

Report by the Mining and Petroleum Gateway Panel  
to accompany a Conditional Gateway Certificate  
for the Narrabri Underground Mine Stage 3  
Extension Project

4 June 2019

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## Executive Summary

The Mining & Petroleum Gateway Panel (the Panel) has determined an Application for a Gateway Certificate by Narrabri Coal Operations Pty Ltd (NCOPL) (the Applicant) on behalf of the Narrabri Mine Joint Venture, for its proposed Narrabri Underground Mine Stage 3 Extension Project in the New England North West region of New South Wales. The Gateway Panel finds that the Application does not meet all the Relevant Criteria and consequently issues the Applicant with a Conditional Gateway Certificate. This report provides both the opinions and the reasoning of the Panel.

The Narrabri Underground Mine Stage 3 Extension Project proposes an underground coal mine within a Gateway Certificate Application Area (GCAA) that is within Exploration License (EL 6243). Approximately 107 hectares of Interim Protocol Verified Biophysically Strategic Agricultural Land (BSAL) has been identified within the GCAA and of this approximately 15 hectares is located immediately above the proposed area of underground mining. In addition, approximately 95 hectares of potential BSAL is located on land within the GCAA where no access has been available to determine the presence of BSAL due to landholder action.

Proposed underground mining using the longwall technique is predicted to result in subsidence of a major part of the total 3,789 ha of the GCAA. The direct impacts resulting from subsidence associated with the underground mining are predicted to include surface cracking of approximately 20 mm (with isolated cracks to 240 mm) and depressions in the land surface up to 2800 mm.

Subsidence impacts on the agricultural productivity of the soil will range from changes to soil water drainage, access to soil water stores, increased surface water ponding and potential inundation of subsoil layers with associated physical and chemical degradation issues, potential changes to soil bulk density and increased erosion potential. Mining induced land surface changes will result in localised, short-term disruptions to land use practices and access.

With regard to verified Biophysical Strategic Agricultural Land (BSAL), it is the opinion of the Gateway Panel that:

- Verification of the extent of BSAL within the GCAA is incomplete. Further site sampling and analysis for an improved application of the BSAL Protocol is required in the areas of the GCAA not currently accessible.
- More examination of the impact's subsidence over the presently mined area to further inform the management of impacts on BSAL and adjoining areas within the GCAA.

With regard to Critical Industry Clusters (CIC):

- There is no CIC land located inside the GCAA or proximal to it.

The proposed mining has the potential for some indirect impacts on local groundwater resources/surface waters and their environs but is unlikely to have a significant indirect impact on either verified or potential BSAL. The two identified 'highly productive' groundwater sources – the Upper Namoi alluvium and the Great Artesian Basin Southern Recharge Groundwater Source which contains the important Pilliga sandstone will be impacted but not significantly, if make good arrangements are entered into as proposed.

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# 1. Purpose and Methodology

*In accordance with the Section 17H(2)(b), Part 4AA Mining and Petroleum Development on Strategic Agricultural Land, State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP), this report states the Mining & Petroleum Gateway Panel's (the Panel) reasons for the opinions expressed in the Gateway Certificate issued on this day to the Narrabri Underground Mine Stage 3 Extension Project*

## 1.1 Terms of Reference

The Mining SEPP provides the Gateway Panel's Terms of Reference.

The Gateway Panel must determine an Application and issue a Gateway Certificate in accordance with Section 17H of the Mining SEPP.

*Section 17H(4) provides the following relevant criteria for the Gateway Panel's determination and recommendations.*

*(a) in relation to biophysical strategic agricultural land- that the proposed development will not significantly reduce the agricultural productivity of any biophysical strategic agricultural land, based on a consideration of the following:*

- (i) any impacts on the land through surface area disturbance and subsidence,*
- (ii) any impacts on soil fertility, effective rooting depth or soil drainage,*
- (iii) increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH,*
- (iv) any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy),*
- (v) any fragmentation of agricultural land uses,*
- (vi) any reduction in the area of biophysical strategic agricultural land,*

*(b) in relation to critical industry cluster land-that the proposed development will not have a significant impact on the relevant critical industry based on a consideration of the following:*

- (i) any impacts on the land through surface area disturbance and subsidence,*
- (ii) reduced access to, or impacts on, water resources and agricultural resources,*
- (iii) reduced access to support services and infrastructure,*
- (iv) reduced access to transport routes,*
- (v) the loss of scenic and landscape values.*

*Section 17H(5) states that in forming an opinion as to whether a proposed development meets the relevant criteria, the Gateway Panel is to have regard to:*

- (a) the duration of any impact referred to in subclause (4), and*

*(b) any proposed avoidance, mitigation, offset or rehabilitation measures in respect of any such impact.*

## 1.2 Methodology

### 1.2.1 The Gateway Panel

The Members of the Gateway Panel that evaluated this Application are as follows.

Professor Snow Barlow, Chairperson – agricultural discipline;

Dr Ian Lavering – mining discipline and report compiler; and,

Mr. George Gates PSM – hydrogeology discipline

Professor Gary Willgoose was originally appointed to this assessment, but had to withdraw in its initial stages due to ill health. Mr Gates was then appointed to the panel.

### 1.2.2 Referrals

In accordance with Section 17G of the Mining SEPP, this Gateway Application was referred to the Commonwealth Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) and the NSW Minister for Primary Industries.

- On 16<sup>th</sup> April 2019, the Gateway Panel received advice from IESC (IESC, 2019).
- On 26<sup>th</sup> April 2019, the Gateway Panel received advice from NSW Minister for Planning and Public Spaces.

### 1.2.3 Meetings with the applicant or third parties

Two members of the Gateway Panel (Prof Barlow and Dr Lavering) conducted a short field investigation of the proposed site (approximately 2 hours) and the adjoining site of current mining operations (12<sup>th</sup> April 2019, Narrabri Underground Mine (Figure 1). Apart from the field investigation which was guided by mine site based NCOPL staff, no meeting was held with any stakeholder who may have an interest in this Project.

### 1.2.4 Gateway Panel teleconference meetings

The Gateway Panel has held the following teleconference meetings in relation to this Application.

- On 28<sup>nd</sup> March by teleconference, following receipt of requested advice from IESC.
- On 10<sup>th</sup> May 2019 by teleconference, to progress this report and finalise work plans.
- On Wednesday May 29<sup>th</sup> by teleconference to finalise report and conclusions.

