m^3/t to 7.03m^3/t on a dry, ash free basis. Considering these parameters, and based on the extraction of 4.2m of coal from the seam of 9m average thickness, the Proponent expects that gas emissions during development could reach 1 200L/s CO_2 in deeper horizons if high permeability persists at depth.

In order to minimise the potential for outburst, which for CO_2 rich environments requires gas content to be less than 6.0m^3/t, and to ensure safe working conditions underground, the initial gas content from the exposed coal would be drained, ventilation would be established and goaf gas drained from the extracted sections of each longwall panel. The following sections summarise a ventilation and gas management strategy to be adopted for the Longwall Project.

2.4.5.2 Mine Ventilation

The ventilation of the mine would be progressively established to maintain the general body CO_2 concentration well below the statutory requirement of 1.25%. This would involve the progressive establishment of three ventilation shafts from the West Mains as well as at the rear of the eight longwall panels, which could operate as ventilation intakes or exhausts.

The principal stages of mine ventilation establishment would be as follows.

- Initial mine development from pit bottom to the first main ventilation shaft (including the development of Tailgate (TG)1 and Maingate (MG)1) would be ventilated by two axial fans located within the box cut, using one of the three drifts as a return airway.
- The first exhaust shaft located at (MG2) would have an internal diameter of approximately 5.5m and be developed as a blind bore from the ventilation shaft area (see **Figure 2.1**). The shaft would be concrete lined and associated surface fans commissioned prior to the commencement of longwall mining. On commissioning of the fans for the MG2 exhaust shaft, the fans in the box cut would be removed with the three drifts becoming intake airways.
- The development and extraction of the northern longwall blocks would progress inbye with the mine being ventilated by four intake and three return main headings (inbye the shaft located opposite MG2).

- An intake shaft and a second 5.5m diameter concrete lined exhaust shaft at approximately MG7 and MG8 respectively would be commissioned to reduce the ventilation load on outbye intake and return main headings.
- Twin return roadways would be employed on the southern side of the West Mains with one on the northern side to minimise overcast construction in the northern headings of the West Mains, with up to four sets of cross-mains overcasts used throughout the life of the mine to share the ventilation load between the northern and southern returns.

Figure 2.8 presents an illustration of the mine ventilation system illustrating the development of mine ventilation as described above (as the longwall unit retreats southwards within LW5 and the West Mains are developed to the maingate of LW7). The ventilation points identified are identified by the panel and gate type where each is to be established, ie. MG2 refers to the maingate of LW2 and TG5 refers to the tailgate of LW5.

Using a two heading gate road configuration, the main ventilation issue for a single roadway tailgate would be maintaining the general body CO_2 concentration below the statutory requirement of 1.25%.

Sources of CO_2 reporting to the tailgate ventilation would include cut coal at the longwall face, from remnant coal in the active goaf and also the adjacent goaf if there is leakage through the chain pillar seals.

The mine ventilation network has been modelled with a longwall face ventilation quantity of $80m^3/s$, all of which would report to the tailgate. Pre- and goaf gas drainage techniques would be used to maintain average tailgate CO_2 concentrations below 1% to allow for peaks in gas emissions (see Section 2.4.5.3).

2.4.5.3 Gas Drainage

2.4.5.3.1 Pre-Drainage

Pre-drainage would be provided for the control of rib emissions, mitigation of the risk of outburst and reduction of post-mining goaf gas emissions. It is noted that gas reservoirs containing CO_2 rich seam gas at the gas contents and fluid pressure present within the Hoskissons Coal Seam are more difficult to pre-drain than methane rich seam gas. This is due to the large reduction in pressure required to promote desorption and the difficulty of keeping water out of down dip holes. As a result, Surface to In-Seam (SIS) pre-drainage, which in contrast to conventional underground in-seam gas drainage allows the Proponent to pre-drain the coal seam prior to establishment of the underground gate roads, is currently being trialled. It is considered likely that once underground mining commences, pre-drainage operations would revert to conventional underground in-seam methods, which requires far less area of surface disturbance. Given the likely use of both methods of pre-drainage, both are considered and described.

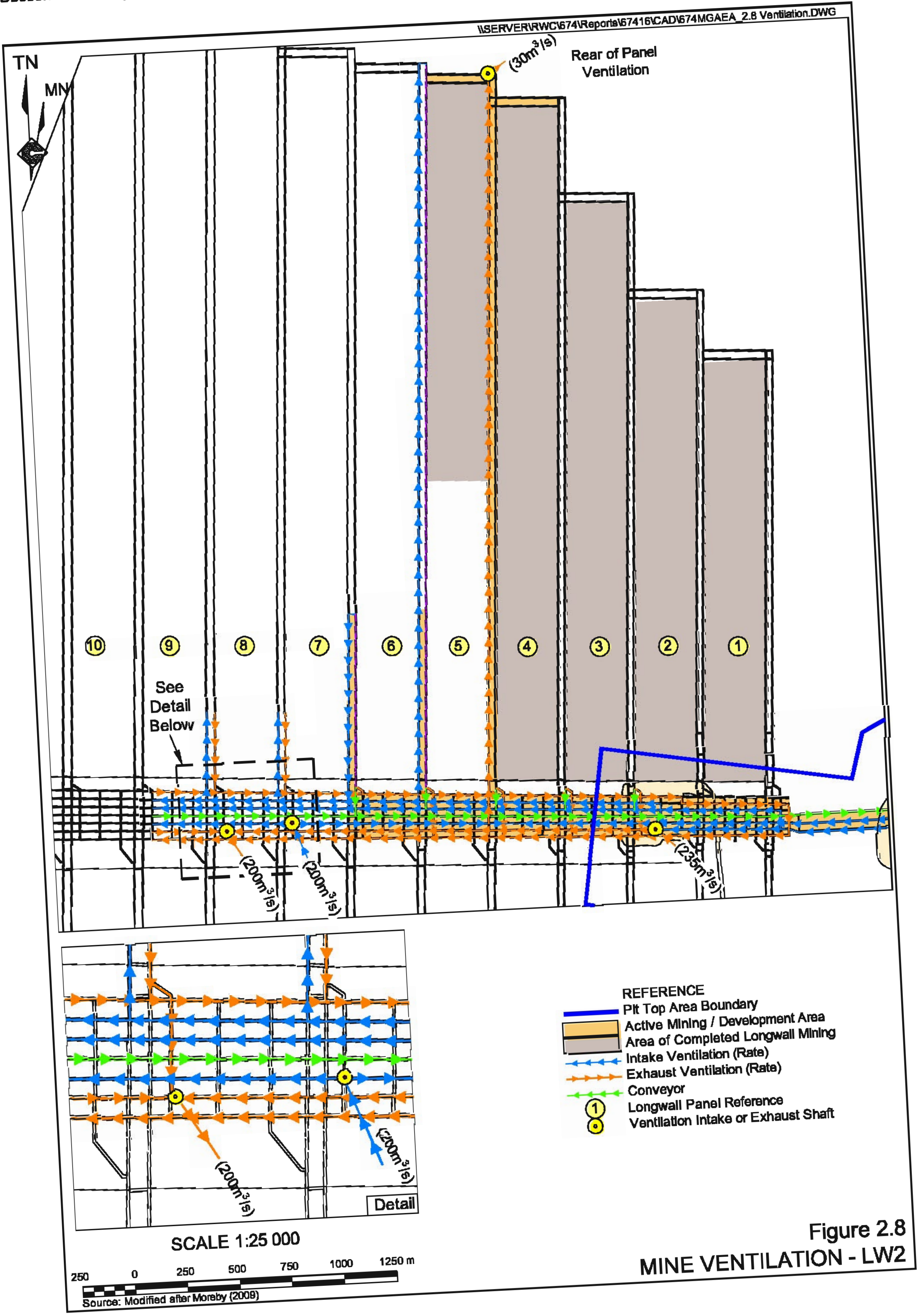


Figure 2.8
MINE VENTILATION - LW2

Surface to In-seam Pre-drainage

Surface to In-Seam pre-drainage using medium radius drilling involves drilling from surface into and along the coal seam (up to 2.5km). The gas (as well as water) is then drawn from the seam using a vacuum pump and either dispersed to the atmosphere or collected for power generation or flaring. Due to the very low methane concentration within the gas, power generation or flaring of the gas is not feasible and so the predominantly CO_2 would be dispersed. The water pumped to the surface would be piped to the Pit Top Area for storage in one of the Water Storage / Evaporation Ponds[2]. SIS pre-drainage provides a significant advantage over conventional in-seam pre-drainage in low desorption underground environments as the coal can be drained well in advance of mining. This form of pre-drainage requires the development of gate road headings of a particular panel prior to the commencement of pre-drainage. Further detail on the proposed location and disturbance associated with the SIS Surface to In-seam pre-drainage is provided in Section 2.4.9.8.

For gas reservoirs, such as that of the Hoskissons Coal Seam which are CO_2 rich, under saturated with significant fluid pressure reduction required for effective pre-drainage, SIS pre-drainage allows commencement of pre-drainage well in advance of mine development. This reduces the possibility that mine development may be held up by underground pre-drainage requirements.

In addition to pre-drainage, SIS holes drilled in the roof of the working section can also serve as goaf drainage holes. The location of these holes is particularly important in thick seams where significant gas emission can originate in close proximity to the face line and cannot therefore be captured by conventional vertical goaf holes.

Conventional Underground In-seam Pre-drainage

The conventional underground in-seam pre-drainage method of pre-drainage is undertaken by drilling from the developed gate road heading into the longwall panel area with the gas collected. The gas is then pumped to the surface from an exhaust pipe range for dispersion, flaring or other use such as power generation. While the conventional underground in-seam pre-drainage method is proven technology, and would not require additional surface disturbance, the rate of drainage would be slow for the CO_2 rich, under saturated with high fluid pressure gas reservoir of the Hoskissons Coal Seam. As noted above, this could potentially delay the commencement of longwall mining in the initial and/or future panels while gas levels are reduced to $<6.0m^3/t$.

2.4.5.3.2 Goaf Gas Drainage

As each longwall panel is completed, the remaining coal above the section mined would continue to desorb gas. In order to maintain all ventilation roadways within the legal compliance limit of 1.25%, current studies indicate that post drainage of the caved (goaf) area would be required to evacuate the CO_2 desorbed from the remaining caved roof. This can only be achieved by post mining goaf drainage via holes drilled from the surface.

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[2] The dewatering associated with the pre-drainage is provided for by the mine dewatering predictions provided by the modelling of Aquaterra (2009). That is, this water is not additional to the predictions included in Section 2.4.8.

The Proponent's conceptual goaf drainage design provides for 250mm internal diameter cased boreholes located about 35m off the tailgate corner of the active goaf at 200m intervals. The boreholes would be drilled to the top of the Hoskissons Coal Seam and connected to surface mobile goaf drainage vacuum plants. Subject to the success of the pre-drainage of roof coal, goaf hole spacing may be increased as operational experience is gained.

With respect to spontaneous combustion, coal of the propensity displayed by the Hoskissons Coal Seam probably has a worst case incubation period of 1.0 to 2.0 months or approximately 4 to 8 pillars retreat at planned production rates. Provision would therefore be made to maintain at least two active holes in the adjacent sealed goaf for nitrogen injection to maintain an inert goaf atmosphere for at least this period.

Further information on the surface activities associated with the installation of the surface mobile goaf drainage vacuum plants is provided in Section 2.4.9.9.

2.4.6 Subsidence Management

The subsidence assessment by Ditton Geotechnical Services Pty Ltd was based on 305m wide longwall panels with a 4.2m mining height at depths of 160m to 380m below the surface. The panel lengths and chain pillar widths are taken to be as presented on **Figure 2.7**, with a gate heading height of 3.5m. Under these conditions, a maximum predicted subsidence of 2.17m would occur where mining is 380m below the ground surface (ie. towards the west), increasing to 2.44m in the east where mining is up to 160m below the ground surface. Given this level of predicted subsidence, it is anticipated that subsidence would extend the following distances beyond the limit of mining (ie. the boundary of the potential longwall panels).

- 150m to 220m beyond the western boundary (23^o to 31^o draw angle).
- 35m to 70m beyond the eastern boundary (12^o to 21^o draw angle).
- 130m to 200m beyond the northern and southern boundaries at the western end, reducing to 35m to 70m in the east (12^o to 31^o draw angle).

The ground surface would tend to subside more towards the centre of the panel, ie. away from the chain pillars between the longwall panels. As a consequence of this differential subsidence, DGS (2009) has predicted the following possible impacts.

- Surface cracking of between 20mm (in the west) and 190mm (in the east).
- Altered surface gradients of up to 6% (3^o) along creeks.
- Potential ponding depths of 0.5m to 1.5m within the watercourses in the flatter areas of the site.
- Possible interaction between discontinuous sub-surface fracturing and surface cracks (where cover depths are <215m) leading to possible creek flow re-routing.
- Possible impacts on subsurface aquifers within 110m to 180m above the proposed panels as a result of direct hydraulic connection to the workings.

Based on the above summary of potential subsidence, the impacts are likely to be largely limited to the Mining Area, the majority of which is owned by the Proponent. The potential impacts, and proposed management of these impacts are described below.

- **Impacts on Groundwater**. Subsidence may result in sub-surface cracking of the geological strata between the coal seam and surface, particularly where cover depths are <215m. This has the potential to impact on one or more aquifers contained within these strata. Groundwater levels would be monitored continuously to ascertain what, if any, impact subsidence is having on local and regional groundwater levels with appropriate licence allocation obtained and contingency measures developed to ensure that no groundwater user is disadvantaged by these impacts. Section 4B.2 considers impacts, and mitigation of impacts on groundwater levels, aquifers and availability in greater detail.
- **Surface Cracking**. Surface cracks which occur as a result of subsidence would be filled in as they are identified. Due to the relatively deep soil profile above the longwall panels, it is likely that many of the smaller width cracks would be filled in naturally by the actions of wind, water and natural soil movement. A bulldozer or grader would be used to fill in the wider cracks by pushing the surrounding soil into the cracks. It is possible that some surface cracks may not be able to be filled in by dozer / grader profiling, eg. for wider than expected cracks, or cracking through drainage lines where surface profiling may impact on the flow path of water. In these instances, subsoil material would be excavated from the Reject Emplacement Area and used to backfill the crack(s).
- **Drainage Line Ponding**. A number of the drainage lines over the Mine Site fall at very gentle gradients and may be susceptible to potential ponding depths of between 0.5m and 1.5m. The actual ponding depths would depend upon several other factors, such as rain duration, surface cracking and effective percolation rates of the surface soils and fractured rock bars/outcrops along the creeks. The Proponent would monitor the impact of any changes to surface drainage paths and surface vegetation in areas of ponding development after each longwall is extracted (if they occur), with stream re-direction or modification works to be undertaken in consultation with an appropriately qualified hydrological professional and/or the DWE. Section 4B.3 describes in more detail the potential impacts and proposed mitigation measures to be adopted for the drainage lines above the proposed subsidence area.
- **Erosion and Slopes Stability**. With the exception of where surface cracking may occur along or through steeply eroded banks present within the creeks (which are likely to slump or topple if cracks develop through them), DGS (2009) considers it unlikely that the predicted subsidence would cause localised surface slope instability or *en-masse* sliding, ie. a landslip, of the ridges or hills. In order to minimise the likelihood of slope instability from increased erosion due to cracking or changes to drainage patterns after extraction, the Proponent would:
  - monitor surface slope displacement along subsidence cross lines;
  - infill surface cracks as they occur;

- regrade or revegetate areas significantly affected by erosion; and
- regularly review and appraise any significant changes to surface slopes after each longwall is extracted.

- **Impacts on Aboriginal Sites / Artefacts**. Unless recommendations for salvage are provided by local Aboriginal stakeholders and supported by the DECC, any archaeological artefacts would be retained in-situ on the Mine Site. The effect of subsidence is likely to be restricted to minor movement of the artefact as the ground level subsides. Further detail on artefact identification and proposed management is provided in Section 4B.6.
- **Impacts on Local Residences**. All residences within the area identified as subject to subsidence are located on properties owned by the Proponent. All residences would be vacated prior to the underground mining passing beneath these residences.

Greater detail on the predicted impacts of subsidence, and proposed management of these impacts is provided in Section 4B.1.

2.4.7 Spontaneous Combustion Management

As noted in Section 2.2.6, the spontaneous combustion risk of the Hoskissons Coal Seam is moderate to high. The risks associated with the spontaneous combustion are minimised through the following.

- The mine design which employs a low resistance ventilation system achieved through a seven heading mains trunk and two heading gate roads (see Section 2.4.5.2).
- Small diameter ventilation shafts to be installed at the rear of every third gate road panel for ventilation of the gate road inbye of the active longwall face thus negating the need for a bleed system skirting the perimeter of the goaf (see Section 2.4.5.2).
- Pre- and post- (goaf) gas drainage systems are to be implemented for gas management purposes (see Section 2.4.5.3) thereby minimising ventilation pressures that would result if the ventilation system only were used to maintain gas concentration to acceptable levels.
- Planned installation of high standard ventilation control devices (see Section 2.4.5.2).
- Installation, operation and maintenance of a dual ventilation monitoring system (telemetric and tube bundle).
- On-site gas chromatograph.
- On-site inertisation capability:
  - Pipework and valves fitted to all goaf seals to allow the injection of inert gas.
  - Potential utilisation of in-seam drainage ranges.
  - Access to Thomlinson Boiler and PSA Nitrogen gas generators, if required.

- Implementation of Ventilation and Monitoring Arrangements and the related spontaneous combustion procedures and action response plans.
- Implementation of a Gas Drainage and Outburst Management Plan which would:
  - Define acceptable negative pressures at the collars of in-seam boreholes.
  - Establish methods of intersecting and management of in-seam boreholes.

2.4.8 Mine Dewatering, Water and Brine Management

2.4.8.1 Mine Dewatering Requirements

As the underground workings and longwall panels are developed and mined, groundwater would flow into the underground workings. The rate of this 'mine in-flow' would ultimately be a function of the hydraulic conductivity of the geological strata above and below the coal seam, the surface area of the underground workings and the occurrence of fractures within the geological strata above the workings. A groundwater model was constructed by Aquaterra Consulting Pty Ltd (Aquaterra, 2009) to predict the rate of mine in-flow throughout the life of the mine. **Table 2.8** presents the predicted mine in-flows throughout the life of the mine (ie. a transient model) for the 'base case' modelling, ie. assuming the mean permeability values for each of the geological strata above and below the Hoskissons Coal Seam.

