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

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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

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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.

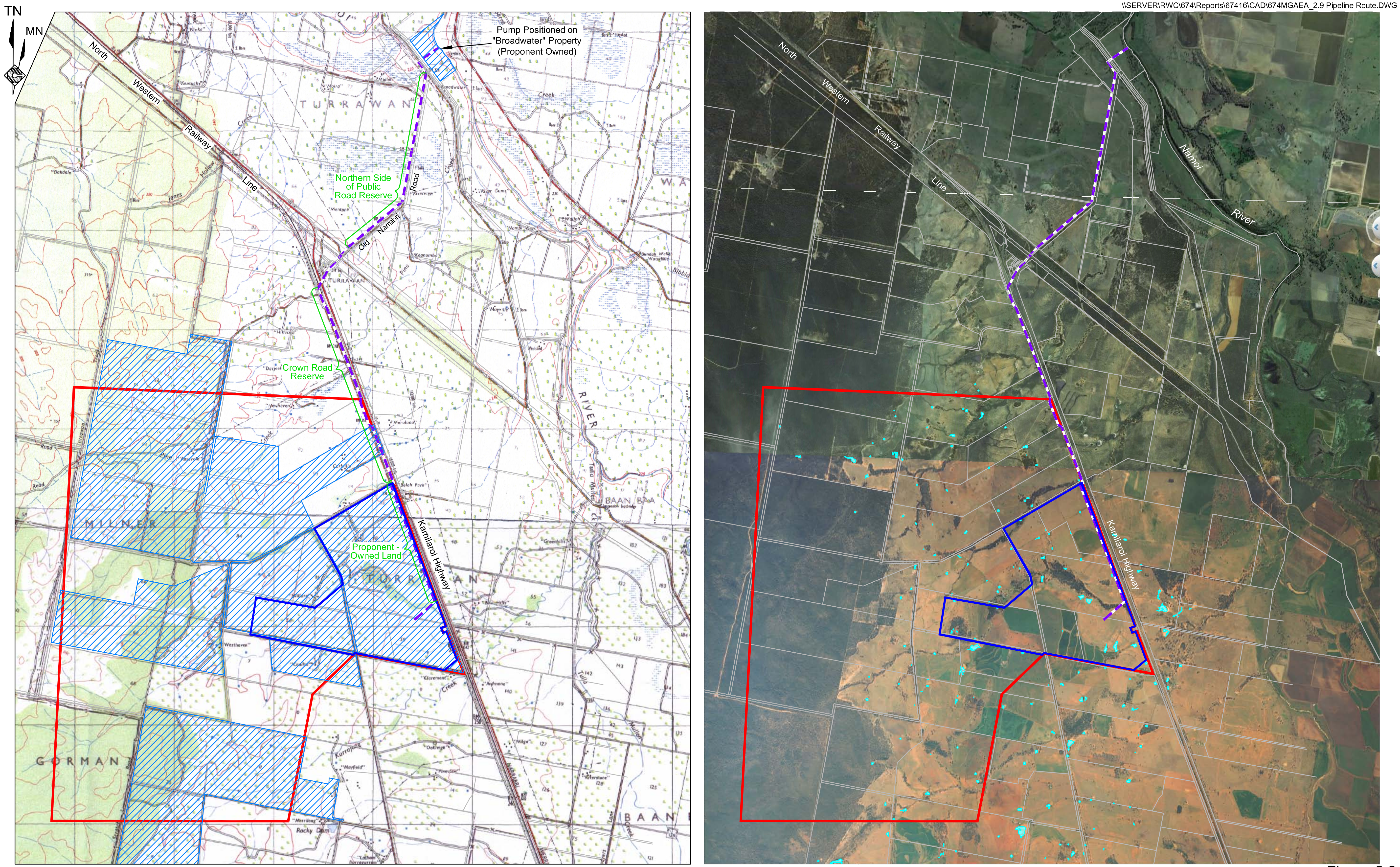
The Proponent is continuing its negotiations with the owners of land on the western side of the crown road reserve aligned between the ARTC rail easement for the North Western Branch Railway Line for access to a narrow easement of land on these properties. It is ultimately the objective of the Proponent 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.



SCALE 1:75 000

1 0 1 2 3 4km

Base Map Source: Narrabri and Baan Baa 1:50 000 Topographic Maps

REFERENCE

- Mine Site Boundary
- Pit Top Area Boundary
- Pipeline Route
- Cadastral Boundary
- Proponent - Owned Land

Base Photo Source: Geo-spectrum (Australia) and Google Earth (2009)

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.