### 1.2.5 Document review

The Gateway Panel has reviewed the following documentation provided by the Applicant as their submission for the panel to assess.

Ditton Geotechnical Services Pty Ltd (DGS), 2019. Narrabri Coal Operations Pty Ltd Mine Subsidence Assessment in Support of a Gateway Certificate Application for the Narrabri Underground Mine Stage 3 Extension Project DGS Report No. NAR-005/1 Date: 23 January 2019, 60 p.

Ecological Australia, 2019. Appendix A - Agricultural Literature Review and Stakeholder Consultation Report Narrabri Underground Mine Stage 3 Extension Project Prepared for Narrabri Coal Operations Pty Ltd 5 February 2019, 22 p.

HydroSimulations, 2019. Narrabri Underground Mine Stage 3 Extension Project: Gateway Application Preliminary Groundwater Assessment Narrabri Coal Operations Pty Ltd NPM Technical Pty Ltd trading as HydroSimulations Project number: WHI016 Report: HS2018/13d Date: January 2019, 75 p.

McKenzie DC, 2018. Agricultural Resource Assessment for Gateway Certificate Application: "Narrabri Underground Mine Stage 3 Extension Project" Narrabri, NSW. A report prepared for Narrabri Coal Operations Pty Ltd by Soil Management Designs, Orange NSW; February 2019.

Narrabri Coal Operations Pty Ltd (NCOPL) 2019. Narrabri Underground Mine Stage 3 Extension Project Gateway Certificate Application Technical Overview, Whitehaven Coal, 23 p.

*The Gateway Panel has also reviewed the following Referral Agency advice relevant to this Application.*

Acting Executive Director Resource Assessments and Business Systems, 2019. Letter to Executive Director, Independent Planning Commission. Direction for the Mining and Petroleum Gateway Panel to issue a Gateway Certificate for the Narrabri Underground Mine Stage 3 Project, 14<sup>th</sup> May 2019.

Department of Planning and Public Spaces 2019. Schedule of Lands for Narrabri Stage 3 Gateway Certificate Application.

<https://majorprojects.accelo.com/public/cd645209ad1ca117458795a45c558512/8.%20Schedule%20of%20Lands.pdf>.

Minister for Planning and Public Spaces, 2019. Letter to Mining and Petroleum Gateway Panel. Advice on the Gateway Certificate application for the Narrabri Underground Mine Stage 3 Extension, Appendix; Technical Assessment by Department of Industry-Lands and Water (DoI) 2019. Advice on the Gateway Certificate application for the Narrabri Underground Mine Stage 3 Extension, including advice provided by the Independent Expert Scientific Committee (IESC) (Commonwealth), 26<sup>th</sup> April 2019.

IESC, 2019. Advice to the Mining and Petroleum Gateway Panel within the NSW Independent Planning Commission on coal mining project: Narrabri Underground Mine Stage 3 Extension Project (IESC 2019-102).

*The Gateway Panel has reviewed the following publications relevant to Gateway Applications.*

Barnett, B., Townley, L.R., Post, V., Evans, R.E., Hunt, R.J., Peters, L., Richardson, S., Werner, A.D., Knapton, A. and Boronkay, A., 2012, Australian Groundwater Modelling Guidelines. Waterlines report 82, National Water Commission, Canberra.

Frazier, P., Jenkins, R. and Trotter, T. (2010). Monitoring the effect of longwall mining on native vegetation agricultural environments. Prepared for the Australian Coal Association Research Program by Eco Logical Australia.

DP&I, 2013. Strategic Regional Land Use Policy, Guideline for Gateway Applicants, Fact Sheet, (the Guideline). State of New South Wales through the Department of Planning & Infrastructure, September 2013.

DPI, 2013. Agricultural Impact Statement technical notes: A companion to the Agricultural Impact Statement guideline. State of New South Wales through the Department of Primary Industries, April 2013.

Hinchliffe, D., Matthew, P., Pillai-McGarry, U., So, H.B., Mulligan, D. (2003). Effect of longwall mine subsidence on plant production on cropping land. Australian Coal Association Research Program.

NSW Government, 2007. State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007, Part 4AA Mining and Petroleum Development on Strategic Agricultural Land (the Mining SEPP). NSW Legislation, State of New South Wales, 2007.

Notice of a Gateway Application in Accordance with Clause 17F(3)B of the State Environmental Planning Policy Mining, Petroleum Production and Extractive Industries 2007. Notice listed in Public Notices Section of Namoi Valley Independent, Thursday, December 13, 2018.

OEH and OAS&FS, 2013. Interim protocol for site verification and mapping of biophysical strategic agricultural land (BSAL). State of New South Wales through the Office of Environment & Heritage and the Office of Agricultural Sustainability & Food Security.

## 2. The Proposed Project

Narrabri Coal Operations Pty Ltd (NCOPL) on behalf of the Narrabri Mine Joint Venture, is the proponent for an extension of an existing underground mining operation (Narrabri Mine) within Exploration Licence 6243 in the New England North West region of New South Wales. NCOL operates the Narrabri Mine on behalf of the Narrabri Mine Joint Venture, which consists of Whitehaven Coal Limited wholly owned subsidiary Narrabri Coal Pty Ltd, Upper Horn Investments (Australia) Pty Ltd, J-Power Australia Pty Limited, EDF trading Australia Pty Limited, Posco Daewoo Narrabri Investment Pty Limited and Kores Narrabri Pty Limited.

The Project is located approximately 25 kilometers southeast of the township of Narrabri and 60 km northwest of Gunnedah (Figure 1). The Project is present within the Narrabri Shire Council Local Government Area. The proposed extension to the existing mine would utilize existing infrastructure and undertake a pattern of long wall panels immediately south of the existing mining operation (Figure 2).

The Exploration Licence (EL 6423) over which the GCAA partially extends was granted in May 2004. The existing mining operation is conducted within Mining Lease ML 1609 and the GCAA extends over the southern part of EL 6243 (Figure 2). The land use near the existing Narrabri Mine and the proposed Extension Project is dominantly devoted to sheep and cattle grazing, some cereal production and horticulture. The Pilliga and Jacks Creek State Forests adjoins the western extent of the EL 6243.



No land mapped as equine and viticulture critical industry cluster, as identified in the NSW State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEEP) is present within the Gateway Application Certificate Area, or proximal to it.