Table 2.8
Predicted Life of Mine Groundwater Inflows

Page 1 of 2

Year	Predicted Mine In-flow	
	ML/day	ML/year[1]
1	0.21	78
2	0.23	83
3	0.34	123
4	0.92	337
5	0.91	334
6	1.39	508
7	1.39	506
8	1.75	637
9	1.77	646
10	2.10	766
11	2.00	730
12	2.51	915
13	2.38	869
14	3.12	1 138
15	2.90	1 059
16	3.55	1 297
17	3.33	1 215
18	3.89	1 419
19	3.77	1 377
20	3.84	1 401
21	3.81	1 390
22	2.62	958
23	3.02	1 102
24	1.96	714

Table 2.8 (Cont'd)
Predicted Life of Mine Groundwater Inflows

Page 2 of 2

Year	Predicted Mine In-flow	
	ML/day	ML/year[1]
25	2.28	832
26	1.56	569
27	1.71	624
28	1.17	429
29[2]	0.21	531

Note 1: Yearly volume is estimated based on daily in-flow rate on last day of relevant year, ie. ML/year = ML/day x 365
Note 2: The groundwater modelling considered longwall mining over 29 years, which is 1 year longer than the life of mine production modelling completed for the proposed Longwall Project (see **Table 2.7**).
Source: Modified after Aquaterra (2009) – *Table 6.13*

The predicted groundwater in-flow steadily increases over time as the effective void space underground continues to increase and peaks in Year 20 at 5.66ML/day (2 066.6ML/year) before steadily declining until the cessation of mining. The declining in-flows is due to the fact that once mining commences in a west to east direction (LW13 to LW26), the active mining areas would be up-dip (at higher elevation) than the goaf areas. As a result groundwater accumulating in the goaf would not flow into the active panels and would not require dewatering.

2.4.8.2 Management of Dewatered Groundwater

The dewatered mine in-flows would be pumped to surface and discharged into Dam A1 within the rail loop (see **Figure 2.2**). From Dam A1, the groundwater would be processed through an Ultrafiltration (UF) and then Reverse Osmosis (RO) circuit of the Water Conditioning Plant, approved (by *Condition 3(4)* of PA 05_102) but as yet not constructed, to reduce the salinity of the water (to <500mg/L). The processed (fresh) water ("raffinate") would be pumped direct into mine storage tank for immediate use or stored in Dams C or D for later use for operational purposes (see Section 2.7.2) and excess dealt with as described in Section 2.4.8.3. The waste product of the Water Conditioning Plant (brine) would be pumped to a series of lined brine ponds, Dams A2, A3 and B within the rail loop as well as the Brine Storage Area to the north of Kurrajong Creek Tributary 1.

It is noted the construction of the Water Conditioning Plant has been brought forward in the life of the mine (under the Stage 1 Narrabri Coal Mine proposal it was anticipated the Water Conditioning Plant would be constructed once mine in-flows reached 0.88ML/day after approximately 10 years). The earlier construction of the Water Conditioning Plant is necessitated by the fact that the longwall mining process requires significantly greater volumes of 'fresh' water than a continuous miner operation. As insufficient water would be available from surface water harvest alone, the untreated groundwater is too saline for immediate re-use underground, and to minimise the requirement to source water from off the Mine Site, the accelerated development of the Water Conditioning Plant would be completed.

2.4.8.3 Management of Surplus Raffinate

Based on the predicted dewatering requirements (see **Table 2.8**), the volume of raffinate would exceed the storage capacity of Dams C and D after approximately 4 to 5 years. The Proponent is currently considering possible beneficial uses of this good quality water, such as potentially irrigation water, however, to ensure there is a confirmed method of disposing of this surplus water, it is proposed to discharge this water to the Namoi River. **Figure 2.9** displays the nominated pipeline corridor between the Mine Site and the Namoi River, which would also be used to pump water from the Namoi River to the Mine Site (should insufficient water be available from surface and groundwater harvesting during the initial few years of the Longwall Project).

In summary, the pipeline corridor is described as follows.

- The corridor follows the eastern perimeter of the Mine Site whilst on Proponent owned land before crossing over into a Crown road reserve which is aligned between the ARTC rail easement for the North Western Branch Railway Line and the privately owned land to the west.
- At the junction of the Kamilaroi Highway and the Old Narrabri Road, the pipeline would cross beneath the North Western Branch Railway Line and Kamilaroi Highway and be aligned within the Old Narrabri Road easement on the northern side of the road.
- The pipeline would remain within the Old Narrabri Road easement before crossing this road and entering the "Broadwater" property and continuing to the Namoi River.

The Proponent is continuing its negotiations with the owners of land on the western side of the crown road reserve aligned between the ARTC rail easement for the North Western Branch Railway Line for access to a narrow easement of land on these properties. It is ultimately the objective of the Proponent to avoid the placement of the pipeline within the road easement (to reduce the potential for disturbance to native vegetation).

The installation of the pipeline is discussed in Section 2.4.9.15. Section 2.7.2 discusses the operational water requirements of the Mine Site in greater detail and Section 4B.3.8.2 considers the probability of this contingency water access strategy being implemented.

2.4.8.4 Brine Management

At an operating specification which generates a 80:20 raffinate:brine output, it is estimated that almost 6 500ML of brine would be generated throughout the life of the Longwall Project (WRM, 2009 – Table 8.6). Annual brine production would steadily increase as mine dewatering increases and based on the predicted dewatering requirements (see **Table 2.8**), the volume of brine would exceed the storage capacity of Dams A2, A3 and B after approximately 5 years.

The excess brine would be pumped to lined ponds that would be constructed within the Brine Storage Area footprint identified on **Figures 2.1** and **2.2**. Notably, **Figures 2.1** and **2.2** provide the maximum footprint of the brine storage in this area (~160ha), with ponds capable of storing the ensuing several years of brine production progressively constructed (Section 2.4.9.14 provides further detail on the design and construction of the brine storage ponds). Each brine pond would be fenced as it is constructed to restrict access to both people and native fauna.

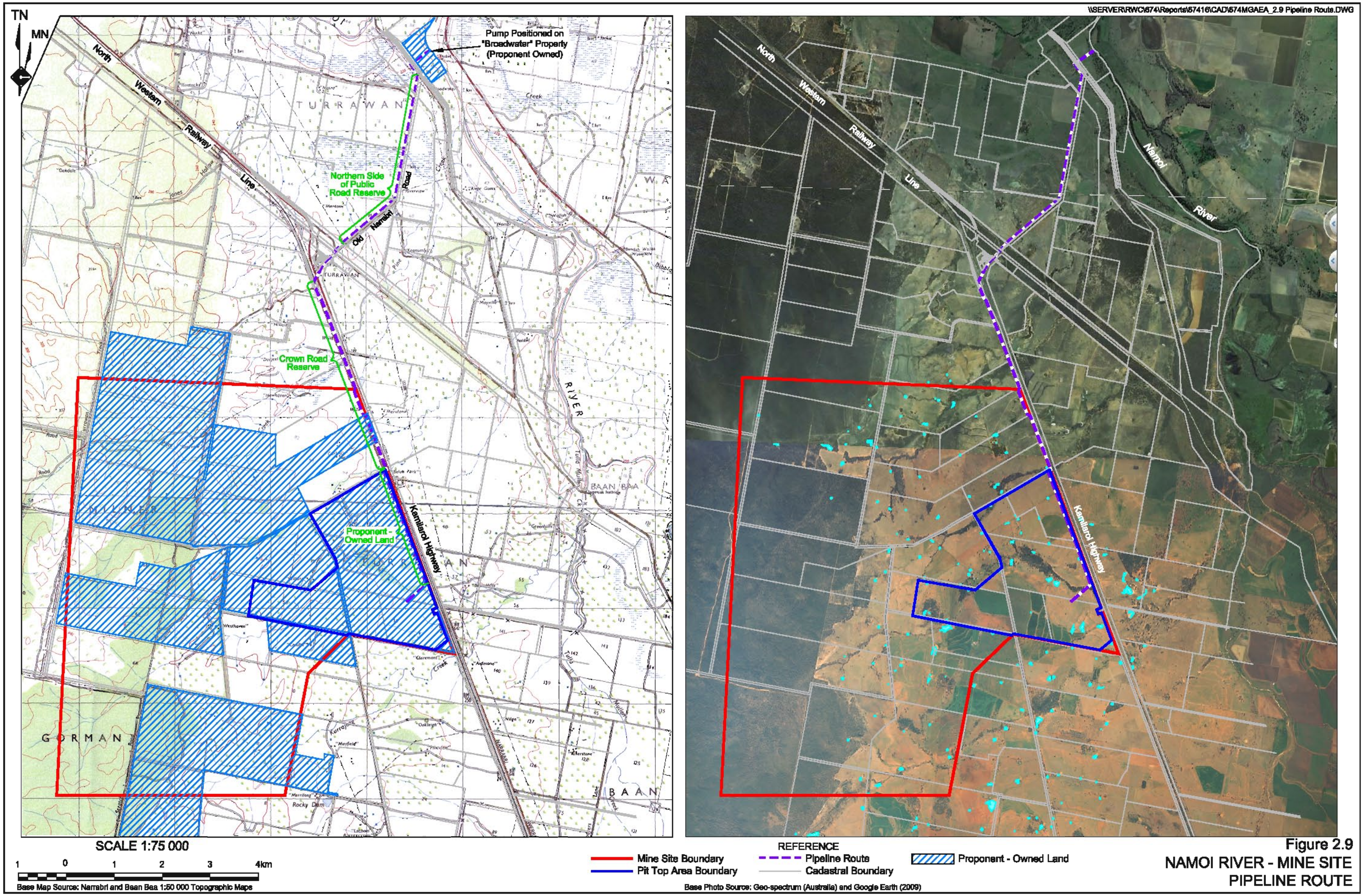

Figure 2.9
NAMOI RIVER - MINE SITE PIPELINE ROUTE

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At the completion of mining, the brine stored within the Brine Storage Area would be pumped into the goaf and retained gate roads of the completed mine through re-use of the cased goaf gas drainage drill holes. The Proponent is also investigating the potential to progressively re-inject the brine solution into the completed goaf areas of the mine as the direction of mining progresses up-dip (west to east, ie. LW14 to LW26). The Proponent intends to complete the transfer of all remaining brine to the underground by the cessation of mining in approximately 30 years.

Section 4B.3 further considers mine dewatering requirements, operational water requirements and a life of mine water balance for the proposed Longwall Project.

2.4.9 Stage 2 Surface Facilities

2.4.9.1 Introduction

The establishment of surface features including the ventilation shafts and fans, gas drainage boreholes and pumps, power supply to the ventilation fans and access tracks to each of these surface features would involve the following tasks.

- Establishment of areas to be disturbed (see Section 2.4.9.2).
- Vegetation clearing, soil stripping and stockpiling (see Sections 2.4.9.3, 2.4.9.4 and 2.4.9.5).
- Construction of access roads to the various surface facilities (see Section 2.4.9.6).
- Construction of ventilation shafts for ventilation of the underground mine workings (see Section 2.4.9.7). Until completed, the drifts and Pit Bottom Area would be ventilated by a fan located within the box cut.
- Surface to In-Seam activities to establish gas pre-drainage bore holes (see Section 2.4.9.8).
- Drilling of goaf gas drainage bore holes and installation of goaf gas vacuum pumps (see Section 2.4.9.9).
- Installation of power lines to supply the main ventilation fans (see Section 2.4.9.10).
- The construction of a longwall unit assembly area (see Section 2.4.9.11).
- An extension to the ROM Coal Pad (see Section 2.4.9.12).
- Construction of the Reject Emplacement Area (see Section 2.4.9.13).
- Construction of brine storage ponds within the Brine Storage Area (see Section 2.4.9.14).
- Installation of the water pipelines between the Mine Site and "Broadwater" property on the Namoi River (see Section 2.4.9.15).

The construction and management of the Coal Preparation Plant (CPP) is considered separately (see Section 2.5). **Table 2.9** lists the indicative areas of disturbance associated with the individual surface components of the proposed longwall mining operations. Section 2.4.9.16 further discusses the total proposed area of disturbance across the Mine Site.

Table 2.9
Indicative Areas of Disturbance for Individual Surface Facilities Required for the Longwall Project

Component	Area (ha)
West Mains Ventilation Fan Site	5.0
Rear of Panel Ventilation Fan Sites	0.25
SIS Pre-drainage Site (Development and Production)	3.5
Goaf Gas Drainage Site	0.25
Internal Power Lines	30m wide corridor
Internal Access Roads and Service Corridors	10m wide corridor
Longwall Assembly Site	2.5
ROM Coal Storage Extension	2.2
Reject Emplacement Area	25*
Brine Storage Area	160*
Note *: This refers to the maximum area of disturbance	

2.4.9.2 Area Identification

While **Figure 2.10** presents an indicative illustration of the locations and areas of disturbance for the various surface facilities required by the longwall mining operations, the exact location of these facilities would be determined based on both operational and environmental factors at the time of construction. The process to be followed in identifying the areas to be disturbed would be as follows.

1. Based on the progression of the underground workings, the preferred surface locations for facilities such as mine ventilation shafts and gas drainage bore holes would be identified. **Figure 2.10** presents the currently proposed locations for these items, however, small changes to mining conditions, heading orientation or alignment, or mining sequence may result in the relocation of any of these. The surface of the preferred location would be inspected by mine management and the general area marked out.
2. Consideration would then be given to the environmental value(s) of the preferred location. If not already surveyed, the Proponent would commission a suitably qualified ecologist and archaeologist (along with representatives of the Aboriginal community) to survey the location and advise of any constraints posed by threatened flora or fauna, or archaeological sites (under the terms of the agreed Aboriginal Cultural Heritage Management Plan). The advice of the consulted ecologist and archaeologist regarding to the location with the least potential impact on environmental values, as well as ongoing management of the site, would then be considered along with what scope is available to relocate the surface infrastructure[3], to refine the location of the proposed disturbance.

[3] Depending on underground requirements for activities such as ventilation and gas drainage, a particular location may be critical to the ongoing safe operation of the mine and the scope to relocate this activity limited. Similarly, the location of a particular activity may not be constrained by mining requirements, eg. access road alignment and as such the scope to relocate this activity may be much greater.

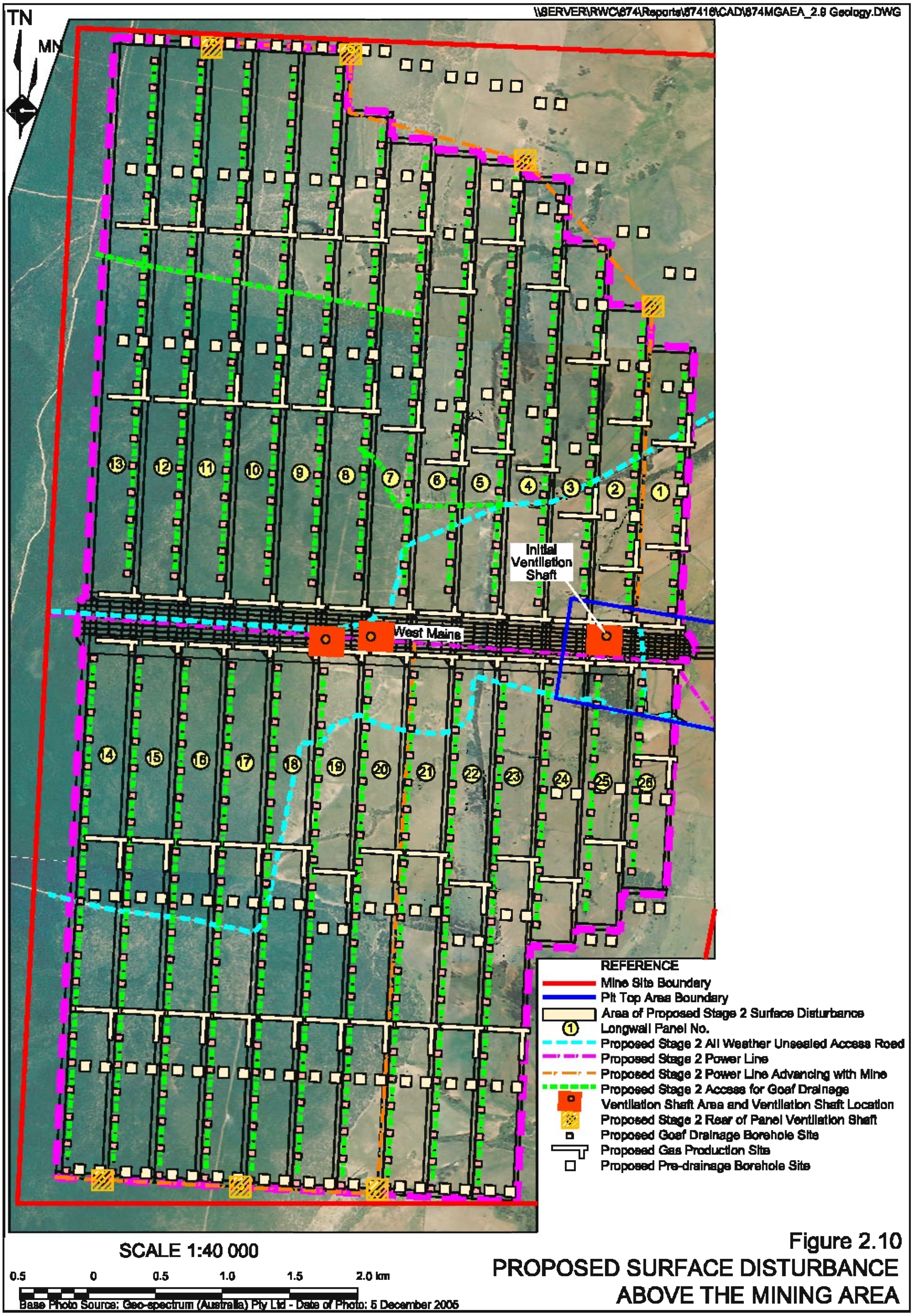


Figure 2.10
PROPOSED SURFACE DISTURBANCE ABOVE THE MINING AREA

3. Following refinement of the exact location for the surface disturbance, the consulted ecologist and archaeologist would then advise on any constraints posed by access to the sites, ie. alignment of the proposed access track to the sites. As above, the advice of the consulted ecologist and archaeologist with regard to the route alignment and management, would be used to refine the alignment of the proposed access.
4. The refined locations of surface disturbance would then be flagged and relevant personnel advised regarding the restrictions placed on activities by this site identification (flagging) and management requirements.

