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.

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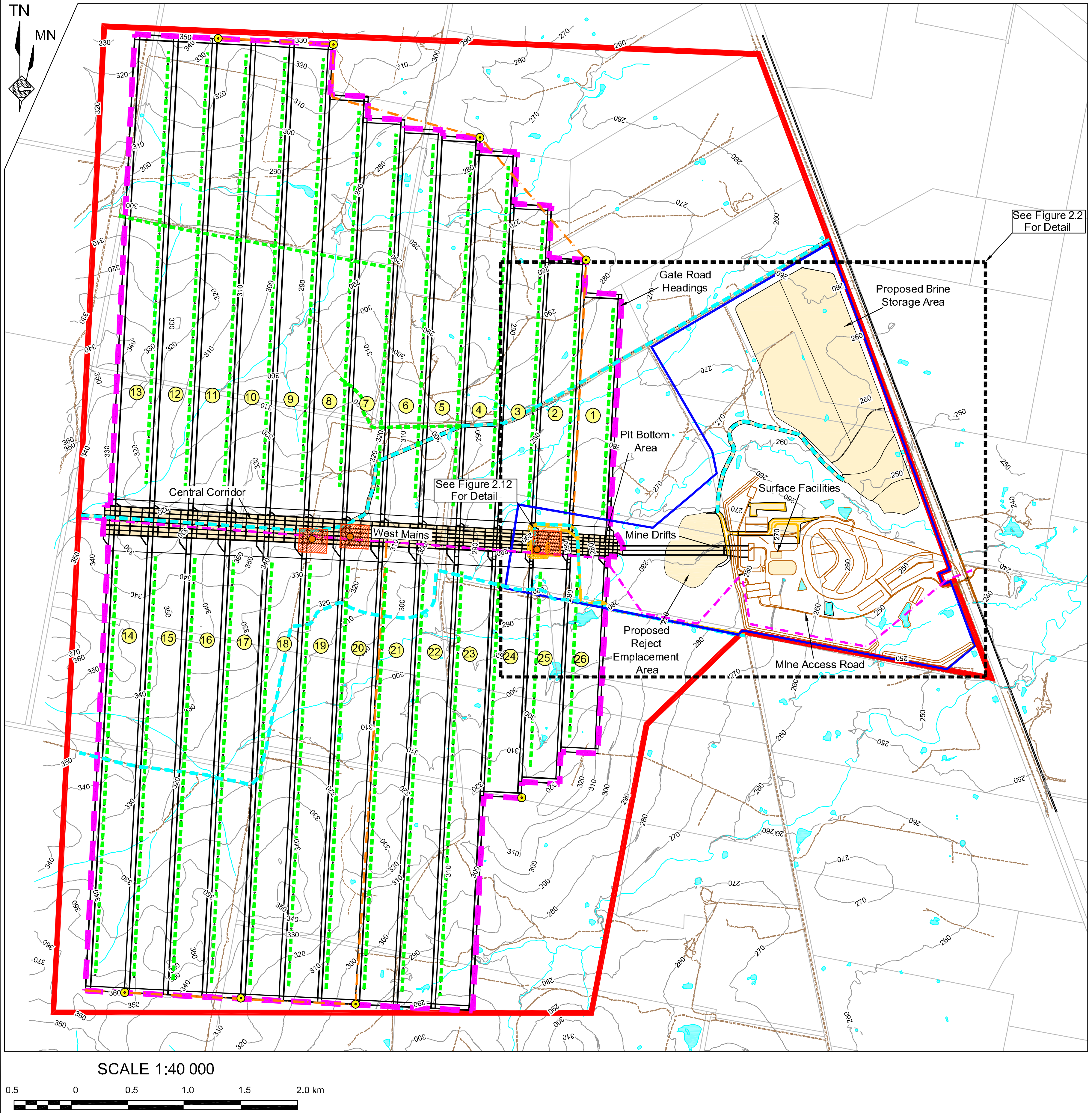

REFERENCE

- Mine Site Boundary
- Pit Top Area Boundary
- Limit of Longwall Mining Area
- Longwall Panel No.
- Underground Gate Road
- Cadastral Boundary
- Contour (m AHD)(Interval = 10m)
- Creek / Drainage Line
- Approved Disturbance within the Pit Top Area
- Area of Proposed Stage 2 Surface Disturbance
- Proposed All Weather Unsealed Access Road
- Proposed Stage 2 Access for Goaf Drainage
- Proposed Power Line
- Proposed Power Line Advancing with Mine
- Ventilation Shaft Area
- Proposed Ventilation Shaft Location
- Proposed Rear of Panel Ventilation Shaft