The proponent of the Project is required to make a Gateway Application because:

- The Project is a proposed development specified in Clause 5 (Mining) of Schedule 1 to State Environmental Planning Policy (State and Regional Development) 2011 that a mining lease under the Mining Act 1992 is required to be issued to enable the development to be carried out because there is no current mining lease in relation to the proposed development; and,
- The proposed development is in part on land which the applicant has identified as being, or potentially Biophysically Strategic Agricultural Land (BSAL).

The project involves an extension of an existing underground mine, in the area of Exploration Lease EL 6243, south of the currently operating mine which is located within in ML 1609. The Project intends to develop and extract additional and or longer longwall panels of coal within the regionally-extensive Hoskissons Coal Seam in a more southerly extension of the subsurface strata presently being exploited. Current mine life is approved until July 2031 with an operational capacity of 11 Mtpa of ROM coal.

### 3. Strategic Agricultural Land Verification

#### 3.1 Biophysical Strategic Agricultural Land (BSAL) verification

For the identification of BSAL in the GCAA the applicant has applied the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land (BSAL Protocol) (OEH & OASFS, 2013). Of the verified 107 ha of BSAL only 15 ha overlies the area likely to be affected by the mining longwall process.

While not verified due to access limitations, an additional 95 ha of potential BSAL is located on land within the GCAA. Of this potential BSAL approximately 60 ha is present above the area to be affected by longwall mining. It is imperative that the status of this potential BSAL be determined as soon as practicable.

#### 3.2 Critical Industry Cluster (CIC)

There are no viticulture or equine industry businesses within or proximal to the proposed Project.

### 4. Assessment of Mining Disturbances

The Gateway process requires that the potential impact on BSAL and/or a CIC is evaluated as either:

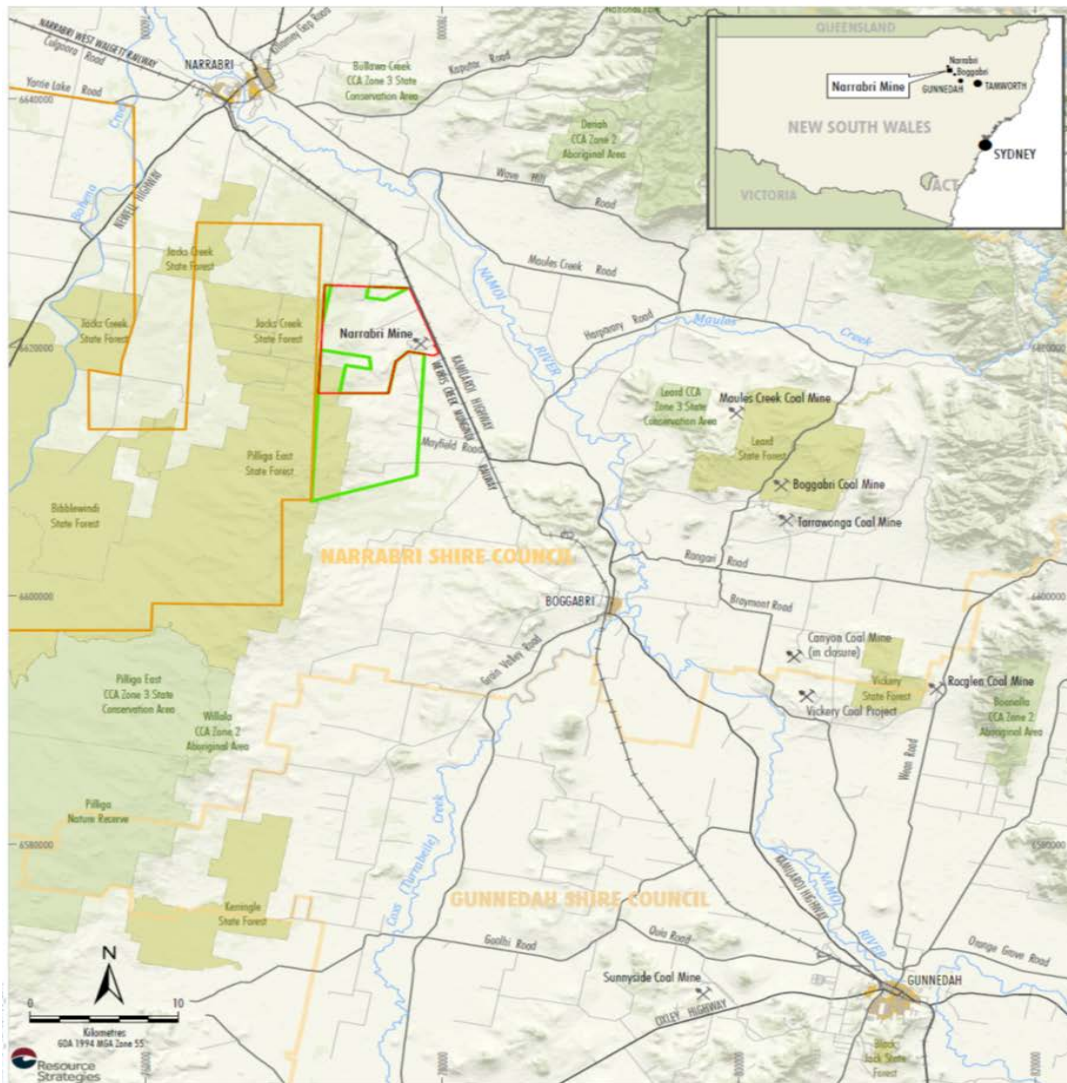
- A direct mining effect whereby part or all of BSAL or a CIC is either removed, worked upon or subsided, or
- An indirect mining effect whereby the state of either the surface water or sub-surface water is significantly altered by mining which then has a direct impact on BSAL and/or a CIC.

The assessment of mining disturbance must consider both direct and indirect impacts as defined above, mine. The proponent has undertaken considerable work to assess the potential impacts that the mining process could have in the GCAA, given one access limitation.

### 4.1 Direct mining disturbances

The Project mining operation within EL 6243 will produce localized subsidence and cracking as a result of longwall mining. The mining process in the GCAA will result in development of surface cracking above each longwall panel. This will be caused by the bending of the overburden strata as it sags down into the newly created void in the coal seam. The sagging strata will be supported by previously collapsed roof material, which compresses over time until maximum subsidence is reached.