2.4.9.3 Vegetation Clearing

While the location of some of the required surface facilities within the western section of the Mine Site would occur within remnant woodland vegetation, the area identification process of Section 2.4.9.2 would ensure that as far as practical, the requirement to clear mature trees and larger areas of other native vegetation would be minimised. It is still likely, however, that some larger trees and areas of native shrub and groundcover would have to be cleared to provide for the access, manoeuvring and operations of construction equipment, eg. drill rigs.

Any required felling of trees would be undertaken in a single campaign as part of site establishment. The trees would be visually inspected for roosting or nesting fauna prior to clearing, with any fauna identified appropriately relocated. Trees would be broken into small sections and positioned adjacent to the disturbed area for future use in the rehabilitation of the disturbed area(s).

The remaining under-storey and groundcover would either be stripped with the topsoil to ensure maximum retention of nutrients and to facilitate the rapid vegetation of the soil stockpiles to minimise the opportunity for erosion, or pushed into stockpiles adjacent to the disturbance for future respreading over the area as part of site rehabilitation.

2.4.9.4 Soil Stripping and Management

2.4.9.4.1 Soil Stripping Requirements

The soil materials within the approximate area of disturbance for the various surface facilities required by the proposed Longwall Project were described and assessed by Geoff Cunningham Natural Resource Consultants (GCNRC, 2009a and 2009b) – see Parts 9a and 9b of the *Specialist Consultant Studies Compendium*. The assessment identified:

- the suitability of the soils present for stripping and long-term stockpiling; and
- the requirement for specific stripping and stockpiling methods and/or erosion control measures.

The assessment was based on field and laboratory examinations of key physical and chemical attributes.

Soil stripping would be required for all drilling sites and ventilation shaft construction areas, as well as the Reject Emplacement Area, Brine Storage Area and ROM coal storage area extension. The remaining facilities, ie. access tracks and power lines, would be constructed or installed above the soil which would be retained in-situ.

2.4.9.4.2 Soil Categories and Stripping

Soils were sampled on the basis of landform units identified by stereoscopic interpretation of the four geological formations over which the soil occurred (Napperby Formation, Garrawilla Volcanics, Pilliga Sandstone, Purlawaugh Formation). A total of 16 landform units were identified on the Mine Site within the four geological formations. Selective soil stripping would also be undertaken when installing the pipeline between the mine site and the Namoi River.

Napperby Formation

- Napperby Formation Drainage Line.
- Napperby Formation Lower and Mid-Slopes.

Garrawilla Volcanics

- Garrawilla Volcanics Drainage Line.
- Garrawilla Volcanics Floodplain.
- Garrawilla Volcanics Upper Slopes.

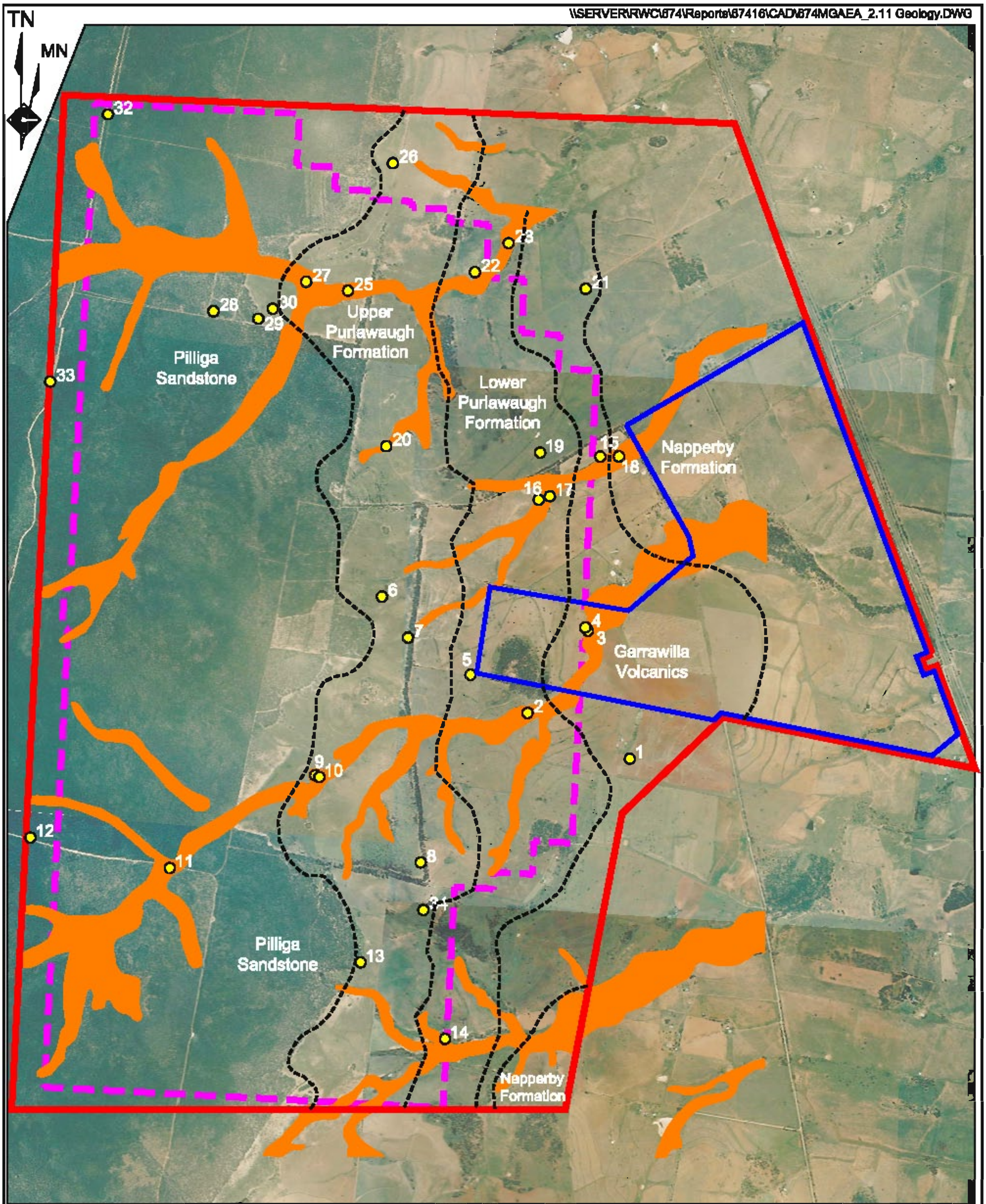
Purlawaugh Formation

- Purlawaugh Formation Crests.
- Purlawaugh Formation Major Drainage Line.
- Purlawaugh Formation Floodplain
- Purlawaugh Formation Lower Slopes.
- Purlawaugh Formation Mid-Slopes.
- Purlawaugh Formation Upper Slopes.
- Purlawaugh Formation Upper Drainage Lines.

Pilliga Sandstone

- Pilliga Sandstone Crests.
- Pilliga Sandstone Drainage Line.
- Pilliga Sandstone Lower and Mid-Slopes.
- Pilliga Sandstone Upper Slopes.

Figure 2.11 identifies the locations of these formations and sampled location(s) of the 16 landform units. An analysis of the chemical and physical properties of the soils of the 16 landform units completed by GCNRC (2009a) has determined that with appropriate controls implemented, all of the soils could be stripped and stockpiled prior to surface disturbing activities and replaced following completion of these activities. Soil stripping associated with



REFERENCE
- Mine Site Boundary
- Pit Top Area Boundary
- Mining Area (Underground)
- Drainage Line Soils
- 1 Soil Test Pit
- Geological Formation Boundary

SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Source: GCNRC (2009a) -Figures 3 & 4

Figure 2.11
GEOLOGICAL FORMATIONS AND SOIL LANDFORM UNITS OF THE MINE SITE

the proposed Longwall Project would be generally restricted to topsoil from drill sites, ventilation shaft areas and access roads. The topsoil would be stripped no deeper than the depths identified by GCNRC (2009a) using mainly a bulldozer and either a front-end loader or backhoe to place the soil in stockpiles.

GCNRC (2009a) does note, however, that the physical or chemical characteristics of some of the soils may make them susceptible to impacts as a result of subsidence. Section 2.8 provides a more detailed description of each of the soils of the 16 identified landform units and the potential impacts associated with subsidence on 14 of the 16 landform units.

2.4.9.5 Soil Stockpiling Methods

All soils within the areas to be disturbed would be stockpiled in wind rows immediately adjacent to the area of disturbance. The wind rows would not exceed 2m in height with the surfaces to be left with a 'rough' surface to assist in runoff control, seed retention and germination. The stockpiles would be seeded using a pasture cover crop to reduce erosion potential and assist in the maintenance of the biological viability of the soil resource. This stabilisation would be undertaken as soon as practicable after the construction of the stockpile to minimise erosion.

Following stockpile construction, the operation of machinery on the stockpiles would be avoided in order to prevent compaction and maintain soil aggregation.

2.4.9.6 Construction of Access Roads and Service Corridors

As illustrated on **Figure 2.10**, a number of access tracks across the Mine Site would be aligned along pre-existing access tracks. However, in order to access the pre-drainage and goaf gas drainage sites along the length of each longwall panel, an access road and service corridor would be constructed along the tailgate of each panel, roughly 30m to the west of each retained chain pillar.

The alignment of each access track and services corridor would be defined as described in Section 2.4.9.2 and construction would be completed as follows.

- Archaeological or ecological sites of significance would be identified and marked with the alignment of the corridor revised if possible to avoid these locations.
- Vegetation would be cleared, as described in Section 2.4.9.3, to create a road and services corridor approximately 10m wide.
- The cleared surface would be graded and compacted.
- Access track and services corridors that traverse drainage lines would be constructed with shallow crossings or using pipelines to maintain natural drainage and reduce erosion hazard.

Excluding the upgrading of pre-existing tracks across the Mine Site, approximately 80km of access road and service corridor would be required throughout the life of the mine. Based on a road and services corridor with a width of 10m, up to 80ha of the Mine Site[4] would be disturbed to provide access to ventilation and drainage infrastructure throughout the life of the mine.

[4] A small portion of each access road and services corridor would coincide with disturbance associated with pre-drainage and goaf gas drainage. As such, the value of 80ha is likely to be an absolute maximum.

2.4.9.7 Construction of Ventilation Shafts

Shafts of up to 6m in diameter would be constructed. The preferred construction technique would be “blind bores”, ie. bores constructed from the surface into the underground workings to depths of between approximately 170m and 320m below surface. The technique involves the drilling of the shaft to the coal seam prior to the development of the roadways in the coal with these roadways connected to the base of the shaft after their final completion. It may be necessary to initiate small blasts within the shaft, particularly when the harder volcanic units are encountered. Such blasts are routine for shaft construction and cause few effects because of their size and depth below the surface. In any event, all blasts would satisfy DECC blasting criteria (see Section 4B.7.3.7). **Figure 2.12** presents the arrangement of the Ventilation Shaft Area during construction and operation.

The construction area for each Ventilation Shaft would be approximately 5ha and incorporate the following component areas.

- Drill rig foundation and shaft drilling zone.
- General equipment laydown area.
- Casing laydown area.
- Stores and container area.
- Parking area.
- Generator, compressor and fuel storage area.
- Spoils handling area.
- Water and drill spoil settlement pond(s).
- Sediment dam.

At each ventilation shaft construction site, vegetation clearing and soil stripping and stockpiling would be undertaken as described in Sections 2.4.9.3 and 2.4.9.4. Where practicable, even within the construction area, trees that can be retained in-situ (without jeopardising the drilling operations or personnel safety) would be retained. The water and drill cuttings pond(s) would be lined with an impermeable black plastic which would eventually be removed prior to pond backfilling and rehabilitation of each Ventilation Shaft Area.

During shaft drilling, a specifically designed bailing bucket would be used to dewater the shaft, with the water pumped to the water storage pond. The bailing bucket would be used in preference to a pumping system due to the impact of drilling fines and muds on the operations of pumping systems. Drilling fluid would be discharged into the settlement ponds. The end product does not have any toxic or harmful chemicals and can be treated for solids and discharged into the environment via a sediment basin. Each drill pad would be designed and constructed such that any overflow from sediment basins or sumps would be retained on the drill pad itself, ie. no run-off would be discharged to local drainage or impact on undisturbed vegetation.

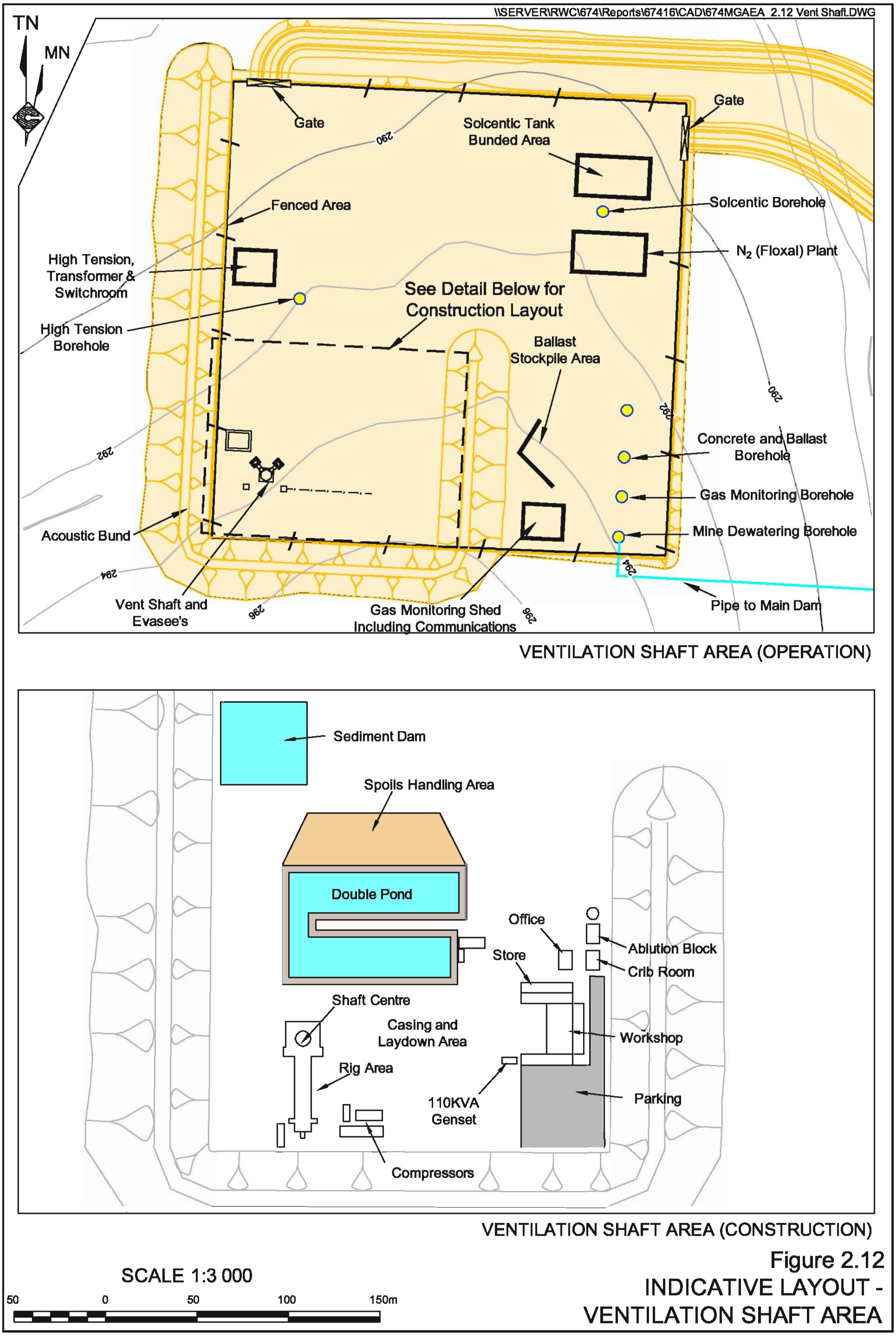


Figure 2.12
INDICATIVE LAYOUT - VENTILATION SHAFT AREA

The waste rock removed during the drilling would be stockpiled within the spoils handling area. This material would be used in conjunction with subsoil to construct the acoustic bund wall around the Ventilation Shaft Area as well as in the backfilling of the water and drill cuttings settlement ponds. Any run-off from these stockpiles would be directed to drill pad sediment basins or sumps, with overflow from these prevented from discharging from the drill pad.

The initial ventilation shaft would be constructed opposite LW2 concurrently with the mining of the West Mains (see **Figure 2.10**) during which time mine ventilation would be provided from surface fans located within the box cut for the three mine drifts. As the underground mine develops to the west, two additional ventilation shafts and surface fan/s would be constructed from surface into the West Mains. Ventilation shafts and fans would also be constructed from surface into the rear of approximately every third or fourth longwall panel (see **Figure 2.10**). These facilities would only be providing / exhausting relatively small quantities of air ($25m^3/s$ – $30m^3/s$) and are likely to be of a maximum diameter of approximately 1m to 1.5m with surface disturbance of a significantly less impact than for the main fan facilities (<1ha). While the additional ventilation shafts and surface fans would be positioned based on the ventilation requirements of the mine, the locations presented on **Figure 2.10** provide an illustration of the likely locations. The layout and construction of the additional ventilation shaft and fan areas would be the same as for the initial site.

The location and number of surface ventilation locations is based on a conservative assessment of ventilation requirements and is therefore likely to provide for more ventilation capacity than may be required, ie. the number of surface ventilation points, and therefore area of surface disturbance is unlikely to exceed that illustrated on **Figure 2.10**. **Figure 2.10** provides for ventilation from the West Mains from Maingates 2, 7 and 8, and rear of panels LW2, LW5, LW9, LW12, LW14, LW19 and LW21. Therefore, on the basis that each West Mains ventilation shaft area would disturb up to 5ha and each rear of panel ventilation shaft area up to 0.25ha, up to 17ha of the Mine Site would be disturbed to accommodate the ventilation requirements of the Longwall Project of the life of the mine.

Access to the locations of the ventilation shafts and fans would utilise existing farm tracks where possible, with any road upgrade (or construction) undertaken as described in Section 2.4.9.5).