Figure 2.1
INDICATIVE MINE SITE LAYOUT

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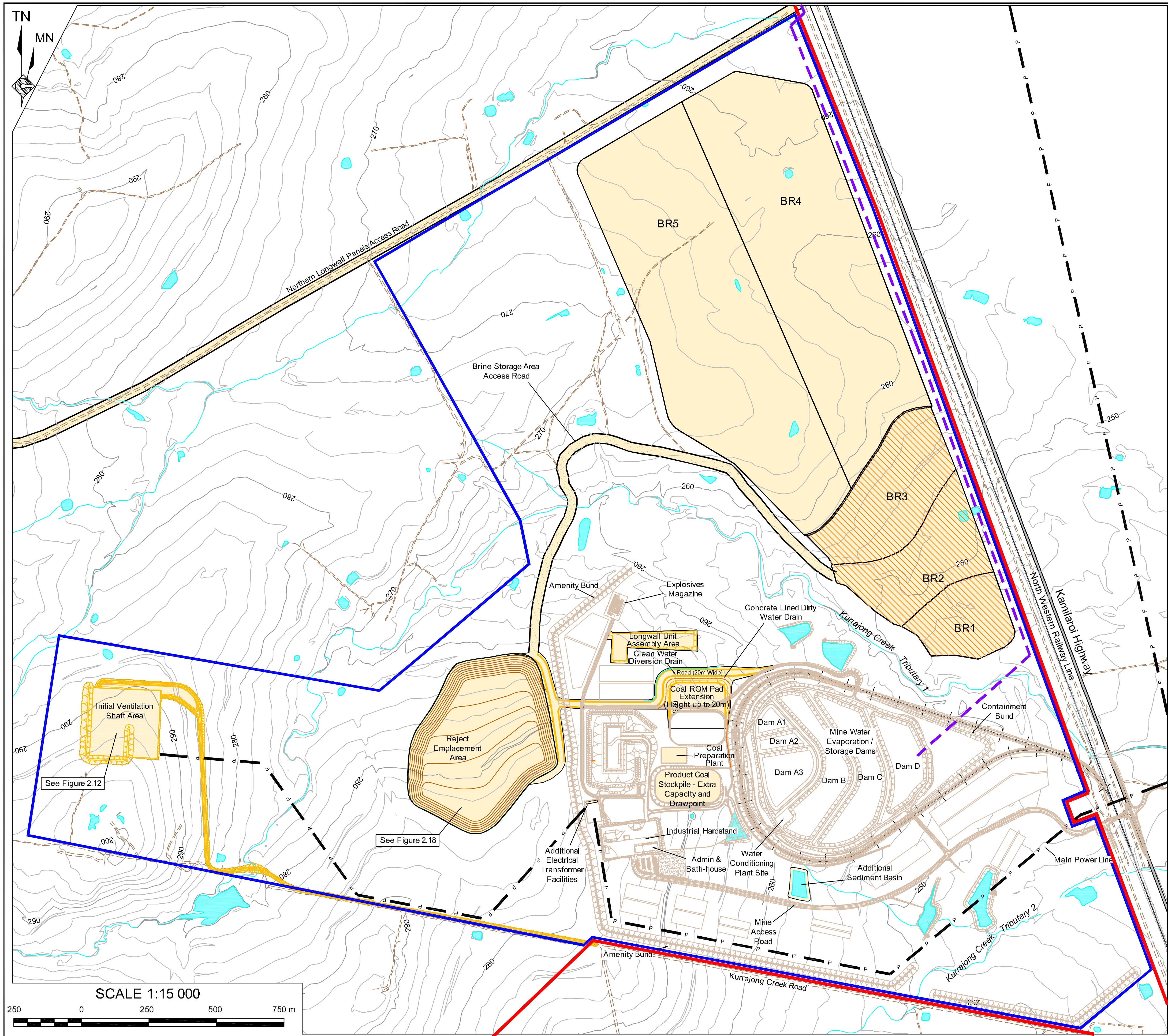

REFERENCE
- Mine Site Boundary*[1]
- Pit Top Area Boundary
- Contour (m AHD)(Interval = 2m)
- Creek / Drainage Line
- Sealed Road
- Unsealed Road / Track
- Approved Disturbance within the Pit Top Area
- Area of Proposed Longwall Project Surface Disturbance
- Initial Brine Storage Pond*[2]
- Power Line
- Water Pipeline Route

Notes: 1. Modified from Stage 1 Boundary

2. Initial 3 Brine Storage Ponds (40ha) provide for sufficient Brine Storage for base case (most likely) groundwater in-flow (and therefore brine generation) predictions.