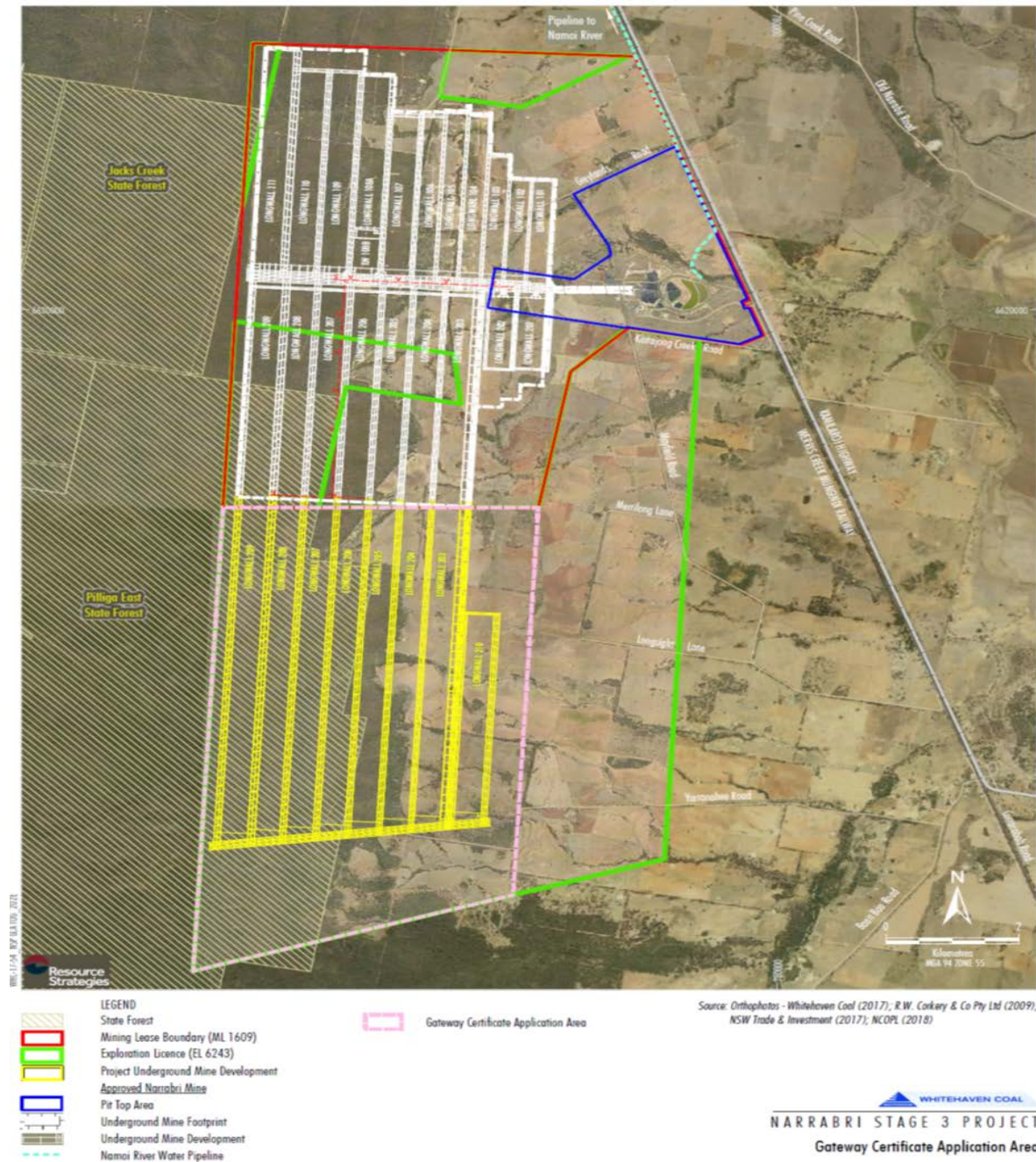
In contrast, the surface of the current mining area (ML 1609) including the existing mine infrastructure area, coal handling and preparation and reject emplacement areas are not proposed to be modified and will have no further direct impacts on BSAL. DGS (2019) has provided an assessment of the potential impacts of subsidence above the proposed mining area.



- LEGEND**
- Mine Site
  - Mining Lease (ML 1609)
  - Exploration Licence (EL 6243)
  - Local Government Boundary
  - State Forest
  - State Conservation Area, Aboriginal Area
  - Proposed Narrabri Gas Project (Santos NSW [Eastern] Pty Ltd)

Source: Department of Land and Property Information (2017); NSW Department of Industry (2017); Geoscience Australia (2011)

**Figure 1.** Project location within the region (NCOPL 2019).



**Figure 2.** The extent of EL 6243, the present and proposed long wall coal mine operation, underground mining panels prosed for the extension project, and the extent of ML 1609 over the existing longwall panels (NCOPL 2019).

#### 4.1.1 Removal or working upon verified BSAL

The applicant proposes to mine longwall panels 383.1 to 417.6 m in length with depths of covering strata ranging from 160 to 420 m (DGS 2019). Some minor mine site infrastructure is required within the GCAA which will occupy 374 ha in total but in most cases, this will be temporary and required only when the mining process is being conducted proximal to each location. Such infrastructure includes temporary gas drainage pipelines to drainage wells above the long wall panels and gate roads. Such pipelines are to be inspected for subsidence damage and decommissioned/rehabilitated as required during and after the mining progresses. An area of 11.2 ha of BSAL is proposed for use by surface infrastructure in the GCAA during the course of the entire extension project.