2.4.9.8 Surface to In-seam Pre-Drainage Drilling Sites

Surface to In-seam (SIS) pre-drainage requires a number of small diameter SIS boreholes to be drilled into and then along the length of the coal seam. The SIS boreholes are drilled from surface inbye of each longwall panel as illustrated on **Figure 2.13a**. Once drilled into the Hoskissons Coal Seam, the SIS boreholes would be split into two or three small diameter lines (see **Figure 2.13a**) to increase the capacity for gas desorption into the boreholes and therefore drainage from the seam. The effective length on these boreholes may extend to 2km, however, the current pre-drainage proposal for the Longwall Project provides for a maximum length of 1.5km. **Figure 2.13a** also illustrates the surface disturbance associated with each “SIS Borehole Drill Site”. An area of approximately 80m x 80m would be required for each SIS Borehole Drill Site (0.64ha), however, as with other surface drilling sites, mature trees and other vegetation would be retained where practicable within each site. Each drill site would be designed and constructed such that any overflow from sediment basins or sumps would be retained on the drill pad itself, ie. no run-off would be discharged to local drainage or impact on undisturbed vegetation. Any run-off from stockpiled material would be directed to the drill site sediment basins or sumps, with overflow from these prevented from discharging.

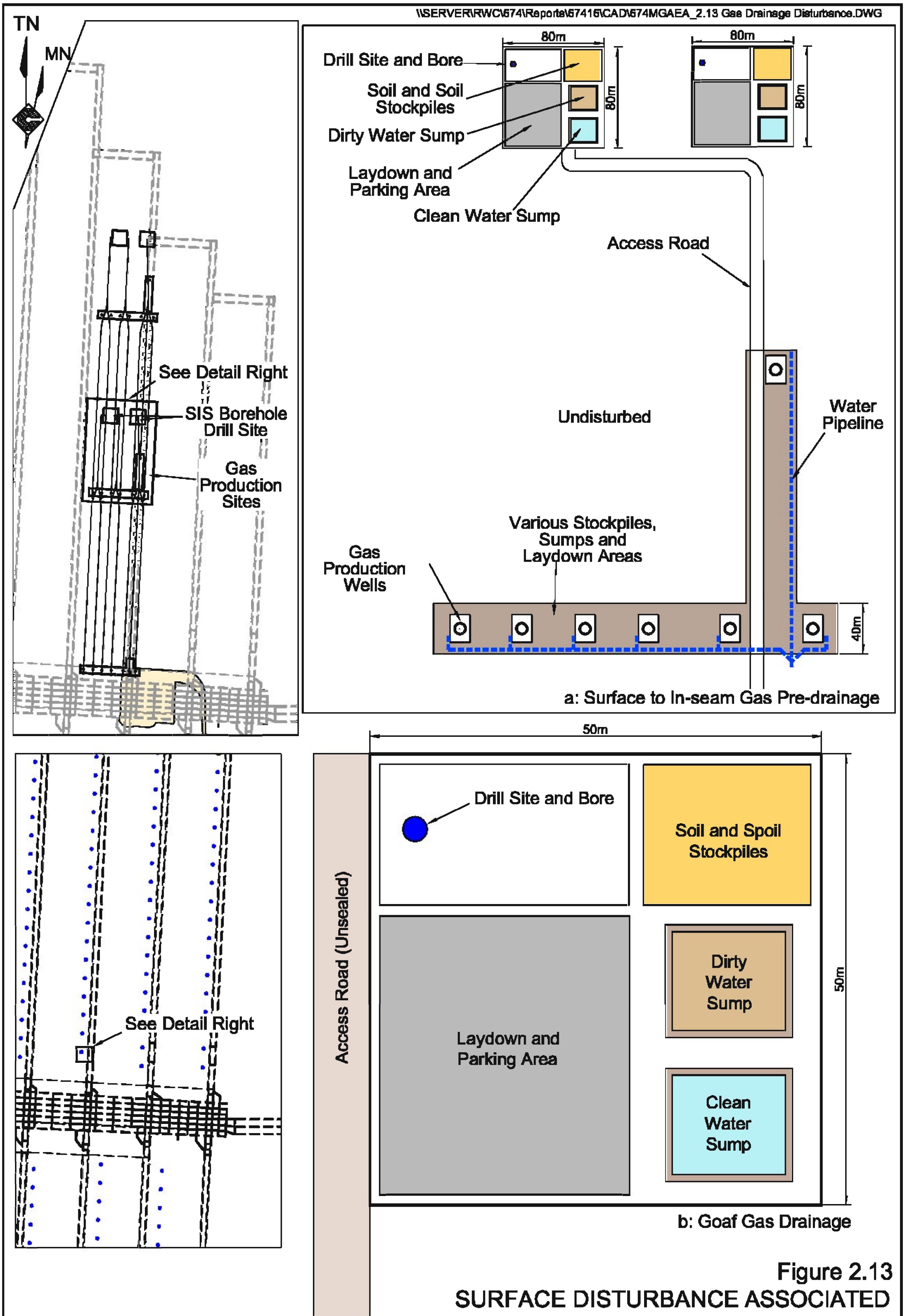


Figure 2.13
SURFACE DISTURBANCE ASSOCIATED WITH GAS PRE-DRAINAGE

At the outbye extremity of each set of SIS boreholes, a pump well would be constructed to intersect each SIS borehole. A pump at the top of each well would be used to extract the gas and water accumulating in the SIS boreholes. **Figure 2.13a** identifies the general arrangement of the "Gas Production Sites", as well as the general surface disturbance associated with each site. The current pre-drainage arrangement provides for seven pump wells at each Gas Production Site (see **Figure 2.13a**), requiring an area of approximately 2.9ha.

Apart from the shorter eastern longwall panels (LW1, LW2, LW24 and LW26), it is anticipated that the length of the blocks would require three sets of Surface to In-seam (SIS) production wells along the length of the longwalls. Only two sets of SIS production wells would be required for the shorter eastern longwall panels. The footprint of disturbance in each case would be reflect that illustrated on **Figure 2.13a**, ie. requiring an area of approximately 3.5ha.

It is noted that a number of the longwall panels LW9 to LW13 and LW20 to LW23 lie very close to the northern or southern boundary of the Mine Site. For these longwall panels, and to ensure that all surface disturbance relating to SIS production wells remains on the Mine Site, the SIS drill sites may need to be drilled up-dip.

As noted in Section 2.4.5.3.1, it is considered likely that once underground mining progresses beyond LW2 or LW3, gate road development will be sufficiently advanced ahead of longwall mining to enable conventional underground in-seam pre-drainage to be undertaken. Given the approximate area of surface disturbance required for this method of pre-drainage would approximate 0.5ha (3ha less than the SIS drilling surface disturbance requirements), the areas of surface disturbance illustrated on **Figure 2.10** are likely to far exceed the areas actually disturbed over the life of the mine. However, for the purpose of this *Environmental Assessment*, the total area of disturbance assumes that SIS drilling would be undertaken for the life of the mine. Therefore, on the basis that three SIS Drill Sites and accompanying Gas Production Sites would be required for Longwall Panels LW3 to LW24, and two would be required for LW1, LW2, LW25 and LW26, the total area of disturbance would be up to 259ha. It is worthy of note that this represents an absolute maximum area of disturbance as the Proponent would reduce, or consolidate with areas of disturbance associated with other activities (eg. access roads), the area of disturbance.

2.4.9.9 Goaf Gas Drainage Drilling Sites

As noted in Section 2.4.5.3.2, gas concentrating in the goaf of the underground workings would be removed via a vacuum pump attached to the top of a cased 250mm internal diameter borehole, located towards the edge of the completed longwall panel and at approximately 200m intervals. The boreholes would be drilled from surface and would therefore require the creation of a drill pad of approximately 50m x 50m. Within the drill pad, provision would be made for the drill site itself, two small sumps and storage of vehicles and drilling materials (see **Figure 2.13b**). An access track would also therefore be cleared and maintained for as long as the goaf gas drainage vacuum pump is required to operate (see Section 2.4.9.5).

At each drill site, vegetation clearing and soil stripping and stockpiling would be undertaken as described in Sections 2.4.9.3 and 2.4.9.4. At most locations, there would be no need to clear any trees and groundcover would be retained over any areas not required for drilling or access requirements. Two small sumps (5m x 5m) for recycling and storage of water and drilling waste would be constructed with each sump lined with an impermeable plastic liner which would eventually be removed prior to sump backfilling and rehabilitation of each drill site. Drill spoil collected and consolidated within the two sumps would be removed as necessary and ultimately used, in conjunction with stockpiled subsoil to backfill the sumps of the drill site. Each drill site would be designed and constructed such that any overflow from sediment basins or sumps would be retained on the drill pad itself, ie. no run-off would be discharged to local drainage or impact on undisturbed vegetation. Any run-off from stockpiled material would be directed to the drill site sediment basins or sumps, with overflow from these prevented from discharging.

As the longwall mining operation progresses to the west, and the slope of the surface increases, some of the drill sites are likely to be located adjacent to ephemeral drainage lines. To prevent runoff from significant rainfall events flowing through the disturbed areas of each drill site, upslope catch banks would be constructed parallel to contour at each of these sites. These catch banks would divert overland flows away from, and discharge the water down-slope of the drill sites.

2.4.9.10 Power Line Installation

A power line easement and access track would be constructed and maintained to each main and tailgate ventilation surface fan, although these would only be extended as each new shaft and surface fan is constructed. As far as practicable, these easements would be aligned to avoid disturbance to any substantial trees within the 30m wide surface corridor. **Figure 2.10** provides the indicative alignment of the power lines to the ventilation shaft areas.

2.4.9.11 Longwall Assembly Site

The longwall assembly area would comprise a flat hardstand constructed by cut and fill methods to the north of the current Pit Top Area infrastructure (see **Figure 2.2**). The area of 2.5ha comprises cleared paddocks and would not result in the clearing of any trees. Topsoil and subsoil would be initially stripped and stockpiled for use in the rehabilitation of the longwall assembly area. The excavated 'cut' material would be preferentially used to build up the 'fill' section of the area, however, this may be supplemented by material excavated from drift construction.

2.4.9.12 ROM Coal Pad Extension

Figure 2.2 also identifies the proposed 2.2ha extension to the ROM Coal Pad and realigned road which runs around the northern areas of the Pit Top Area. The ROM Coal Pad extension would be constructed using material excavated from drift to provide a hard and flat surface. The realigned road would similarly be elevated above natural topography using material excavated from drift construction.

2.4.9.13 Reject Emplacement Area

The proposed coal screening and washing process (see Section 2.5.3) would generate both coarse and fine reject material. This reject would be transferred from the coal handling and processing facilities of the Pit Top Area to a Reject Emplacement Area (see **Figure 2.1**). An area of up to 25ha has been allocated to the west of the box cut for the storage and management of this reject material. Further detail on the generation, transfer and management of the reject material is provided in Section 2.5.4.

2.4.9.14 Brine Storage Ponds

As noted in Section 2.4.8.4, a site water balance prepared for the Longwall Project reflecting the results of the groundwater modelling, operational water requirements and the treatment of raw groundwater producing 80% raffinate and 20% brine, predicts that after 3 to 4 years of operations, additional brine storage would be required to that provided by Dams A2, A3 and B. The volume of surplus brine is predicted to gradually increase throughout the life of the mine. The footprint for the Brine Storage Area identified on **Figure 2.2** covers an area of approximately 160ha, which with an average storage depth of 5m would provide sufficient storage capacity of approximately 8 000ML, sufficient for the predicted brine generated over the life of the Longwall Project[5].

Acknowledging the uncertainty associated with mine in-flow predictions, the Proponent would progressively construct brine storage ponds within the nominated area. Each cell would provide sufficient capacity for several years predicted brine generation and would provide the Proponent with flexibility to modify the brine management to reflect observed mine in-flows and brine generation.

- In the event that mine in-flows are significantly less than predicted, the total footprint area would be reduced to reflect the lower volumes of brine that would be generated.
- Similarly, in the event that a beneficial use for either the raw groundwater of brine is identified (reducing the reliance on either brine generation or storage), the total footprint area would be reduced.
- In the event that mine in-flows are significantly greater than predicted, the depth of each brine storage pond would be increased to ensure that the total footprint area would not be increased.

Based on the current predictions for mine dewatering and brine generation, **Figure 2.14** displays the layout and typical sections through the brine storage ponds of the Brine Storage Area. Given the uncertainty over mine dewatering requirements, a conceptual layout for the brine storage ponds has been provided for brine production for the Life of Mine, with the size of each cell increasing to accommodate the increasing volume of water generated by the mine throughout this period.

Each brine storage pond would be constructed with a storage depth of approximately 5m and 0.5m freeboard. The cell walls would be constructed with a slope of no greater than 3:1 (H:V). A sequential process of topsoil removal would be adopted, with subsoil recovered from the floor of each cell used to construct the perimeter walls. The topsoil would be used to stabilise the outer slopes of the cell walls (which form the perimeter of the Brine Storage Area). Surplus topsoil would be stored in dedicated stockpiles around the perimeter of the Brine Storage Area.

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[5] This area accounts for the proposed construction of the Brine Storage Area as a series of progressively constructed cells (which would reduce the total storage capacity due to the volume of earth required to construct each cell wall).

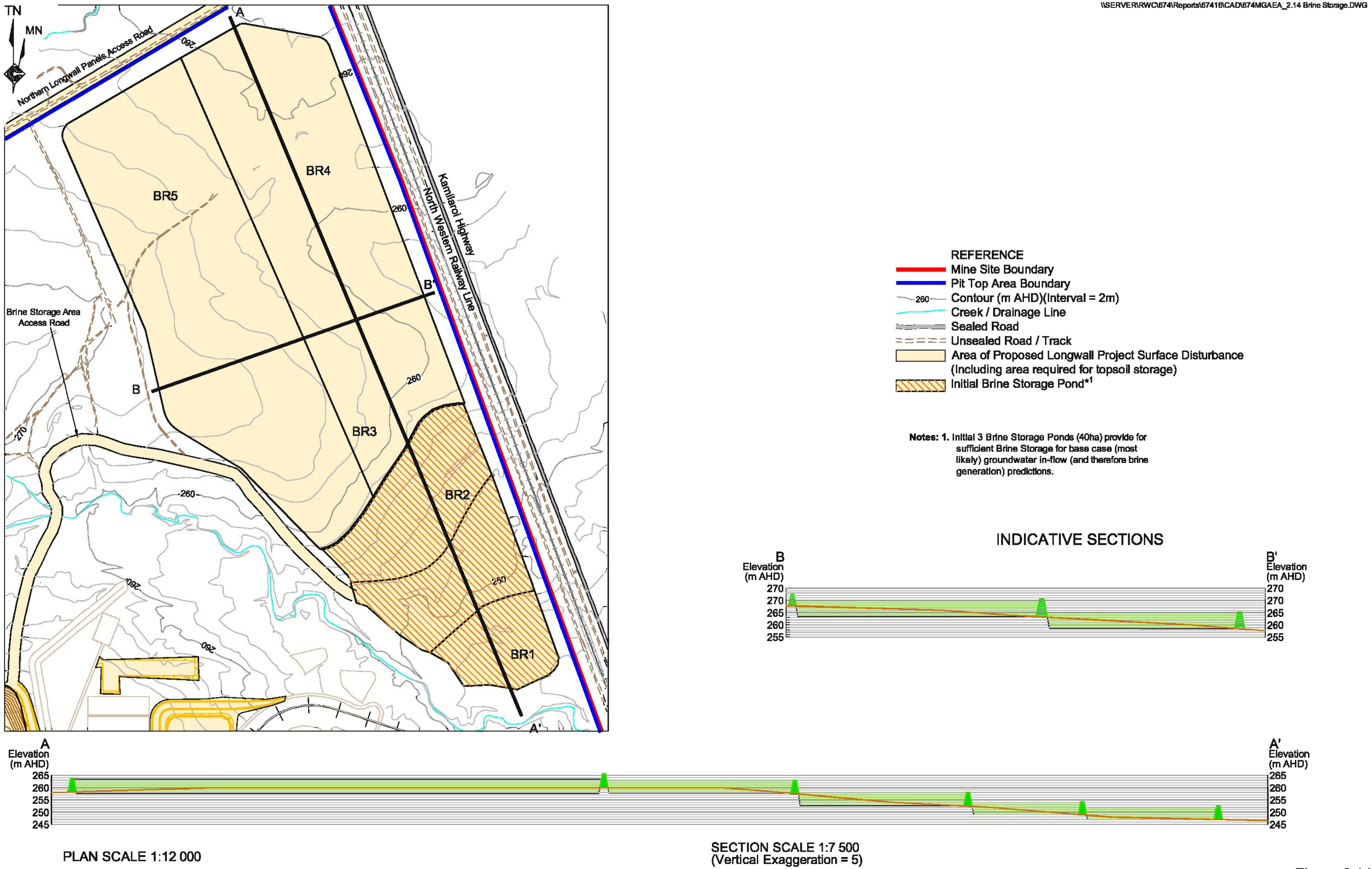

Figure 2.14
BRINE STORAGE AREA

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As the water to be held within the evaporation / storage ponds would be saline in nature, the ponds would be constructed to be effectively impermeable. Based on the South Australian publication "*EPA Guidelines – Wastewater and Evaporation Lagoon Construction (EPA 509/04)*", a permeability of $1x10^{-9}$m/s would be the maximum allowable level of material used to construct the floor and walls of the evaporation / storage ponds. To achieve this level of permeability, the Proponent would first compact a layer of clayey material, of at least 300mm thick, obtained from in-situ material over the constructed cell wall. Care would be taken to ensure that any rocks and/or coarse or sharp material is removed or compacted within the cell batter. An impermeable plastic liner (similar to that used to line Dams A1, A2, A3 and B within the rail loop) would then be laid over the cell floor and inner walls.

Based on the predicted mine dewatering requirements and existing storage facilities available within the rail loop (346ML), it is anticipated that the first storage cell would not be required for between 4 and 5 years, with construction commencing approximately 6 to 12 months prior to the cell being required. Additional cells would be designed and constructed to store the anticipated volume of brine to be generated over the following 2 to 5 years and similarly would be constructed approximately 6 to 12 months prior to the cell being required.

Observed mine in-flows and water use on the Mine Site would be monitored and compared to the predictions and assumptions used in the preparation of the site water balance. These observations would be used to validate the in-flow predictions and recalculate the necessary storage capacity of the Brine Storage Area. The size and design of the brine storage ponds would be modified as required (within the Brine Storage Area footprint) to accommodate the re-calculated water balance for the Longwall Project.