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 14º 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 <u>Pilliga Sandstone</u> 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.

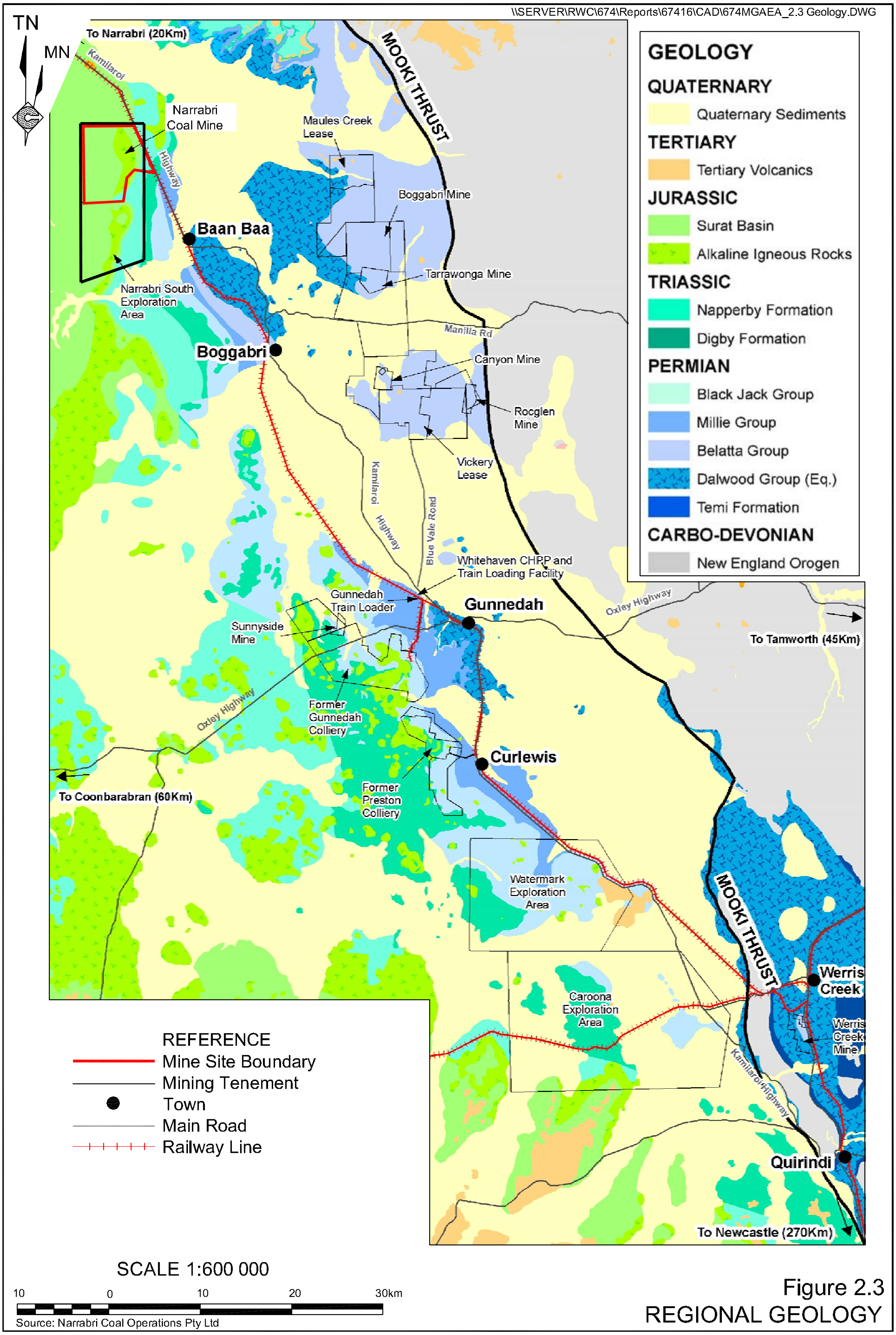

Figure 2.3
REGIONAL GEOLOGY

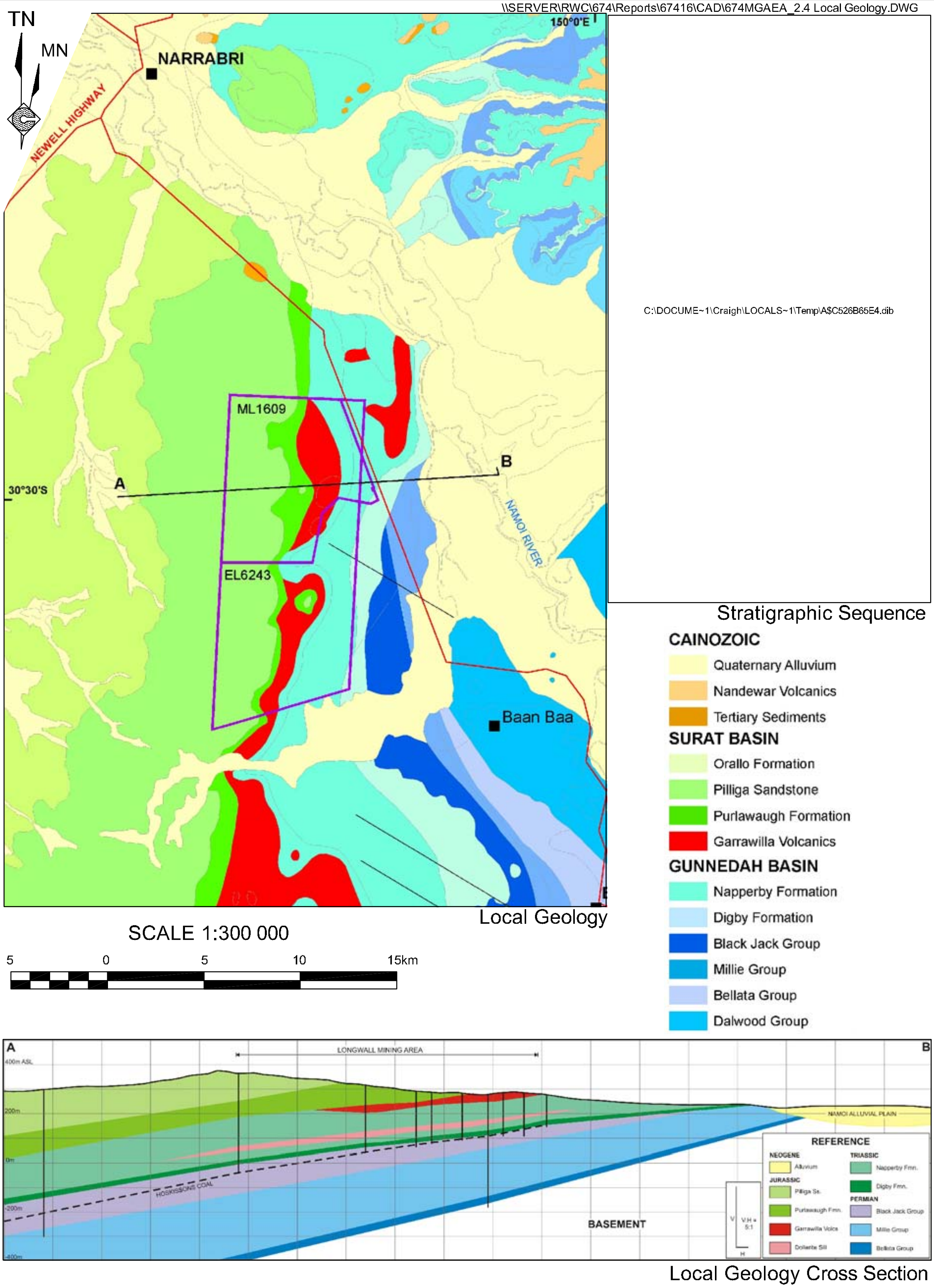

Figure 2.4
LOCAL GEOLOGY AND STRATIGRAPHY

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.