#### 4.1.2 Disturbance due to mining subsidence

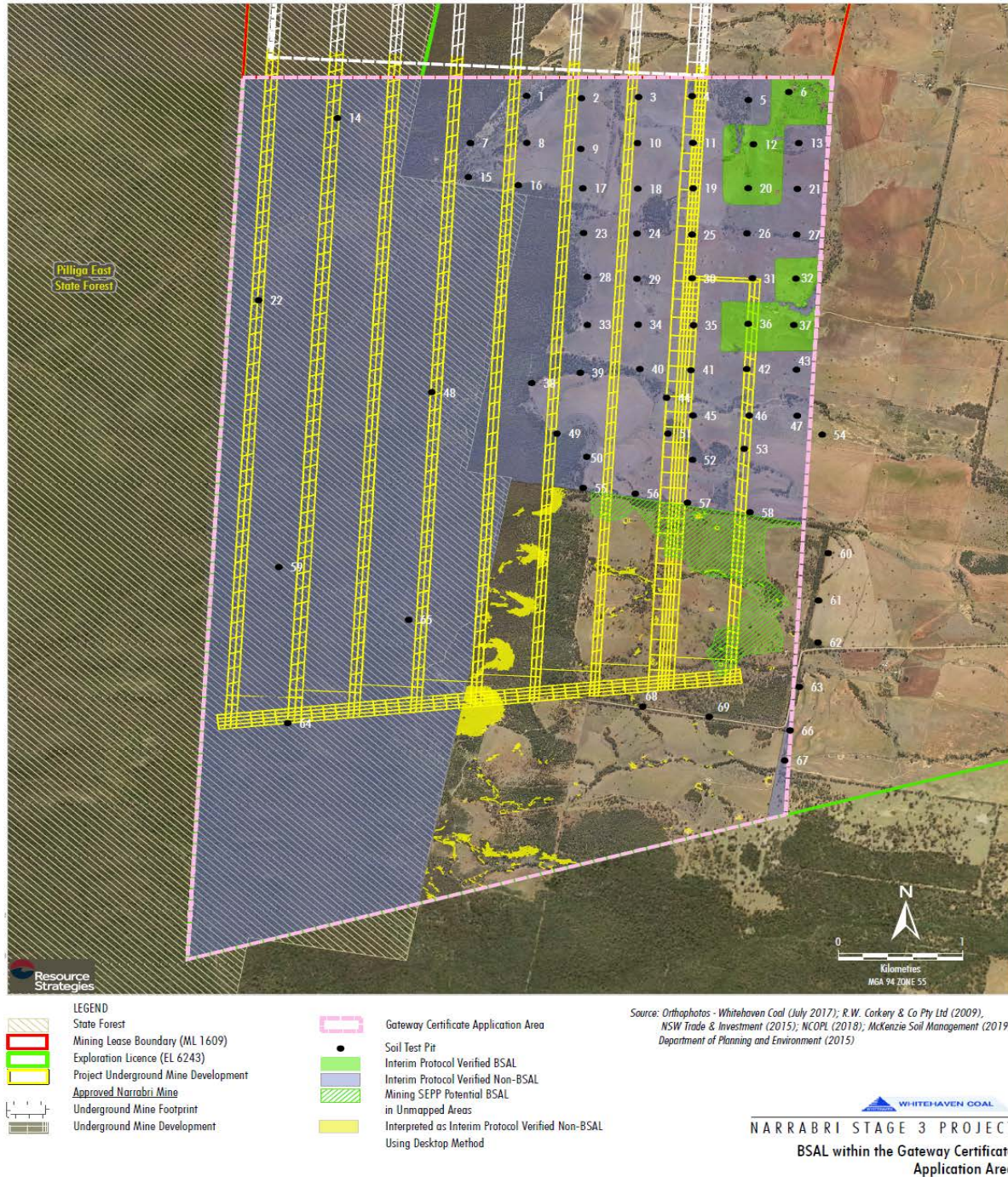
The Project will undermine the 15 ha of BSAL verified by the Applicant and will impact upon an additional 60 ha of potential BSAL which awaits verification by the applicant. The total maximum vertical subsidence for the verified and potential BSAL areas is predicted to be 2.8 meters.

The following general features are present in the areas overlying longwall mining in the GCAA. The existing surface features within the zone of expected subsidence include the following:

- Gently undulating terrain with ephemeral watercourses and creeks.
- Semi-cleared, agricultural land (predominately used for grazing cattle and sheep) above the first two longwalls (LW203 and LW210) in the eastern section of the Application Area.
- Pilliga East State Forest above five longwalls (LW205 to LW209) in the western half of the Application Area.
- Poor quality sub-surface groundwater aquifers at depths generally ranging from 40 m to 150 m.
- Thirty-nine (39) farm dams for livestock watering.
- Unsealed access roads and property fencing.
- Yarranabee Road.

The mining process is expected to impact upon each of these features in the following manner. Of specific concern to this assessment are potential surface cracks and their impact upon watercourses and infrastructure. Connective cracking is estimated to range from 121 m to 297 m above the proposed panels, depending upon the depth to the level of mining. Surface cracking widths are estimated to range from 20 mm to 240 mm, with occasional (<5%) cracks wider than this over the shallower panels. In flatter topographic areas, surface cracking is expected to be typically between 25 mm and 50 mm, with some localised cracking around 100 mm or greater.

A total of twelve (12) potential ponding locations are predicted in the GCAA, which are present within verified or potential BSAL. The majority of potential ponding areas already exist in the topography and will develop further along the watercourses but will remain within the confines of the existing channel structure. The changes to existing maximum pond depths are estimated to range from -0.1 m to 0.9 m in the GCAA and from -0.1 m to 0.6 m in the verified and potential BSAL. The changes to ponded areas within the verified and potential BSAL locations range from -0.09 ha to +0.9 ha with ponded volumes increasing by 0.16 ML to 2.47 ML.



**Figure 3.** Location of verified BSAL in GCAA and location of test pit sites. NB the area of potential BSAL in the GCAA not confirmed due to access limitations (NCOPL 2019).

The following specific mining-related issues arise as a consequence of the proposed mine in the GCAA region.

- Direct hydraulic connection to the mine workings due to sub-surface fracturing could encroach to within 38 m to 171 m depth below the surface in the GCAA; the shallowest being above the proposed LW210 where it underlies the verified and potential BSAL. There is potential for connective cracking in the zone above LW210. The development of such could be indicated by borehole extensometer and mining performance data. It may therefore be necessary to modify the layout of LW210 geotechnical mining if extension results indicate that connective cracking has taken place.
- There is potential for surface cracking to change creek flows as water could be re-routed into open cracks to below-surface pathways which may then re-surface downstream of the mining extraction limits in the mining area.
- In most of the mining area of the GCAA subsurface fractures which do not connect with the surface will have another impact; they will increase the rock mass water storage capacity and horizontal permeability without direct hydraulic connection to the workings. Local groundwater levels will be lowered in the medium to long term as a consequence.