2.4.9.15 Water Pipeline between the Mine Site and Namoi River

Two pipelines, each of 300mm in diameter, would be laid within a trench approximately 1.2m deep within the alignment described in Section 2.4.8.3. Beneath the roads and railway line traversed by the pipeline corridor, the pipelines would be installed with the aid of an under-road / rail boring machine. The boring machine would also be used to install the section of the pipelines that would traverse beneath Kurrajong Creek – Tributary 1. The two pipelines would enable the Proponent to either pump water from the Namoi River to the Mine Site, or raffinate from the Mine Site to the Namoi River. Each pipeline would be installed with leak detection equipment, such as flow meters pressure gauges placed at regular intervals along the length of the pipeline.

An excavator would be used to dig and fill in the trench with emphasis placed upon separating the topsoil. Efforts would be made to avoid disturbing mature vegetation along the route, however, this would be unavoidable over parts of the corridor (especially along the road easement which runs parallel to the Mine Site which is only 10m to 12m in width and heavily vegetated in parts). The in-filled trench would be allowed to revegetate naturally as the soil excavated would be replaced immediately following the placement of the pipes.

2.4.9.16 Subsidence Monitoring Lines

In accordance with the recommendations of DGS (2009), the Proponent would install subsidence monitoring survey pegs between 10m and 15m apart, both along longitudinal lines line extending in-bye and out-bye from each longwall panel starting and finishing point, as well as two transverse subsidence lines across the northern and southern panels.

To establish each subsidence monitoring line, an access track the width of a light vehicle would be required (~3m). It is estimated that up to 100km of access tracks would be required, with the majority of these utilising pre-existing tracks created for pre-drainage or goaf gas drainage access. Only the transverse subsidence lines are likely to require additional disturbance to that described in the previous sections, 20 000m x 3m = 6ha. Given the conservative nature of the estimated disturbance described in the preceding sections, it is considered that this area is already incorporated into estimates of surface disturbance.

2.4.9.17 Summary of all Surface Disturbing Activities

Based on the proposed mine design, ventilation and gas drainage requirements, and additional disturbance associated with other activities associated with the Longwall Project, **Table 2.10** provides the anticipated maximum area of disturbance associated with the Longwall Project. In total, approximately 700ha would be disturbed to varying degrees. Further discussion on the extent of disturbance of native vegetation within this area is provided in Section 4B.4.5.

Table 2.10
Indicative Areas of Disturbance for Surface Facilities Required for the Longwall Project within the Mine Site

Component	Area (ha)
Ventilation Fan Sites	17
SIS Pre-drainage Site (Development and Production)	259*
Goaf Gas Drainage Sites	100
Internal Power Lines	57
Internal Access Roads and Service Corridors	80
Longwall Assembly Site	2.5
ROM Coal Storage Extension	2.2
Reject Emplacement Area	25*
Brine Storage Area	160*
Total	**698.7**
Note *: This refers to the maximum area of disturbance	

2.5 COAL PROCESSING AND REJECT MANAGEMENT

2.5.1 Introduction

As part of the resource evaluation completed for the proposed Stage 2 operations, a comprehensive review of coal quality and washability was undertaken. Based on this review, it has been determined that all coal mined from the underground operation would be subject to processing, albeit simple crushing and/or coal washing to achieve a high yield of the ROM to product coal.

The following subsections describe the modifications to Pit Top Area infrastructure, the coal processing and stockpiling operations and the management of the coarse and fine reject that would be generated by the processing operations.

2.5.2 Modifications to Approved Coal Handling and Preparation Facilities

As illustrated on **Figure 2.15**, the ROM coal pad would be extended to the north to provide for the increased stockpile requirements and additional infrastructure required to accommodate the increase in coal production from 2.5Mtpa to a maximum of 8.0Mtpa. The ROM coal pad extension would increase the size of the pad from approximately 2ha to approximately 4.2ha and would, in combination with the elevation of the ROM coal drift conveyor and stacking system, increase the ROM coal storage capacity to 400 000t.

The coal conveyor and stacking system would be upgraded to accommodate the increased volume of ROM coal produced annually. The coal processing circuit would also be modified from that approved for the Stage 1 operations, principally to incorporate a washing circuit for the larger sized coal (>16mm) and by-pass system for the <16mm sized coal.

Finally, as a consequence of adding a washing circuit to the coal handling and preparation facilities, both coarse reject (stone and oversize [>50mm] coal) and fine reject (<0.5mm material) would be produced. The Proponent proposes to progressively develop a Reject Emplacement Area over a maximum area of 25ha to store the coarse and fine reject material.

2.5.3 Coal Handling and Preparation Facilities

Figure 2.16 identifies the following components of the coal handling and preparation facilities, together with a flow chart mapping the process from the ROM coal. **Figure 2.17** provides a detailed illustration of the washing and dewatering circuit of the Coal Preparation Plant (CPP).

Crushing and Screening

- Drift conveyor to deliver primary sized (<200 mm) ROM coal from Pit Bottom to the surface. The conveyor would deliver coal at a rate of up to 3 500t per hour.
- An overhead ROM coal stacking system with a travelling tripper[6] which would tip ROM coal from a height of 13m above the base of ROM coal pad. The ROM coal pad would have a storage capacity of 400 000t.
- Two ROM coal reclaim tunnels would deliver the ROM coal from the ROM coal pad at a rate of up to 1 000t per hour to a rotary breaker.
- The rotary breaker, would reduce the coal from <200mm to <125mm at a rate of 1 000t per hour.
- From the rotary breaker, the <125mm coal would be conveyed to a dry screen for separating the >16mm coal for washing through the CPP and the <16mm coal which would by-pass the CPP and be transferred directly to the product coal stockpile pad.

[6] The travelling tripper allows the ROM coal to be tipped from the conveyor at any point along the stacking system.

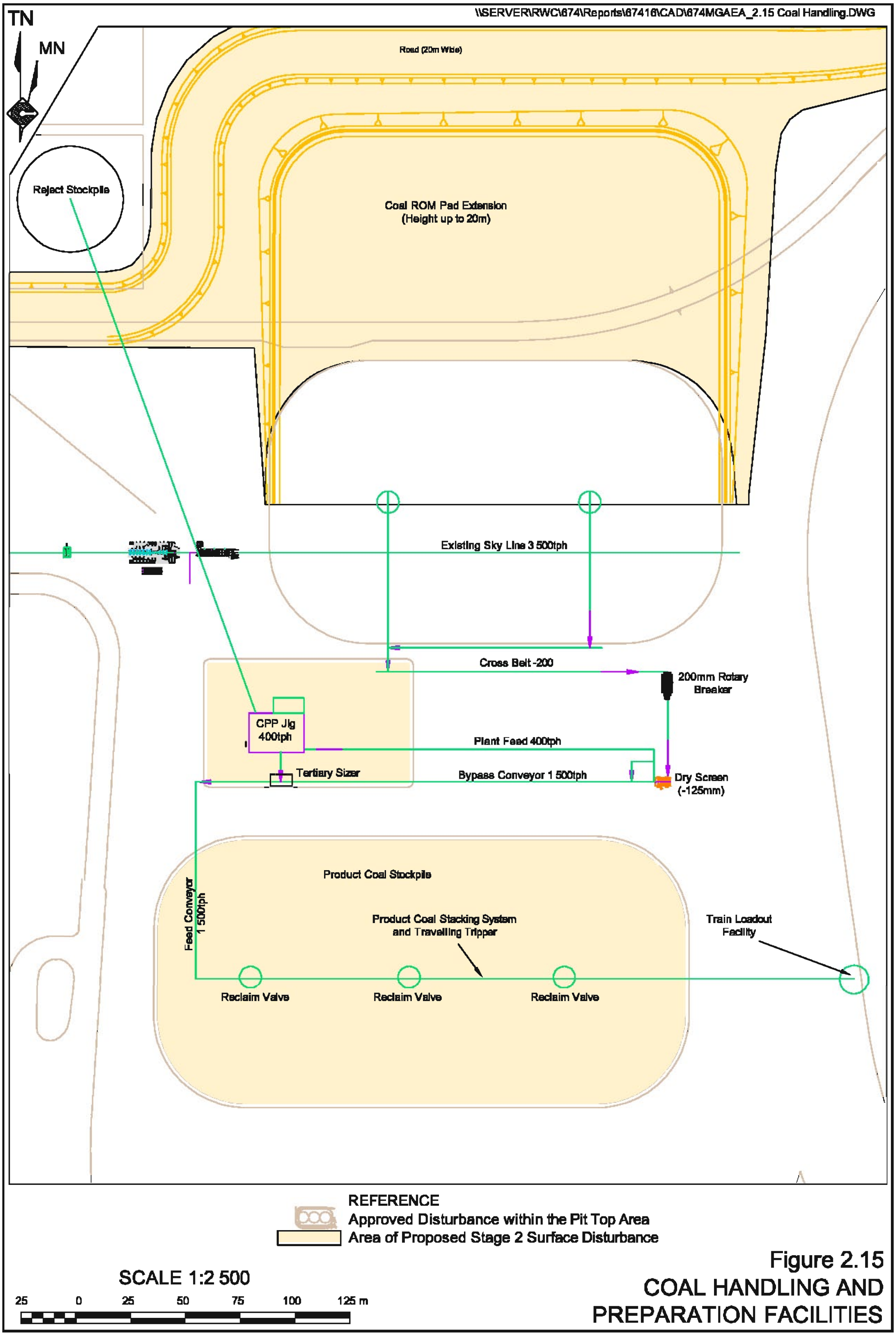

Figure 2.15
COAL HANDLING AND PREPARATION FACILITIES

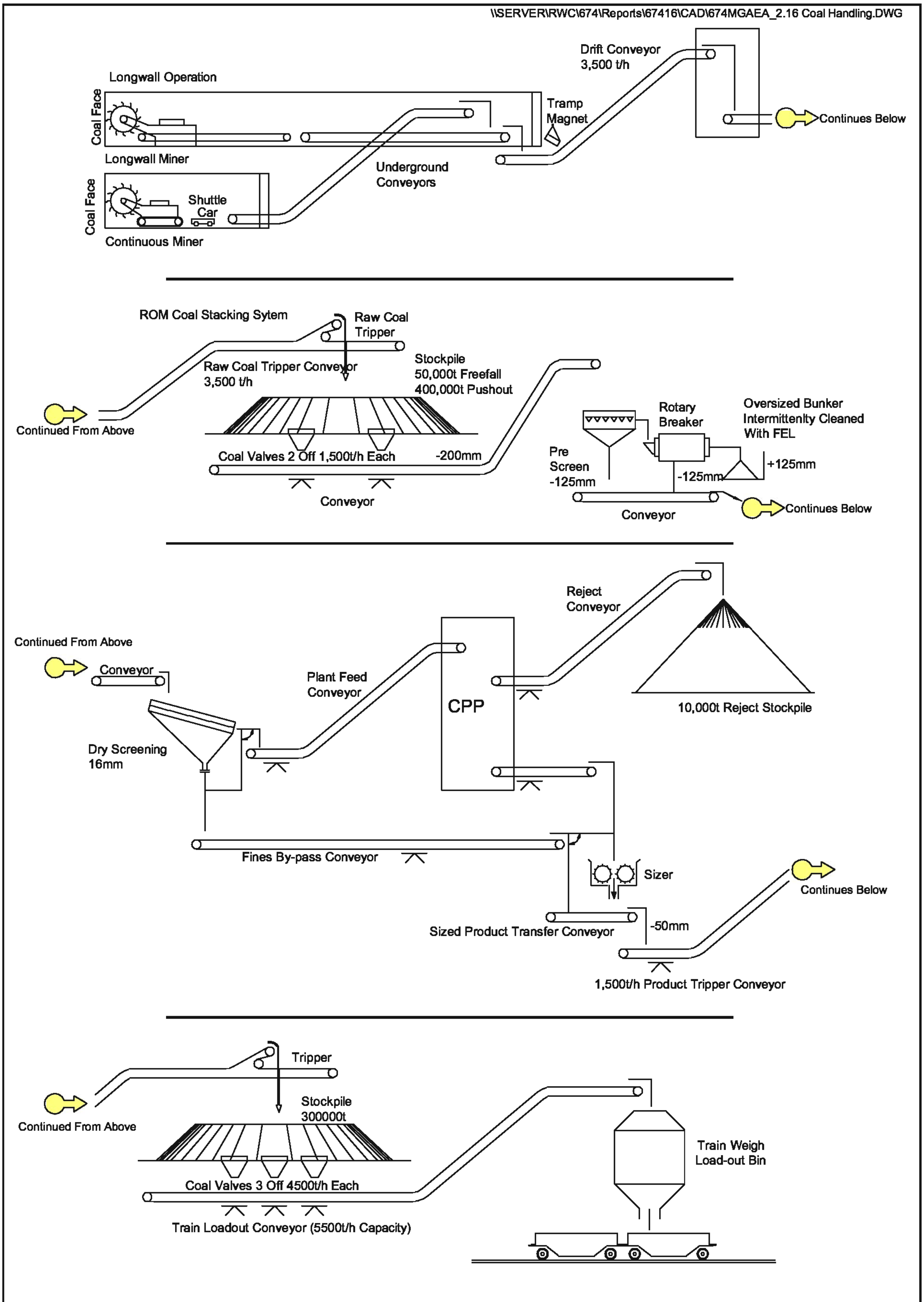

Figure 2.16
MINING / PROCESSING FLOWSHEET

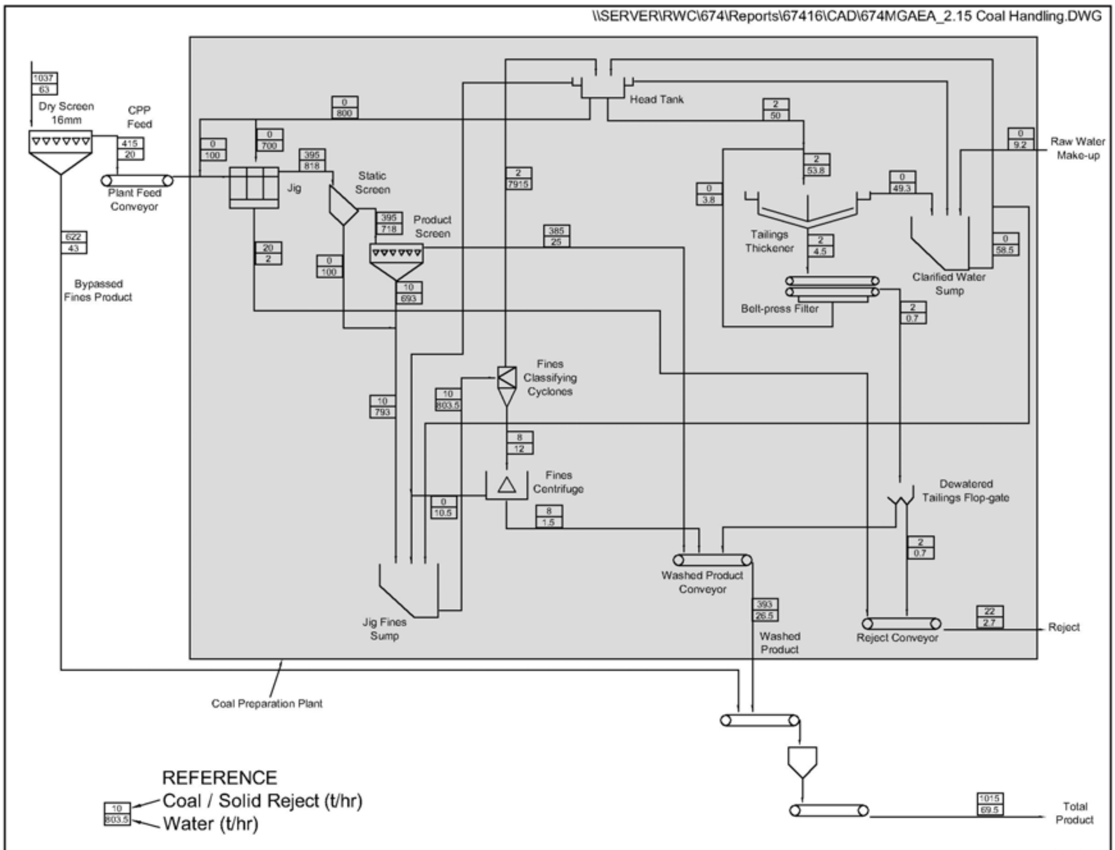

Figure 2.17
COAL PREPARATION PLANT FLOW SHEET

Coal Preparation Plant (Washing)

- Water would be added to the >16mm coal within a jig washing plant ("the jig") with the >50mm coal and other reject screened off by a tertiary sizer and sent to the reject pile prior to loading to trucks and placement within the Reject Emplacement Area. The jig would wash the coal at a rate of approximately 435t per hour.
- The washed coal would then pass over a static screen and then a final product screen before being re-introduced to the by-pass conveyor for delivery to the product coal stockpile pad.
- The water and fines mixture ("fines") from the jig would report to the jig fines sump and would be separated within classifying cyclones into <0.1mm ("ultra-fine reject") and >0.1mm material.
- The >0.1mm material would be dewatered within a fine coal centrifuge with the water returned to the washing circuit and the dewatered fines conveyed for inclusion with the washed product coal.
- Water containing the ultra-fine reject would overflow from the classifying cyclone and report to a head tank. From the head tank, the water would either be introduced to the jig or sent to a tailings thickener to thicken the ultra-fine reject which would be sent to a belt-press filter for final dewatering and generation of filter cake. A bleed line from the head tank to the thickener ensures ultrafine material does not continually recirculate and build up within the plant.

- The filter cake would then be conveyed, via a flop-gate to a conveyor for transport to either a product or reject stockpile. Any remaining water would be captured at the flop-gate and delivered to the washed product conveyor to maintain product coal moisture.

Product Coal Stacking

- Both the by-pass circuit and CPP circuit would deliver coal to an overhead coal product stacking system above the product coal storage pad. A travelling tripper would allow for the discharge of coal (from a height of 20m above the floor of the pad) at any point along the length of the stockpile. The capacity for the product coal storage pad would be increased from 100 000t to 350 000t with dozer push.
- A product reclaim tunnel would be constructed beneath the product coal storage pad, incorporating three reclaim valves spaced approximately 80m apart. From the reclaim tunnel, trains would be loaded using a fully automated, batch weighing system at a rate of approximately 5 500t per hour.

Reject Stockpile Management

- The coarse reject and filter cake would be conveyed to a conical stockpile west of the ROM coal pad. The reject would be regularly loaded by front-end loader to trucks for placement within the Reject Emplacement Area to the west of the coal handling and preparation facilities.