Given the above, and the uncertainty in the precise behavior of the fracture systems subsidence modelling, the Gateway Panel believes the potential impacts on the GCAA, and the verified and potential BSAL from subsidence alone, requires some additional investigation and documentation. Surface survey monitoring has been employed to inform the mining process of the extent of subsidence and cracking in cleared grazing areas in ML 1609. Future monitoring in the GCAA will be undertaken in a similar manner. It would however, require extensive clearing of natural vegetation to install survey monitoring lines over LW206 to LW209. As these lines fall within the limits of the Pilliga East and Jacks Creek State Forests and the adjoining pastoral land. They do not contain verified or potential BSAL.

#### 4.1.3 Duration of impacts, mitigation and rehabilitation measures

In geological terms, the project proposes to repeat the operational procedures evident within ML 1609 in the GCAA with no variation, with the exception of the layout of long wall panels. The target coal is located within the Hoskissons Seam which has an average thickness of 5 m in the GCAA, and sub-crops to the east at 130 m AHD and to the west at greater depths. Based on bore core testing results, the proposed mining section of the seam comprises low to moderate strength coal with minor carbonaceous siltstone/mudstone bands. The proposed mine roof coal consists of similar strength coal with a higher proportion of low strength carbonaceous siltstone/mudstone.

The key feature of long wall mining is the nature and frequency of sub-surface and near-surface fracturing and subsidence. The Applicant proposes to remediate and manage these issues by repairing cracks as and when they occur on the surface. If the scale and pattern of cracking and subsidence is greater and or more frequent than anticipated, then the Applicant can vary the panel height or width of the long wall excavations so as to reduce whatever unexpected risk factors s and when they arise.

While no significant surface slippage and or instability is expected, it is most likely to occur on a small scale in the banks of creek channels where slippage should be most frequently encountered. As a general rule, the maintenance of the limited ground cover is considered and absolute minimum.

Changed surface slopes in the elevated areas could promote the formation of closed depressions, especially across panels with flatter surface topography, altering natural drainage pathways to watercourses and farm dams.

Maximum change to ponding depths is expected to be up to 0.6 m, with 12 potential ponding areas predicted within the GCAA. There are nine surface dams that may have their inflow affected by ponding promoted by mining-induced subsidence. DGS (2019) identified three small areas of potential ponding upon verified or potential BSAL. Managing the ponding should be undertaken by monitoring of changes in surface drainage in areas of active mine-induced subsidence. Removing the ponds would require earthworks sufficient to reinstate the channel and/or dam inflow regime.

A total of 39 dams currently exist above the predicted impact area, nine of which may have their inflows affected by upstream ponding due to the proposed longwalls (DGS 2019). To date no dams impacted by subsidence in ML 1609 have required any remedial work. If necessary earthworks should be undertaken where subsidence impacts negatively upon existing dams in the GCAA.

The limited area of BSAL impacted by mine infrastructure in the GCAA is to be retained by stripping and stockpiling of topsoil prior to disturbance (NCOL 2019) and managed so as not to degrade the resource during the stockpiling or rehabilitation phases. The range of mining and exploration activities associated with the mine in the GCAA should be undertaken in a manner which would not prevent or deplete the quality of the original landform and soil qualities present in the region prior to mining. All possible effort, resources and diligence should be devoted to rehabilitating the area affected by these activities after the mining process is complete.

## 4.2 Indirect mining impacts

In the following assessment, the Gateway Panel has considered the advice from the Independent Expert Scientific Committee (IESC, 2019) and Department of Industry – Water (DoI Water, 2019).

The Panel has assessed this application against specific criteria in the AIP, which includes assessing the impacts on aquifers, connected rivers with reliable flows and associated water dependent assets (including the environment). It also requires accounting for water take through a licensing regime.

The AIP includes a set of minimal impact considerations for assessing the impacts of all aquifer interference activities, including mining. All NSW groundwater sources have been categorized as being either 'highly productive' or 'less productive', based on the general character of the water source meeting or not meeting the criteria of 1500 mg/L total dissolved solids and a bore yield rate of greater than 5 L/s. This categorization applies to a whole groundwater source as it is defined in a water sharing plan (WSP), not to the specific groundwater conditions at a particular location.

Impact considerations relate to impacts on the water table and aquifer pressure, as well as to groundwater dependent ecosystems and to groundwater and surface water quality. Applicants are required to provide estimates of all quantities of water that are likely to be taken from any water source during and following the end of the activity, and to make predictions of all impacts associated with the activity.

The Water Management Act 2000 includes the concept of ensuring “no more than minimal harm” for both the granting of water access licenses and the granting of approvals. This is not equivalent to a ‘no

impact' scenario. The approach is one of keeping cumulative impacts in a catchment at an acceptable level and sharing the water resources between the environment and other water users.

Level 1 impacts are considered acceptable, while Level 2 impacts require further studies to assess whether a project will prevent the long-term viability of a dependent ecosystem or water assets or requires better arrangements to mitigate impacts.

#### 4.2.1 Impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy)

##### *Geology and Groundwater Flow*

The Preliminary Groundwater Assessment (PGA) by HydroSimulations (2019) states that the proposed Narrabri Mine Extension (NME) is situated within the Permo-Triassic Gunnedah Basin, near the northern and western boundaries of the Basin and the eastern margin of the Surat Basin, a sub-basin of the Great Artesian Basin.

The hydrogeological regime in the vicinity of the NME can be described as:

- a porous hard rock groundwater system that occurs throughout the stratigraphic sequence of Jurassic and Triassic formations and Permian coal measures; and
- aquifers associated with the Quaternary unconsolidated alluvial sediments of the Upper Namoi River floodplain (also known as the Upper Namoi Zone 5 Groundwater Source).

HydroSimulations (2019) states that “The conceptual flow model is one where the dominant recharge occurs through infiltration from rainfall and runoff. The dominant natural discharge processes are evapotranspiration (ET), seepage face flow and baseflow to the local streams. Under natural conditions groundwater flow is from elevated areas to lower parts of the catchment. While under mining conditions, some localized groundwater flow paths would be altered to flow towards the collapsed roof which would act as a groundwater sink. Actual vertical percolation of recharge through rock layers is very limited and most recharge is likely to occur at subcrops after which the recharge water will move along relatively more permeable strata, parallel to bedding. The higher permeability of the alluvial areas and runoff concentration within drainage channels means that recharge will also tend to be higher in those areas”. **Figure 4** shows the conceptual groundwater flow model.

There are two important groundwater sources in the vicinity of the mine within the hydrogeological regime described above that are considered as ‘highly productive’ under the AIP. They are the Quaternary Upper Namoi Alluvial aquifer (Upper Namoi Zone 5 Groundwater source) and the Jurassic Pilliga Sandstone aquifer (part of the Great Artesian Basin Southern Recharge Groundwater source). Impacts to these groundwater sources are the primary concern of the Gateway Panel.

The Panel considers the conceptualization of the regional geology and hydrogeology to be plausible and adequate at this early stage of assessment and that the processes of groundwater flow from one water source to another have been identified at a broad scale. At a local scale there are still uncertainties such as the extent to which fracturing, caused by mine subsidence, will modify groundwater flow and also the impacts of faults and a basalt intrusion on flow.



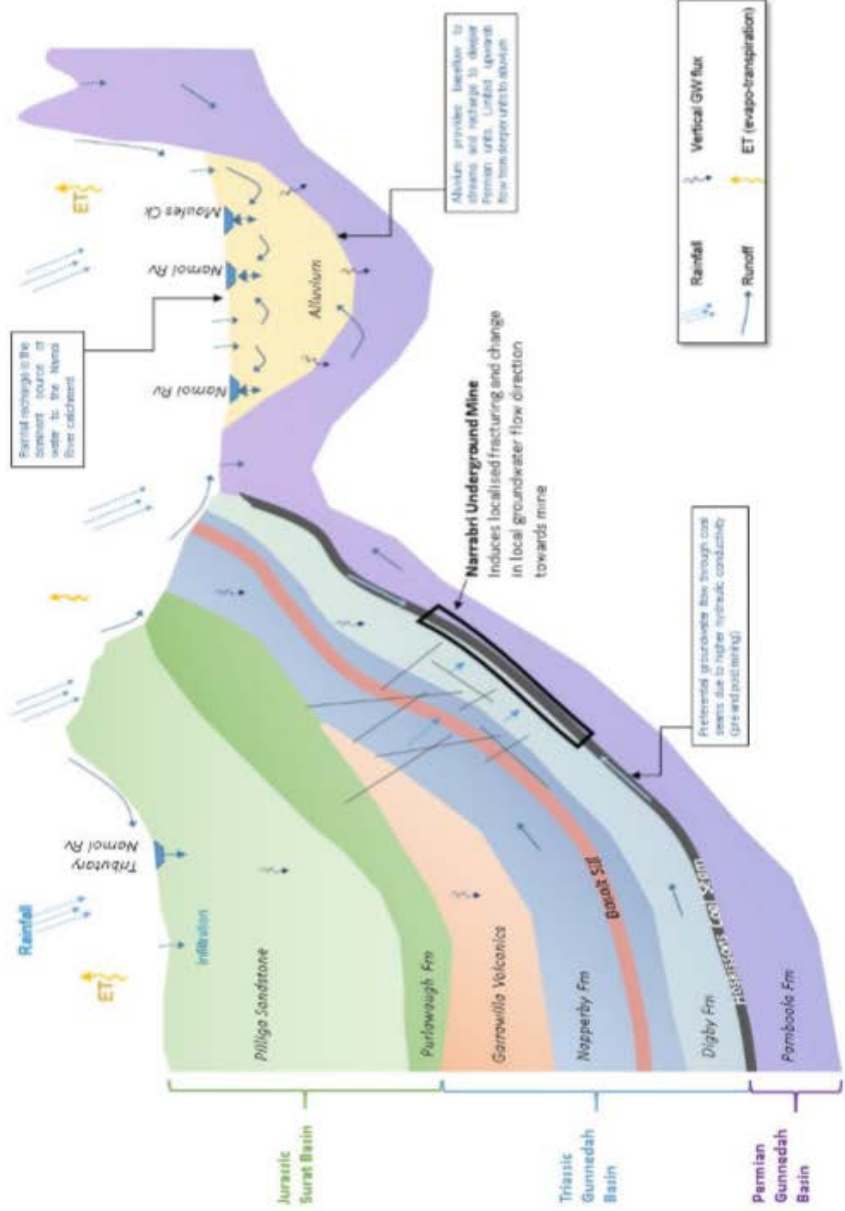


Figure 4. Conceptual Groundwater Flow Model (from HydroSimulations, 2019).

### ***Groundwater Monitoring***

The groundwater monitoring network currently consists of more than 50 monitoring sites. The objectives of the monitoring are to establish baseline groundwater quality and water level data that provides a basis for calibrating the groundwater flow model which can then be used in predicting and assessing potential impacts of the proposed mine.

Monitoring bores (piezometers) have been established at various depths into different formations to obtain information for the layers in the groundwater flow model. Also, some Multi-level vibrating wire piezometers (VWPs) have been installed within the Jurassic, Triassic and Permian formations to obtain continuous water level data.

The Panel agrees with the IESC and DoI Water that if the project progresses to an EIS, the 2013 monitoring program should be updated with additional monitoring bores. In particular, the spatial coverage of the groundwater monitoring network should be expanded to where there are currently no monitoring bores i.e. to the west and south of the proposed extension.

### ***Hydraulic Parameters***

Hydraulic parameters (hydraulic conductivity and specific storage) have been obtained from a combination of previous local studies/investigations, laboratory tests and on-site field tests. A range of hydraulic conductivity data for the interburden units above the Hoskissons Coal Seam were obtained. Some tests overlapped with the Hoskissons Seam, providing data for that seam.

It is reported that geotechnical properties (Young's Modulus and Poisson's Ratio) for 41 core samples have been analysed to infer specific storage values.

It is usual with longwall coal mining for the hydraulic properties of the interburden material above the mined coal seam to be increased as a result of caving and subsidence above longwall panels. It is generally accepted that it is difficult to measure or predict hydraulic properties accurately under these circumstances. The proponent has considered this issue in some detail and included the predicted height of fracturing in the model sensitivity/uncertainty studies.

The Panel notes that hydraulic properties for the present groundwater flow model differ somewhat from those of the earlier models. The IESC has requested more explanation for these differences in an EIS.

The longwall mining within the GCAA is predicted to result in surface cracking of approximately 20 mm width (with isolated cracks to 240 mm width) which are thought to extend to about 10 m. in depth. Predictions are that mining will cause depressions in the land surface up to 2.8 meters.