2.5.4 Management of Processing Reject

2.5.4.1 Reject Quantities and Characteristics

The coal preparation process is expected to remove up to 5% of the total ROM feed as reject, which would be predominantly rock from the floor of the workings. About 90% of this would be coarse reject (16mm to 125mm) with the remainder being filter cake produced by the dewatering and thickening of the ultra-fine reject that is not blended with the coal products. The two reject streams would be mixed prior to conveying and stockpiling within the Reject Pile (see **Figure 2.15**). Consequently, there would be no requirement for a separate fines disposal facility, and the combined reject would be a clean, low moisture gravel-sized material well suited to the construction of the Reject Emplacement Area by conventional “earthmoving” procedures.

Based on a recoverable coal resource of approximately 170 million tonnes and a 30 year mine life, the total reject to be accommodated in the Reject Emplacement Area would approximate 8.2 million tonnes. Assuming a conservative dry density of 1.5tonnes/m^3, the total volume of the reject to be managed within the Reject Emplacement Area would approximate 5.7 million m^3.

2.5.4.2 Reject Emplacement Area Location, Design and Construction

The proposed location of the Reject Emplacement Area (see **Figure 2.2**) is on the north-facing side of a low ridge immediately to the west of the box cut for the mine drifts. The Reject Emplacement Area would be bounded on the north by Kurrajong Creek, and on the south by the crest of the ridge. The proposed location of the Reject Emplacement Area falls gently at about 1.5° from the ridge to the bank of Kurrajong Creek over a distance of about 600m.

The area allocated to the Reject Emplacement Area is approximately 25ha, although it would be developed progressively throughout the life of the mine and the entire area may not be required for the management of reject material. The emplacement would be constructed against the slope of the ridge, rising to a maximum of 15m above the natural surface level.

The Reject Emplacement Area would be constructed as a series of elongated (north-south oriented) cells in a westerly direction. Each cell would be approximately 20m wide to accommodate the truck operating requirements. Prior to placing waste, the emplacement footprint would be progressively stripped of topsoil and subsoil to a depth of about 400mm, with the stripped material being either stockpiled for later use in the rehabilitation of the emplacement, or placed directly on completed sections of the emplacement or at other locations on the Mine Site where rehabilitation may be required. The coal reject may generate saline leachate and testing of the reject would be undertaken to determine the propensity of the material to generate saline, or otherwise contaminated leachate. In the event that the testing indicates the reject has a propensity to generate saline leachate, or leachate with elevated concentrations of other contaminants, the base of each cell would be constructed to be effectively impermeable. To achieve a permeability of $1x10^{-9}$m/sec or less, the Proponent would either:

- compact a layer of clayey material (at least 300mm thick) over the base of each cell, taking care to ensure that any rocks and/or coarse or sharp material are removed or compacted within the cell batter; or
- in the event insufficient in-situ material of suitable impermeability is not available, additional clay would be imported or an impermeable plastic liner used.

Shallow piezometers (lysimeters) would be installed down-slope of the Reject Emplacement Area to monitor salinity levels and confirm no leaching of saline material.

A comprehensive drainage system would be constructed prior to the commencement of the initial cell and all subsequent cells (see **Figure 2.18**). The surface water system would include:

- diversion drains to the east and south of the Reject Emplacement Area to prevent clean runoff from entering the area;
- catchment drains at the western and northern perimeter of each cell to capture runoff from the active area of the Reject Emplacement Area; and
- a storage basin (SB3) at the northern end of each cell from where the collected water would be pumped back to the main mine water management ponds for re-use and/or treatment as appropriate.

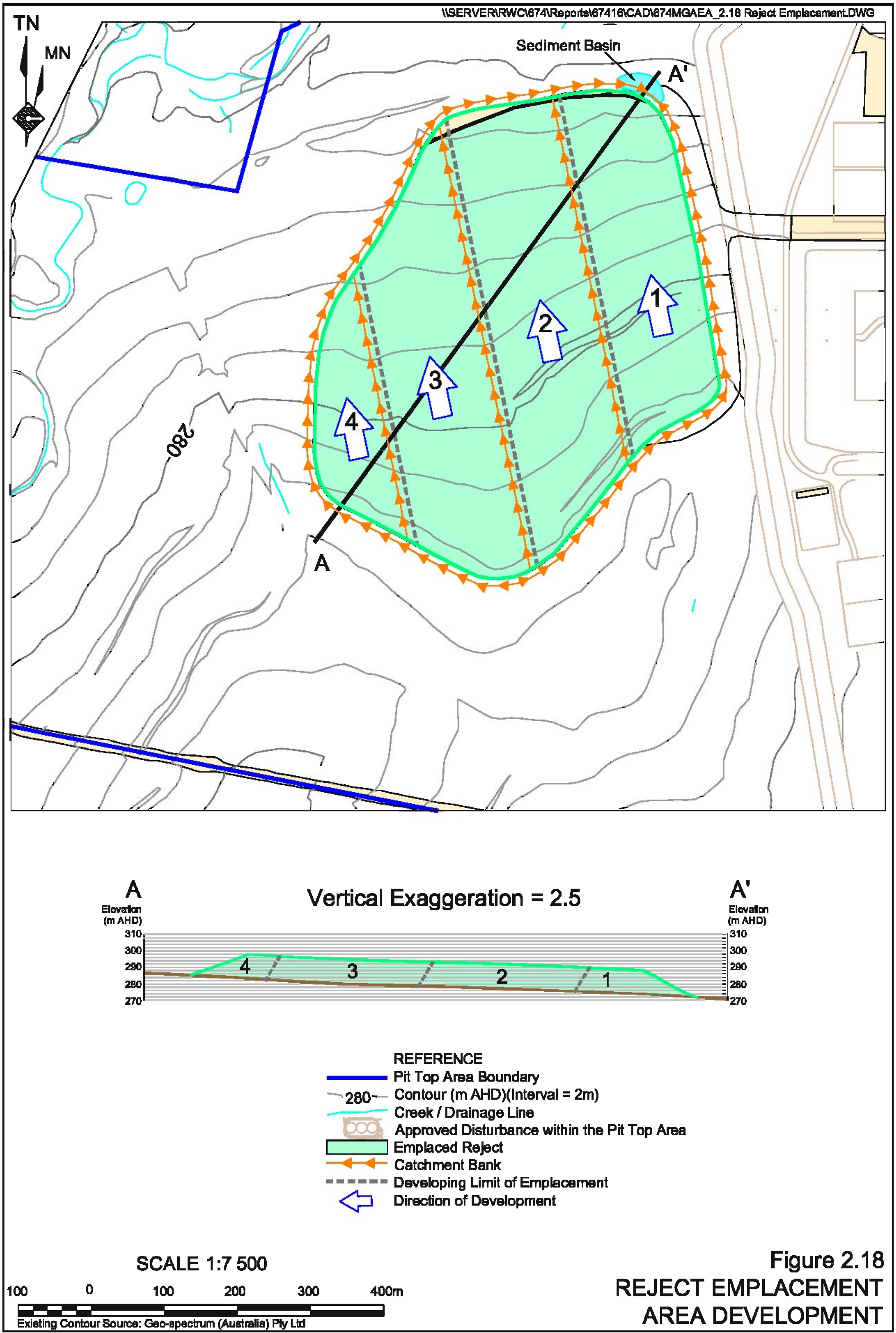

Figure 2.18
REJECT EMPLACEMENT AREA DEVELOPMENT

Reject would be paddock-dumped within the active Reject Emplacement Area cell and then spread by dozer to form a typical lift thickness of about 1.5m. Each lift would be compacted by a combination of track rolling by the dozer and trafficking by the reject delivery haul trucks. The initial eastern batter of the Reject Emplacement Area, as well as the progressive development of the northern and southern batters, would be created with a slope of 14° (4H:1V) as this would form the final face of the landform once the Reject Emplacement Area is completed. The active western batter would be maintained at angle of repose (>30°) until the final cell is completed when the external batter would be reduced to 14°.

2.6 TRAIN LOADING AND COAL TRANSPORTATION

The Proponent forecasts that with the use of the 5 500t/h capacity overhead load-out facility, a 72 wagon train with a capacity of 5 400t would be loaded and despatched in approximately 90 minutes upon arriving at the rail loop. The Pit Top Area rail loop could accommodate longer trains, which would reduce the number of rail movements generated by the Longwall Project.

The operation and timing of trains along the North Western Branch Railway Line is determined by the Hunter Valley Coal Chain Logistics Team, and as such, the Longwall Project requires 24 hour, 7 days a week train operation to ensure the flexibility to operate within the train paths allocated to the haulage contractor. While daytime loading would be preferable, it may not always be possible.

At the proposed maximum mining rate of 8Mtpa and an average train capacity of 5 400t, an average of five trains would be loaded and despatched each day of the week[7]. The Proponent anticipates the number of loaded trains despatched daily would vary from three to seven, and occasionally eight per day. The rate of despatch would vary to meet shipping arrival schedules at Port Newcastle.

2.7 SERVICES

2.7.1 Potable, Ablutions and Fire Fighting Water Requirements

All potable water required for ablutions and related uses would be imported to site on a regular basis and stored in small water tanks located adjacent to the relevant surface infrastructure.

2.7.2 Operational Water Requirements

Operational water would be required primarily for dust suppression both underground and within the Pit Top Area, as well as within the CPP washing circuit.

[7] This accounts for coal rail unavailability for periods during the year.

Based upon operational experience during Stage 1 of the Narrabri Coal Mine, consideration of water requirements at similarly sized underground mines and the completion of a water balance analysis of the CPP, the Proponent estimates the annual water requirements would be as follows.

- Underground dust suppression and other requirements - up to 465ML.
- Coal handling and processing (including sprays on conveyors, screens and crushers, dust suppression on stockpiles and coal washing. - up to 100ML.
- Other surface water usage (dust suppression, ablutions, wash pad etc.) - up to 42ML.

In addition to the above operational water requirements, between 54ML and 101ML of water is expected to be lost via evaporation from water storages each year.

Up to 607ML of water would be required by the Longwall Project each year, which equates to 1.67ML per day. A proportion of this water would be recycled through capture and re-use underground make, the Proponent estimating this would represent between 25ML and 298ML each year. The remaining water would be sourced from a range of sources including.

- Groundwater in-flow and capture within the box cut - 27ML.
- Harvesting of surface water runoff from the industrial and processing areas of the Pit top Area (SB1) - 71ML[8].
- Harvesting of surface water runoff from the remaining sediment basins and dams on the Pit Top Area - 100[8].
- Groundwater treated through a Water Conditioning Plant - 50ML to 1 800ML[9].
- Water harvested from the Namoi River under licence - Yet to be established.

The Proponent holds two licences to account for the water inflows to the mine that are pumped to the surface, namely:

i) WAL AL811436 for groundwater extraction from the Intake Beds of the Great Artesian Basin of up to 244ML per year [10]; and

ii) 90BL254679 for groundwater extraction from the Gunnedah Basin of up to 818ML per year.

A more detailed analysis of the site water balance has been prepared by WRM Water and Environment (WRM, 2009), which is reproduced in full as Part 3 of the *Specialist Consultant Studies Compendium*. Section 4B.3 provides a summary of this balance which considers both the potential for water deficit and surplus over the entire mine life, based on over 110 years of rainfall records for the area.

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8 Refers to surface water harvest available during median (50^{th}%ile rainfall) year.

9 Assumes 80% of dewatered groundwater is recovered as raffinate from the Water Conditioning Plant.

10 3.65ML of the allocation under WAL AL811436 accounts for the predicted loss in groundwater within the Intake Beds of the Great Artesian Basin groundwater source associated with the proposed Longwall Project.

2.7.3 Electricity

Permanent mains power is supplied via a spur line from a new 66kV power line located to the east of the Kamilaroi Highway. The 66kV of the spur line is converted to 11kV for use at the site offices, buildings and the crushing / sizing plant within a substation on the Pit Top Area. An additional electrical transformer to meet the load requirements for the Longwall Project would be installed within the substation (see **Figure 2.2**).

The 11kV power line would be extended through the Central Corridor and to the tailgate ventilation locations progressively as the mine is developed (see **Figures 2.2** and **2.10).**

Power would also be provided to the underground mine workings as required initially from the substation with all cables placed via the transport drift. Provision has been made at each ventilation shaft location to provide the power underground via boreholes within the shaft compounds.

Annual power usage once the mine achieves its maximum production level of 8Mtpa would be in the order of 49 megawatt hours.

Lighting on the Pit Top Area would typically comprise soft lighting oriented to minimise visual intrusion to the surrounding landholders.

2.7.4 Communications

On-site communications would be by a combination of mobile phones and land phone/fax lines installed to service mine management and contract staff in the Pit Top Area. Two-way radio communication would be used between surface equipment operators. The primary means of communication in the underground mine would be by telephone with the additional use of the PED underground communication system whose infrastructure would be placed along the construction access roads and services corridor (see Section 2.4.9.5).

2.7.5 Fuel

Fuel storage and refuelling facilities for the mobile equipment would comprise one 50 000L WorkCover - approved self-bunded fuel tank and an adjacent refuelling bay, located adjacent to the surface buildings.

During the initial 12 months of the Stage 2 mine, during which construction of the Coal ROM Pad extension, CPP, longwall unit assembly area and Ventilation Shaft Area would be ongoing, it is estimated fuel use would be approximately 3 300kL.

Annual diesel fuel usage for the mine once construction is complete would be approximately 2 000kL.

2.7.6 Explosives

While it is unlikely that explosives would be required during Stage 2 mining, and therefore no requirement for their storage on site, an explosives magazine would be maintained within the Pit Top Area to provide storage for explosives in the event an emergency required their use.

2.8 WASTE MANAGEMENT

2.8.1 Nature of Wastes

The principal wastes that would be generated throughout the life of the Longwall Project can be categorised as production and non-production wastes.

The following production wastes would be generated on the Mine Site.

- Mined rock from the development of the ventilation shafts and gas drainage boreholes. The management of the mined rock from the ventilation shafts and gas drainage boreholes is described in Sections 2.4.9.7 and 2.4.9.8.
- Coarse and fine reject generated by the CHPP. Management of coarse and fine reject generated by the CHPP is described in Section 2.5.4.
- Brine generated by the Water Conditioning Plant. The management of brine is described in Sections 2.4.8.4 and 2.4.9.14.

Non-production wastes would include:

- general domestic-type wastes from the on-site buildings and routine maintenance consumables (see Section 2.8.2);
- oils and grease, including potentially contaminated water from the maintenance workshop, washdown pad and fuel storage areas (see Section 2.8.3); and
- sewage (see Section 2.8.4).

2.8.2 Domestic-type Wastes and Routine Maintenance Consumables

All paper and general wastes originating from the surface facilities area, together with routine maintenance consumables from the daily servicing of equipment, such as grease cartridges, would be disposed of in 205L drums and 240L mobile garbage bins located adjacent to the various buildings. These bins would generally be collected regularly and the contents placed in large waste storage receptacles or dumpsters positioned adjacent to the maintenance workshop to await removal by a licensed industrial waste collection contractor. Industrial waste collection would be undertaken fortnightly, or more frequently, if required.

Separate collection systems would be employed for recyclables such as paper and cardboard, drink containers (cans and PET bottles) and ferrous and non-ferrous metals, each of which would be despatched off site at appropriate intervals.

2.8.3 Oils and Grease

Routine maintenance of the more mobile mining and earthmoving equipment would generally be undertaken in the maintenance workshop within the Pit Top Area, while underground equipment would be subject to minor maintenance in-situ and brought to the surface for more substantial maintenance. Major equipment maintenance would be undertaken at facilities away from the mine.

Within the maintenance workshop, waste oils and grease would be collected and pumped to bulk storage tanks by oil evacuation pumps. All parts and packaging would be collected and transferred to the maintenance workshop for disposal or recycling.

Waste oils and grease would be stored appropriately at the maintenance workshop and collected by a licensed waste recycling contractor as required for recycling.

2.8.4 Sewage

The Proponent maintains toilet and ablution facilities within the mine facilities area for the site workforce and visitors. These facilities incorporate self irrigating eco-cycle septic sewage system(s) approved by Narrabri Shire Council and regularly serviced as required by Council and the manufacturer. The treated septic system water is used to irrigate on the landscaped areas around the site office.

The existing facilities are considered adequate for the increased workforce that would be required for the Stage 2 (longwall) operations.

2.9 TRAFFIC

2.9.1 Stage 2 Construction Period

During the Stage 2 construction period, the traffic generated above the normal operational traffic traveling to and from the mine would include both light vehicles and heavy vehicles.

The full-time equivalent construction workforce of 75 persons would generate approximately 90 light vehicle movements per day. The incoming components for the coal preparation plant, shaft boring equipment, etc. would be delivered largely on standard semi-trailers or B-doubles and low loaders. Some components of the longwall equipment would be delivered by road whilst most would be delivered by rail. Daily heavy vehicle movements would vary from 0 to 20 per day.

It is not expected that there would be many oversize loads, however, whenever necessary, they would be escorted as required during the approved periods of the day. Oversize loads would vary from 0 to 4 per day.

2.9.2 Stage 2 Operations

The indicative vehicle movements during Stage 2 operations are provided in **Table 2.11**. This represents an increase in traffic to the Mine Site of approximately 40%, with the existing internal roads and intersection with the Kamilaroi Highway sufficient to manage the predicted traffic levels.

Table 2.11
Indicative Vehicle Movements During Mining Operations[1]

Activity	Vehicle Type	Estimated Average Daily Vehicle Movements	
		Average	Maximum
Equipment / supplies deliveries	Semi-trailer, rigid truck, occasional low loader	4	10
Workforce[2]	Passenger vehicles	256[3]	300
Miscellaneous	Various light vehicles	20	40
TOTAL	Heavy	4	20
	Light	276	370

[1] One round trip = 2 movements [2] Assumes 211 employees [3] Assumes 1.7 employees/vehicle

Occasional low loaders would be used during operations to transport earthmoving equipment to and from site and longwall components requiring off-site servicing.

2.10 HOURS OF OPERATION AND MINE LIFE

2.10.1 Hours of Operation

The proposed hours of operation are proposed to remain as approved under PA 05_0102 and presented in **Table 2.12**.

Table 2.12
Proposed Hours of Operation

Activity	Hours/Days
Surface Facilities Construction	
Vegetation clearing / soil removal	7:00am to 10:00pm / 7 days
Surface Infrastructure construction	7:00am to 10:00pm / 7 days
Reject emplacement area development	7:00am to 10:00pm / 7 days
Raw materials / supply delivery	7:00am to 10:00pm / 7 days
Ventilation Shaft Construction	24 hours / 7 days[1]
Gas drainage bore construction	24 hours / 7 days
Mining Operations	
Pit Bottom Area development	24 hours / 7 days
Underground mining	24 hours / 7 days
Gas drainage	24 hours / 7 days
Ventilation fan operation	24 hours / 7 days
Crushing, screening, washing and stockpiling	24 hours / 7 days
Rail loading and transportation	24 hours / 7 days
Surface maintenance	24 hours / 7 days
CPP reject disposal	24 hours / 7 days[2]
Raw materials / supply delivery	7:00am to 10:00pm / 7 days

Note: 1 Operations initially for 4 months then at approximately 5 year intervals
2 Reject disposal activities would generally be restricted to 7:00am to 10:00pm, 7 days per week. However, it is possible that the proportion of reject material generated by the CPP may exceed the predicted average 5% level for short periods. To account for these periods of elevated reject production, contingent hours of operation would be 24 hours / 7 days (when inversion conditions do not prevail).

2.10.2 Mine Life

The 170Mt of coal recoverable from the 26 longwall panels and associated development roadways would support a mine for a period of approximately 30 years based upon an annual production rate of up to 8.0Mt.

2.11 EMPLOYMENT

2.11.1 Construction

The workforce throughout the 60 week Stage 2 construction period is expected to be in the order of 75 full time equivalent persons. At times, in excess of 100 persons would be involved in construction activities on site.

2.11.2 Operations

The projected mine workforce assumes an average coal production rate of up to 8.0Mtpa and the projected three-shift underground mining and surface coal crushing / sizing operations. All plant and equipment operators would be multi-skilled. The mining workforce would be employed directly by the Proponent, with some specialist services contracted. Based upon the operation of three continuous miners in conjunction with the longwall unit, the Proponent estimates that the Longwall Project would provide employment for 211 persons, comprising 186 mine workers and 25 staff.

A number of technical, professional and mine support service personnel would also be expected to visit the Mine Site on an “as needs” basis including cleaners, rubbish removal contractors, specialist tradespersons and sales representatives, environmental, mine planning and geotechnical consultants, as well as the Proponent’s senior management personnel.

The Stage 2 mine workforce would comprise a core workforce that would be employed by the Proponent as part of Stage 1 mining operations. This workforce would be supplemented by additional personnel, preferentially with experience in coal mining (and preferably longwall mining) or related industries. The experienced personnel would be supplemented by suitable local persons. The Proponent would continue to support employment of local district personnel, with arrangements for training and certification put in place to ensure suitable applicants can acquire the necessary skills. The local indigenous community would continue to be encouraged to be involved in this program.

2.12 SAFETY/SECURITY MANAGEMENT

2.12.1 Introduction

The Proponent currently implements procedures and controls to protect the safety of its own or contracted employees, visitors to the mine, the public in general, as well as local landowners and land users as part of the Stage 1 construction and operation activities. These measures would be continued to ensure the security of the mine facilities and equipment from unauthorised access or use for the Longwall Project.

It is the Proponent's policy that each person employed on, or visiting the, Mine Site is provided with a safe and healthy working environment and, to achieve this, the Proponent would maintain its recruitment, induction and training program to achieve the following objectives.

- To ensure compliance with statutory regulations and maintain constant awareness of new and changing regulations.
- To eliminate or control safety and health hazards in the working environment in order to achieve the highest possible standards for occupational safety.
- To ensure the suitability of prospective employees through a structured recruitment procedure.
- To provide relevant occupational health and safety information and training to all personnel.
- To develop and constantly review safe working practices and job training.
- To conduct regular safety meetings and provide an open forum for input from all employees.
- To provide effective emergency arrangements for all employees, and general public protection.
- To maintain good morale and safety awareness through regular employee assessment and counselling (if required).
- To ensure all contractors adopt the Proponent's policy objectives and maintain safety standards at all times while working on its premises.
- To develop public awareness of the safety standards and objectives at the proposed Stage 2 of the Narrabri Coal Mine.

Central to all aspects of site security and safety at the proposed Stage 2 of the Narrabri Coal Mine would be:

- the adoption of a pro-active approach to employee and public safety;
- strict compliance at all times with the requirements of the:
  - *Coal Mine Health and Safety Act 2002;*
  - *Coal Mine Health and Safety Regulation 2006 ;*
  - *Dangerous Goods Act 1975;*
  - *Occupational Health and Safety Act 2000 (and Regulation 2001);*
  - all other relevant legislation and Australian Standards;
  - WorkCover Authority; and
  - Department of Primary Industries - Minerals.
- the prioritisation given to addressing any safety issues identified by an Inspector or Mine Safety Officer or authorized government official (as specified in the *Coal Mine Health and Safety Act 2002*); and
- an Occupational Health and Safety Policy to cover all component activities at the mine.

The Proponent is required under the *Coal Mine Health and Safety Act 2002*, to develop and implement a Health and Safety Management System and a Major Hazard Management Plan for the Narrabri Coal Mine.

2.12.2 Safety/Security Measures

The Proponent would continue to implement the following measures in association with the development of the Longwall Project.

i) Erection and maintenance of temporary fencing around the additional areas of surface disturbance associated with the Longwall Project, eg. ROM Coal pad extension, CPP and Longwall Unit Assembly Area. A security fence would also be erected around the various components related to the initial and subsequent ventilation shafts. Internal agricultural fencing would also be maintained to enable the continuation of agricultural activities in those areas not designated for mining-related activities.

ii) Signage would be maintained along the Mine Access Road as it enters the property advising visitors to sign in, office location and personal protective equipment requirements.

iii) Position security/warning signs at strategic locations around or within the Mine Site indicating the presence of construction operations. The signs would be positioned to alert employees/visitors entering the Pit Top Area and passing motorists.

iv) Employee induction in safe working practices and regular follow-up safety meetings and reviews.

v) Ensure all crushing and conveying equipment at all times complies with all relevant requirements and standards.

vi) Strictly complying with all mining lease, planning approval and licence conditions.

vii) Establishment and demarcation of construction areas within the Mine Site in accordance with Section 87 of the *Coal Mine Health and Safety Regulation 2006*.

2.13 REHABILITATION AND DECOMMISSIONING

2.13.1 Introduction

Disturbance on the Mine Site requiring rehabilitation may be classified as that required for:

- the long-term operation of the mine, eg. box cut, the surface facilities and rail infrastructure of the Pit Top Area, the Ventilation Shaft Areas, the Reject Emplacement Area and the Brine Storage Area;
- areas temporarily disturbed during the progressive development of the mine, eg. longwall unit assembly area, access roads and gas drainage sites; or
- the repair on impacts resultant from subsidence.

The following subsections address the proposed rehabilitation for each category of disturbance.

2.13.2 Disturbance Associated with Long-term Mine Components

2.13.2.1 Objectives

The Proponent's rehabilitation objectives for those areas of mine-related surface disturbance within the Pit Top Area and Ventilation Shaft Areas that would be in place for the entire mine life can be defined in the short term and long term.

- In the short term, ie. during the construction and establishment phase, the objectives would be to stabilise all earthworks, drainage lines and disturbed areas no longer required for mine-related activities in order to minimise erosion and sedimentation, and to reduce the visibility of the activities from adjacent properties and the local road network.
- In the longer term, ie. with respect to closure, the Proponent's objectives are to provide a low maintenance, stable and safe landform that blends with the surrounding topography and which maximises the return of agricultural land with an agricultural land suitability comparable to the existing levels.

2.13.2.2 Site Establishment and Construction Activities

Areas disturbed as part of site establishment and construction activities and not required for ongoing operations, eg. batters of fill slopes created for the extension of the ROM Coal Pad, would be stabilised as soon as possible following disturbance. Surface stabilisation would be achieved through sowing a pasture seed mix relevant to the season in which planting occurs. **Table 2.13** lists the indicative components of both a winter and summer pasture seed mix together with typical fertiliser application rates. The actual seed mix would be based on seed availability at the time.

2.13.2.3 Decommissioning Activities

On cessation of mining and processing activities, many of the structures and facilities would be decommissioned and removed from site prior to final rehabilitation of the Pit Top Area and Ventilation Shaft Areas, including:

- the Coal Processing Plant and associated infrastructure;
- various fuel storages, workshops and offices;
- infrastructure related to the box cut and drifts;
- surface infrastructure related to the ventilation shafts; and
- roads not to be maintained in the final landform.

Table 2.13
Winter and Summer Pasture Species Seed Mixes

Summer			**Winter**		
Pasture Species	**Rate (kg/ha)**	**Fertiliser**	**Pasture Species**	**Rate (kg/ha)**	**Fertiliser**
Grasses					
Bombatsi Panic	1 – 2	Di-ammonium Phosphate (DAP) 250kg/ha	Phalaris (Sirolan or Holdfast)	1 -2	Di-ammonium Phosphate (DAP) 250kg/ha
Green Panic *[2]	2 – 4		Wallaby Grass	0.3 - 1	
Rhodes Grass *[2]	1 – 2				
Purple Pigeon Grass	1 – 2				
Legumes *[1]					
Subterranean Clover	4 - 5		Subterranean Clover	4 - 5	
			Barrel (Sephi) medic	2 – 4	
			Snail (sava) medic *[2]	3 – 5	
			Woolly Pod Vetch	4 – 6	
			Serradella (Elgara)	1 – 2	
			Lucerne	0.5	

*[1] Inoculated with appropriate rhizobia
*[2] Specific Soil Conservation Application

There may be potential, however, for a future land owner to retain some items of surface infrastructure such as storage sheds and workshop buildings. Retention of any items would be negotiated with the future land owner at the time.

Following the removal of surface infrastructure from the drift portals within the box cut, the entries would be sealed in accordance with appropriate guidelines and the void backfilled. Similarly, the infrastructure associated with the ventilation shafts would be removed and the shafts sealed in accordance with guidelines.

Any potentially hydrocarbon-contaminated material would either be removed or bio-remediated on site.

2.13.2.4 Final Landform and Land Use

With the exception of the area associated with the rail loop and Reject Emplacement Area, the final landform within the Pit Top Area, and other sites of long-term disturbance would be similar to that which currently exists. **Figure 2.19** displays the features of the indicative final landform within and adjacent to the Pit Top Area.

With the exception of the rail loop and a section of the perimeter amenity bund wall adjacent to Kurrajong Creek Road, all land disturbed during the life of the mine would be returned to a land capability / agricultural land suitability similar to the existing levels. This would be achieved principally through the re-instatement of a comparable soil profile across those areas disturbed throughout the life of the Longwall Project. Given this commitment, the Proponent intends that the bulk of the areas disturbed would be returned to land of comparable agricultural potential as its original state.

The intention to retain the rail loop may influence the succeeding land use depending upon land use around the Pit Top Area at that time.

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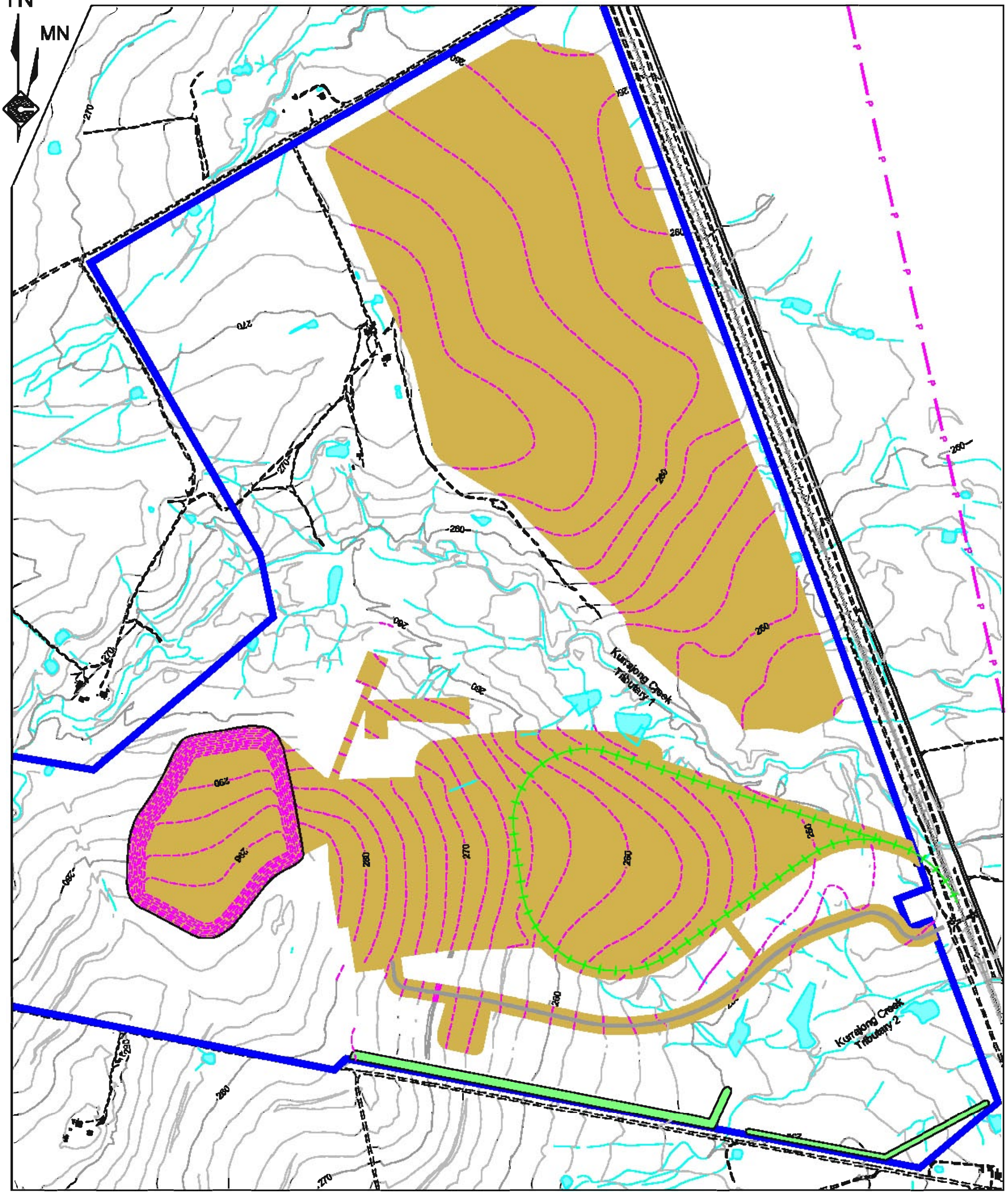

REFERENCE
- Pit Top Area
- Power Line
- Mine Access Road Retained
- Site Rail Access Retained
- Existing Contour (m AHD)(Interval = 2m)
- Creek/ Drainage Line
- Dam/ Water Storage
- Perimeter Amenity Bund Retained
- Reconstructed Landform Contour (m AHD)(Interval = 2m)
- Former Area of Disturbance

SCALE 1:20 000

200 0 200 400 600 800 1000 m

Existing Contour Source: Geo-spectrum (Australia) Pty Ltd

Figure 2.19
INDICATIVE FINAL LANDFORM PIT TOP AREA

2.13.2.5 Proposed Rehabilitation

Since mine closure would not occur until the cessation of coal mining, this section only provides a conceptual closure plan which would be further developed in consultation with the relevant government authorities closer to the time of closure. This approach would ensure that the closure plan addresses the most relevant requirements and methods, applicable at that time.

The additional disturbance of the surface topography within the Pit Top Area for the Stage 2 Longwall Project would be an extension of Coal ROM Pad, establishment of a longwall unit assembly area and construction of the Reject Emplacement Area and dams within the Brine Storage Area. The rehabilitation of these areas of disturbance is described as follows, within the context of the overall rehabilitation of the entire Pit Top Area.

Box Cut and Drifts

The drift entries would be sealed and the box cut backfilled to replicate the pre-mining landform. The material used to backfill the box cut would be sourced from the perimeter amenity bund.

Rail Loop

There is potential for the rail loop to be considered valuable infrastructure for the future land owner and hence retained on closure. In the unlikely event the rail loop is not to be retained, the cutting would be filled with material excavated from the footprint of the nearby ROM and product stockpile area and the entire disturbance footprint would be reprofiled to recreate a similar topography to that which currently exists, ie. undulating and sloping to the east.

ROM Coal and Product Coal Stockpile Areas

The cut and fill disturbance within the ROM Coal Pad, Product Coal Stockpile Area and longwall unit assembly area would be profiled to ensure it has safe and stable slopes on construction. These slopes would be shaped to create a more undulating landform, more consistent with the surrounds. Should additional material be required to create the desired slope, this would be sourced from material excavated from other site components.

Perimeter Amenity Bund

With the exception of the sections of the perimeter amenity bund adjacent to or near Kurrajong Creek Road, the perimeter amenity bund would be removed with the material used to backfill the box out. The retained section of bund would be well vegetated and would act as a wind break for future agricultural activities and fauna habitats. Most surface water structures around the margins of the areas disturbed would also be retained to allow for continued water management across the Pit Top Area following mine closure. The dams likely to be retained are displayed on **Figure 2.19**.

Mine Access Road

The retention or removal of the sealed Mine Access Road would be dependent on the final land use of the site and the requirements of the future land owner. All internal minor roads and tracks would be removed and pre-mining topography re-instated.

Dams A to D

It is not proposed to modify the proposed rehabilitation strategy for the Evaporation / Storage Ponds within the rail loop from that presented in the Environmental Assessment of the Stage 1 Narrabri Coal Project (RWC, 2007). A summary of the proposed rehabilitation of these dams is as follows.

- The black plastic liner within each pond would be removed and transported to a waste disposal facility.
- The salinity level of the compacted clay floor beneath the liner would be analysed to confirm that no contamination has occurred as a result of breaches in the liner.
- Any evidence of saline contamination would trigger the implementation of a Salinity Contamination Contingency Plan (to be developed in consultation with relevant government agencies). Confirmation of no saline contamination would allow the area to be rehabilitated to its prescribed final landform ie. the evaporation / storage ponds would be backfilled and a landform comparable with the existing landform would be created.

Reject Emplacement Area

As the permanent 14º external batters of each cell of the Reject Emplacement Area are formed, they would be progressively capped with the previously stripped subsoil and topsoil. As far as practicable, the soil to be respread would be taken directly from soil stripping in advance of the next cell of the Reject Emplacement Area. On completion of each cell to the nominated 15m height, the top surface would be profiled to create a series of transverse (ie. east-west) drainage swales and respread with topsoil. These drainage swales would collect runoff and direct it down to a permanent drain around the perimeter of the Reject Emplacement Area leading to the collection pond. The completed surfaces of the Reject Emplacement Area would be revegetated with a fast growing cover crop to stabilise the landform, with pasture species ultimately sown to enable a return to agriculture over this area once mining is completed. This method of progressive completion of the final landform would allow the reject to be progressively capped to minimise infiltration by rainfall, and would allow permanent rehabilitation and revegetation to also be carried out progressively, avoiding the need to stockpile large quantities of topsoil for extended periods.

Brine Storage Area

The brine stored within the various ponds within the Brine Storage Area would be re-injected into the longwall goaf through the disused goaf gas drainage holes towards the completion of mining. Progressively re-injecting brine into the goaf of the completed longwall panels would ultimately result in the removal of all brine within the brine storage ponds. Rehabilitation of the remaining pond structures would be almost identical to that of Dams A to D, that is:

- the black plastic liner of each pond would be removed and transported to a waste disposal facility;
- the salinity level of the compacted clay floor beneath the liner would be analysed to confirm that no contamination has occurred as a result of breaches in the liner; and

- on confirmation that there remains no contamination, the pond walls would be pushed in to fill in the ponds, the area re-profiled as illustrated in **Figure 2.19**, topsoil would be respread over the created landform and the areas revegetated with pasture species.

Ventilation Shaft Areas (including Tailgate Fan / Exhaust Sites)

All remaining infrastructure, eg. fans, evasees, storage sheds, fuel storages, etc., would be decommissioned and removed from the Mine Site. The shafts would be filled in (or sealed) by a method approved by the relevant government agency and the surrounding bund wall removed. The material from the surrounding bund walls would either be pushed into the shafts, or used to backfill the sumps and profile the areas. Where appropriate, the remaining areas would be deep-ripped to promote plant growth.

Previously stockpiled soil and cleared vegetation material would then be spread over the profiled landform (which would be similar to that which currently exists with a central raised area) and the area revegetated with appropriate pasture or native vegetation species (depending on the vegetation which occurred within each area in the pre-mining environment). Reliance would be placed upon natural regeneration in the smaller disturbed areas, whereas direct seeding of native species would be undertaken in areas within native vegetation communities.

Access Tracks and Service Corridors

It is proposed to progressively close, rip and provide for natural revegetation of the minor tracks on site once they are no longer required for operational purposes. Any vegetation cleared would be re-spread across the track to prevent access and assist in promoting natural regeneration.

The various access and service tracks required throughout the life of the mine would only be rehabilitated at the end of the mine life and then once they are not required for access for monitoring, etc. Following the cessation of all mining-related activities, all remaining tracks, etc. (not required for ongoing maintenance / management of the land would be ripped and allowed to naturally regenerate.

2.13.2.6 Monitoring and Maintenance

The Proponent’s commitment to effective rehabilitation would involve an ongoing monitoring and maintenance program for the life of the mine.

The areas of the Pit Top Area which have been progressively rehabilitated to date (as part of site stabilisation activities) are, and would continue to be, regularly inspected and assessed against the short and long term rehabilitation objectives outlined in Section 2.13.2.1. During regular inspections, aspects of rehabilitation to be monitored would involve:

- evidence of any erosion or sedimentation from areas with establishing vegetation cover;
- success of initial pasture / cover crop establishment;
- adequacy of drainage controls; and
- general stability of the rehabilitation site.

Where rehabilitation success appears limited, maintenance activities would be initiated. These may include re-seeding and where necessary, re-topsoiling and/or the application of specialised treatments such as composted mulch to areas with poor vegetation establishment. Tree guards would be placed around planted seedlings should grazing by native animals be excessive. If drainage controls are found to be inadequate for their intended purpose or compromised by grazing stock or wildlife, these would be replaced and/or temporary fences installed to exclude grazing of native vegetation by native or domestic fauna.

Should areas of excessive erosion and sedimentation be identified, remedial works such as importation of additional fill, subsoil or topsoil material or redesigning of water management structures to address erosion would be undertaken.

2.13.3 Temporary Disturbance Associated with the Progressive Development of the Mine

2.13.3.1 Introduction and Objectives

Drilling and borehole construction associated with pre- and goaf gas drainage would require areas above the underground mining area to be progressively disturbed. Access roads/tracks and power lines constructed between these sites would also be required resulting in further surface disturbance. As gas drainage for each longwall panel is completed, the bores and gas drainage infrastructure would become redundant. All infrastructure would be removed and areas of disturbance rehabilitated should they not be needed for any other reason, eg. end-of-mine brine disposal.

The following objectives have been adopted when developing the rehabilitation procedures for those temporary areas of disturbance associated with gas drainage.

- To locate each gas drainage site in such a way that minimises the amount of disturbance to native vegetation or sites of heritage significance and hence rehabilitation requirements.
- To retain soil and vegetation resources for use in the rehabilitation of each site.
- To produce a stable final landform conforming with the vegetation type of the surrounding area.

2.13.3.2 Final Landform and Land Use

Each site would be rehabilitated such that the final landform would be very similar to that which currently exists.

The final land use of each site would correspond to that of the surrounding land. That is, where gas drainage sites are located within agricultural land, the site would be rehabilitated to provide for agriculture, however, where the surrounding land is dominated by native vegetation, the site would be revegetated to provide for native vegetation re-establishment.

2.13.3.3 Proposed Rehabilitation

Once gas drainage requirements are completed and there is no other identified ongoing need for the site, each site would be rehabilitated as follows.

Infrastructure Decommissioning, Bore Sealing and Capping

The gas drainage vacuum pump, generators and any other infrastructure would be removed from the site. Each bore hole would then be backfilled and capped in accordance with the EDG01 guideline "*Borehole Sealing Requirements on Land: Coal Exploration*".

Sump Decommissioning and Backfill

Water retained within the sump(s) adjacent to each borehole site would be allowed to evaporate. Any consolidated drill cuttings and fines would be excavated, the plastic liner removed and the sump backfilled using the consolidated drilling spoil stockpiled during the bore construction phase. The surface of the backfilled sumps would be covered with the topsoil and subsoil stripped and stockpiled during site establishment, lightly scarified and covered with any stockpiled leaf litter and/or broken material.

Drainage Control

Any upstream diversion banks or downstream catch banks would be pushed over and profiled to natural surface level. The profiled surface would then be ripped or lightly scarified and covered with available soil, leaf litter and/or broken vegetation.

Other Cleared Surfaces

Where cut and fill works were required, these areas would be re-excavated to return the site to its natural slope. This and the remaining cleared surfaces of the drill site would be ripped or lightly scarified and the remaining stockpiled soil and broken vegetation spread over the area. Re-seeding with pasture or native tree and shrub species would be undertaken depending on the proposed final land use, ie. agriculture or native vegetation.

Access Tracks

Unless required for future access to monitor or manage subsidence-related impacts, the tracks constructed to access each gas drainage site would be progressively closed and rehabilitated. The tracks would be ripped using the tynes of a bulldozer (or similar) and previously cleared topsoil and vegetation (if any) would be pushed over the ripped surface. No seeding is considered necessary as natural regeneration of vegetation from seed in the topsoil and the surrounding environs is expected.

2.13.3.4 Monitoring and Maintenance

Once the access roads are closed and rehabilitated, access to these sites may not be available. As such, the access tracks would only be closed and rehabilitated once periodic monitoring illustrates that the sites are stable and the designated vegetation is becoming established.

2.13.4 Subsidence Areas

2.13.4.1 Objectives

The primary objective of subsidence rehabilitation is to ensure that any cracking or surface deformation resulting in changes to local drainage patterns is identified promptly and remediated as soon as possible after the impacts are identified.

2.13.4.2 Final Landform and Land Use

As noted in Section 2.4.6, the likely surface cracking would typically be less than 20mm to 190mm (19cm). As such, where surface cracking occurs, the final landform and land use would be almost identical to that of the pre-subsidence environment.

2.13.4.3 Proposed Rehabilitation

Surface Cracking

Given the relatively deep soil profile above the longwall panels, and the predicted cracking widths remaining below 20cm, it is expected that many of these cracks would be in-filled naturally through action of wind, water and soil movement. Should natural processes not completely fill each crack, the ground surrounding each crack would be ripped or graded to in-fill the crack. Notably, the locations of the gas drainage sites and access roads have been located to approximate the alignment of cracking expected. This would minimise the potential for areas to be disturbed simply to access areas of subsidence-related surface cracking, thereby minimising disturbance of native vegetation principally to repair cracking.

In the event that more significant cracks occur which cannot be simply filled in through surface ripping, these may need to be filled with additional material sourced from within the footprint of the Reject Emplacement Area or nearby gas drainage drill site.

Once the cracks have been in-filled, these would be profiled to natural topographic levels and covered with available leaf litter or broken vegetation.

Local Drainage

Surface subsidence may also impact on local drainage patterns with ponding or re-direction of channels within local creeks and tributaries possible.

In the case of ponding, no further work would be undertaken unless the ponding significantly affects downstream flows and vegetation. Should this occur, the advice of a qualified hydrologist would be sought to identify the most affective way of re-establishing more natural flow patterns.

Should subsidence result in the re-direction of creek or tributary flows, once again the advice of a qualified hydrologist would be sought to identify the most affective way of re-establishing more natural flow patterns.

2.13.4.4 Monitoring and Maintenance

Impacts of subsidence would be monitored in accordance with a Subsidence Management Plan to be prepared for the Mine Site. An overview of the proposed monitoring component of this plan is presented in Section 4B.1.7.

2.13.5 Noxious Weed Management

The Proponent is keen to avoid any noxious weed infestations and would take the necessary precautions to prevent the excessive growth of weeds within the rehabilitated areas and the long term soil stockpile areas. When appropriate, campaign weed spraying would be undertaken prior to the stripping of topsoil and periodic visual inspections would be undertaken of disturbance areas. The appropriate noxious weed control or eradication methods and programs would be undertaken in consultation with I&I NSW-Agriculture and/or the local Noxious Weeds Inspector.

2.13.6 Surrounding Land Management

The land owned by the Proponent beyond the areas proposed to be disturbed would be leased to surrounding landowners for agricultural purposes.

The Proponent would implement the principles of responsible land ownership and ensure that feral animals and weeds are managed appropriately across its entire land holding. Cooperation with adjoining land owners would be a regular feature of the ongoing land management within the Mine Site.

2.14 CONSIDERATION OF ALTERNATIVES

2.14.1 Introduction

The Director-General's Requirements issued for the Longwall Project (**Appendix 2**) require that the *Environmental Assessment* provides a description of feasible alternatives considered in developing the project reflecting the requirement to describe alternatives in Schedule 2(3) of the *Environmental Planning and Assessment Regulation 2000* which refers to "*an analysis of any feasible alternatives to carrying out of the proposed development or activity, having regard to its objectives, including the consequences of not carrying out the development or activity*". The following alternatives were considered by the Proponent during the planning stages for the Longwall Project but were rejected in favour of the components incorporated earlier in this section.

The consideration of feasible alternatives to the activities proposed relate principally to:

- mining methods, ie. longwall mining vs continuous miner vs top coal caving; and
- gas management, ie. the method of draining and dispersing the gas.

The "no development" option, ie. the consequences of not developing the proposed Longwall Project, are discussed in Section 6.4 (as part of a justification for the proposal).

2.14.2 Mining Methods

Continuous Miner Method

One option considered by the Proponent was to continue the development of the Narrabri Coal Mine as a continuous miner operation, which in effect is the "no development" option. This mining method has the advantage of reducing the environmental impact of the mine as:

- there would be no measurable surface subsidence;
- there would be no requirement to undertake goaf gas drainage (reducing the area of surface impacted by these activities);
- ventilation requirement would be reduced, which would also reduce the area of surface disturbance on the Mine Site; and
- the requirement for a coal preparation plant (and Reject Emplacement Area) would be avoided as better quality coal could be specifically targeted by the continuous miners operated underground.

The continuous miner method has a number of major disadvantages which include the following.

- The volume of coal able to be mined on an annual basis (2.5Mtpa) would be insufficient to meet market requirements committed to by the Proponent, which could jeopardise coal contracts and therefore the viability of the mine.
- The continuous miner method is a higher cost per tonne method than longwall mining. To mine using this method would increase the cost of the coal to the customer and thereby potentially affect market competitiveness.
- The continuous miner method would leave a far greater proportion of the coal, thereby not maximising the resource and in doing so sterilising the remaining resource.

It was on the basis of these disadvantages that the Proponent indicated its intention as part of the Stage 1 proposal to progress to a longwall operation at the Narrabri Coal Mine. As discussed in Section 1.4.4, the progression to the Longwall Project has been accelerated as all the required geological, geotechnical and other underground information has been obtained.

Therefore, assuming the additional impacts associated with the Longwall Project can be adequately mitigated or offset, the longwall mining method offers a more cost effective method and better utilisation of the resource.

Top Coal Caving Method

The top coal caving mining method has also been considered by the Proponent. This mining method provides for the extraction of the caved section of coal which forms behind the longwall unit as it retreats within each longwall panel. An advantage of this mining method is that by recovering the caved coal, the mineable resource would almost double, ie. up to 9m of coal could be recovered as opposed to the 4.2m recovered by longwall mining alone. There are several disadvantages associated with this method, however, and they include.

- By removing additional coal, the impacts of surface subsidence and on the local groundwater aquifers would be increased.
- By recovering the majority of the coal seam, including the lower quality coal near the roof of the Hosskisons Coal Seam, a far larger and more complex coal handling and preparation plant would be required. This would require additional area to construct and operate, increase the volume of waste generated and increase the annual water requirement of the mine.
- This mining method has not been attempted within the Hoskissons Coal Seam (nor the Gunnedah Basin), and while longwall mining has not been undertaken within the Hoskissons Coal Seam either, longwall mining is a more common mining method which has been undertaken in a variety of coal seams that could be considered equivalent.

On the basis of the additional infrastructure and disturbance associated with the top coal caving method, and given the compatibility of the longwall mining method to future progression to top coal caving, the Proponent has decided to collect more information on the nature of the Narrabri Coal Mine underground conditions before potentially proposing progression to a top coal caving method.

2.14.3 Gas Management

Coal emissions include CO_2, CH_4, CO and nitrous oxides, all of which need to be reduced to sufficiently low concentrations to ensure safe working conditions underground. As noted in Section 2.4.5, these gases would be initially pre-drained from the coal seam prior to longwall mining, removed from the underground atmosphere by ventilation during mining and drained from the collapsed goaf within the completed longwall panels. These gases are all greenhouse gases and as part of this proposal would be dispersed to the atmosphere either from vacuum pumps installed on the drainage units or from the ventilation fans.

The Proponent investigated several options for managing the gas and ventilated air as follows.

- Gas Flaring. CH_4 is a flammable gas and if contained in high enough concentration within the gas to be drained from a mine, can be pumped to a central location and flared. This converts the CH_4 to CO_2 which is approximately 21 times less effective as a greenhouse gas and would therefore reduce the greenhouse gas emissions of the Mine Site. The required concentration to effectively flare CH_4 needs to exceed 40%, which is well above the CH_4 concentration of the gas within the Hoskissons Coal Seam which, while variable, averages approximately 10%.

The Proponent would continue to undertake analyses of the gas composition underground and should CH_4 concentrations amenable to flaring be identified, this option would be revisited.

- Sale of gas to Eastern Star Gas. The Proponent made initial enquiries with Eastern Star Gas, a company which operates a coal seam gas extraction operation within a borefield to the northwest of the Mine Site, regarding their interest in acquiring the drained gas as part of their gas generation activities. As for (1) above, the low CH_4 concentration of the gas made the construction of the required infrastructure to acquire the gas unfeasible and this option was not investigated further.
- Power generation and destruction of CH_4 by the installation and operation of one or more Ventilation Air Methane (VAM) units. Thermal or catalytic oxidation VAM units destroy methane in concentrations from about 0.3 to 0.9% CH_4 with each unit able to operate with approximately $17m^3/s$ of gas mixture. The Proponent commissioned Mr Roy Moreby – an Underground Mine Environmental Engineer, to consider the potential installation and implementation of one or more VAM units as part of the mine's gas drainage and ventilation strategy. Mr Moreby concluded it would be likely that the methane concentration in ventilation air reporting to main exhaust shafts would be below the 0.3% CH_4 threshold for VAM units for most, but perhaps not all of the mining area. It is possible that CH_4 concentrations within the mine may increase such that the VAM mixture may increase above the critical 0.3% CH_4 percentage.

  On the basis of these outcomes, mine air would initially be ventilated direct to the atmosphere via the ventilation fans, however, further research would be undertaken to determine whether the operation of one or more VAM units may be feasible in the future.

While the potential to utilise or destroy CH_4 would continue to be investigated, direct dispersion to the atmosphere remains the most practical option.

2.14.4 Brine Management

Several alternative uses or disposal methods for the accumulated brine have been considered by the Proponent during the preparation of this *Environmental Assessment*.

Alternative Uses for the Brine

In particular, several commercial salt producing operators were contacted by the Proponent to ascertain whether it would be feasible to either, transfer the brine to an existing operation, or have a small salt production plant constructed and operated on the Mine Site.

The discussions determined that transferring the brine from the Mine Site to an operating salt production facility would not be feasible given the fact that the brine, whilst concentrated saline solution would still be liquid.

It was also established that further detail would be required on the groundwater chemistry before more detailed plans related to the establishment of a salt production plant on the Mine Site could be considered. The variable nature of the groundwater chemistry is also a constraint on this method of using the brine.

Alternative Disposal for the Brine

Transporting the brine from the Mine Site for disposal elsewhere, eg. into the ocean as is undertaking by desalination plants, is not a feasible alternative due to liquid state of the brine.

The only feasible alternative to disposing of the brine through re-injection would be to allow evaporation to gradually concentrate and remove the water. The concentrated salt could then be excavated and disposed of off-site. However, given the volume of brine anticipated to be stored on the Mine Site, this could take many years which would result in an ongoing environmental liability being retained on the Mine Site.

The above notwithstanding, the Proponent recognises that advances in technology may occur over the 28 year mine life of the Longwall project. The Proponent would continue to investigate possible alternative use or disposal methods for the brine over the life of the mine.

The Proponent has committed to initiating a study by a recognised firm of engineering consultants to investigate the technical and economic viability of alternative methods of use or disposal of the brine produced. It is proposed an initial report would be completed within 3 years of the receipt of project approval with commitments to further reports, if required, beyond that date.