There is some uncertainty about whether the fracturing above the collapsed roof will reach ground surface or connect with the mining induced surface tensile cracks thought to extend to about 10 m below ground surface. The height of fracturing has the potential to influence stream losses and predictions of mine inflows. The IESC notes that "the potential for connective cracking is considered 'unlikely' to 'possible' pending review of further borehole extensometer and mining performance data".

### ***Groundwater Flow Modelling***

The IESC notes that the modelling provided by the proponent exceeds the requirements for the Gateway process. Modelling for this Gateway assessment has been built on an existing numerical model

(HydroSimulations, 2016), retaining full spatial and temporal detail. The MODFLOW-SURFACT V4 software was used for the current model. This allows for both saturated and unsaturated flow conditions.

The model is semi-regional and contains 11 hydrogeological layers. The extent is 75 km from west to east and 53 km from south to north, extending over an area of nearly 4000 square kilometres. The dimensions of the model cells vary from 50 m in the vicinity of the mine to 500 m towards the model edges.

Model calibration was carried out against measured mine inflows for stages 1 and 2 of the Narrabri Mine and 59 targeted time series groundwater levels. The modeler, used a combination of auto-sensitivity analysis and manual modification of zones and model parameters. The overall performance of the model is considered to be satisfactory with performance statistics generally within modelling guidelines (Barnett et al., 2012). The model was also verified using some 14 months of time series water level data not previously used and performed satisfactorily.

The Panel notes that the model will be further refined and developed to meet the Secretary's Environmental Assessment Requirements (SEARs) when issued. Additional work has been identified by the proponent. This refinement work will include a cumulative impact assessment incorporating the nearby (proposed) Narrabri Gas Project. No cumulative assessment has been undertaken to date. Further model development work, that will help increase confidence in model, is outlined in the IESC (2019) report. The model as currently set up doesn't allow leakage of water from minor ephemeral streams to the groundwater system and additional work should be carried out to see if this realistically represents the physical system.

The proponent has undertaken some sensitivity testing and uncertainty analysis (fracture height above the collapsed roof). The groundwater model simulations indicate a similar groundwater response (both water level drawdown and mine inflows) regardless of the assumed height of the fracture zone above the Hoskissons Seam. This lack of model sensitivity to the assumed extent of the fracture zone height is both surprising and concerning to the EISC and the Panel. The reasons for this lack of sensitivity needs to be explored during the further development of the model for input to an EIS. Also, a wider range of parameters should to be included in any sensitivity/uncertainty analysis for an EIS.

The current modelling predictions indicate that the impacts on both the water table and pressure level in the 'highly productive' Upper Namoi alluvial aquifer (Upper Namoi Zone 5 Groundwater source) will be minimal (Level 1).

Impacts on the groundwater pressure level in the Great Artesian Basin Southern Recharge Groundwater Source will be Level 2 which exceeds minimal impact, because two bores have water level impacts greater than 2m. The predicted impact level (Level 1) on the water table in the Great Artesian Basin Southern Recharge Groundwater Source is considered by DoI Water to be questionable. DoI Water seeks clarification that NCOL have correctly used the minimal impact considerations criteria for the Great Artesian Basin Southern Recharge Groundwater Source.

Additional key findings of the HydroSimulations (2019) preliminary groundwater assessment are that a Level 1 impact acceptable impact has been assessed for:

- high priority groundwater dependent ecosystems;

- high priority culturally significant sites;
- lowering of water quality beneficial use categories; and
- increase in Namoi River salinity.

The modelling predicts peak mine inflows will be about 5.1 ML/day (about 1,847 ML) during 2037 and that groundwater flow direction will be little affected in all layers, with the exception of the deeper layers in close proximity to the mine, where there will be a localised reversal of flow direction, for an extended period, towards the mine. Recovery of groundwater water levels have been predicted over a 200-year period. Whilst this is considered beyond the accuracy of the model it gives an indication that full water level recovery of some model layers will take in excess of this period, including the Pilliga Sandstone aquifer in close proximity to the mine.

## 5. Panel Assessment of Impacts on Strategic Agricultural Land

The Gateway Panel has assessed and determined the potential impacts of the proposed Narrabri Underground Mine Stage 3 Extension Project on BSAL as follows (findings are summarized in Table 1). The Project will have a relatively low impact on much of the area within the 2,134 ha of the GCAA and cause direct impacts to 75 ha of presently verified BSAL and 60 ha of potential BSAL due to subsidence effects. These subsidence effects are considered significant and irreversible but manageable within the current agricultural practices and land use patterns.

**Table 1.** Summary of Gateway Panel determination of impacts on BSAL.

<b>17H(4)(a) BSAL</b>	<b>Determined Impact</b>
(i) any impacts on the land through surface area disturbance and subsidence,	Significant
(ii) any impacts on soil fertility, effective rooting depth or soil drainage,	Significant
(iii) increases in land surface micro relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH	Significant
(iv) any impacts on highly productive groundwater (within the meaning of the aquifer interreference policy	Not significant
(v) any fragmentation of agricultural land uses,	Not significant
(vi) any reduction in the area of biophysical strategic agricultural land.	Significant - not all potential BSAL and been verified

### 5.1 Significance of the project’s potential impacts on BSAL

#### 5.1.1 Any impacts on the land through surface area disturbance and subsidence

Subsidence has the potential to create issues with surface water flow, surface ponding and soil inundation and at the other extreme, access to soil water reserves. Any significant periods of inundation could affect the chemical and physical fertility of affected soil, thereby impacting the agricultural productivity of verified BSAL. Restriction of access to water in the soil profile may also impact the agricultural productivity of verified BSAL.

### 5.1.2 Any impacts on soil fertility, effective rooting depth or soil drainage

The potential for surface-water ponding and soil compaction in subsidence depressions, and subsoil inundation of BSAL means that the fertility, effective rooting depth and soil drainage may be significantly impacted in localised areas of presently verified BSAL soils and potential BSAL soils in the unsurveyed area of the GCAA (Figure 3). Evidence from this site and other published studies of the impacts of subsidence on the productive capacity of agriculture soils indicate that the effective rooting depth of may not be affected provided that prolonged periods of inundation do not occur. In the areas identified by the modeling to be prone to ponding, due to mining subsidence, the EIS must address this potential subsidence ponding. Where the catchments of farm dams are likely to impacted by subsidence consideration should be given to replacing subsidence-impacted dams with new dams in unaffected areas, if that is practical.

### 5.1.3 Any increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH

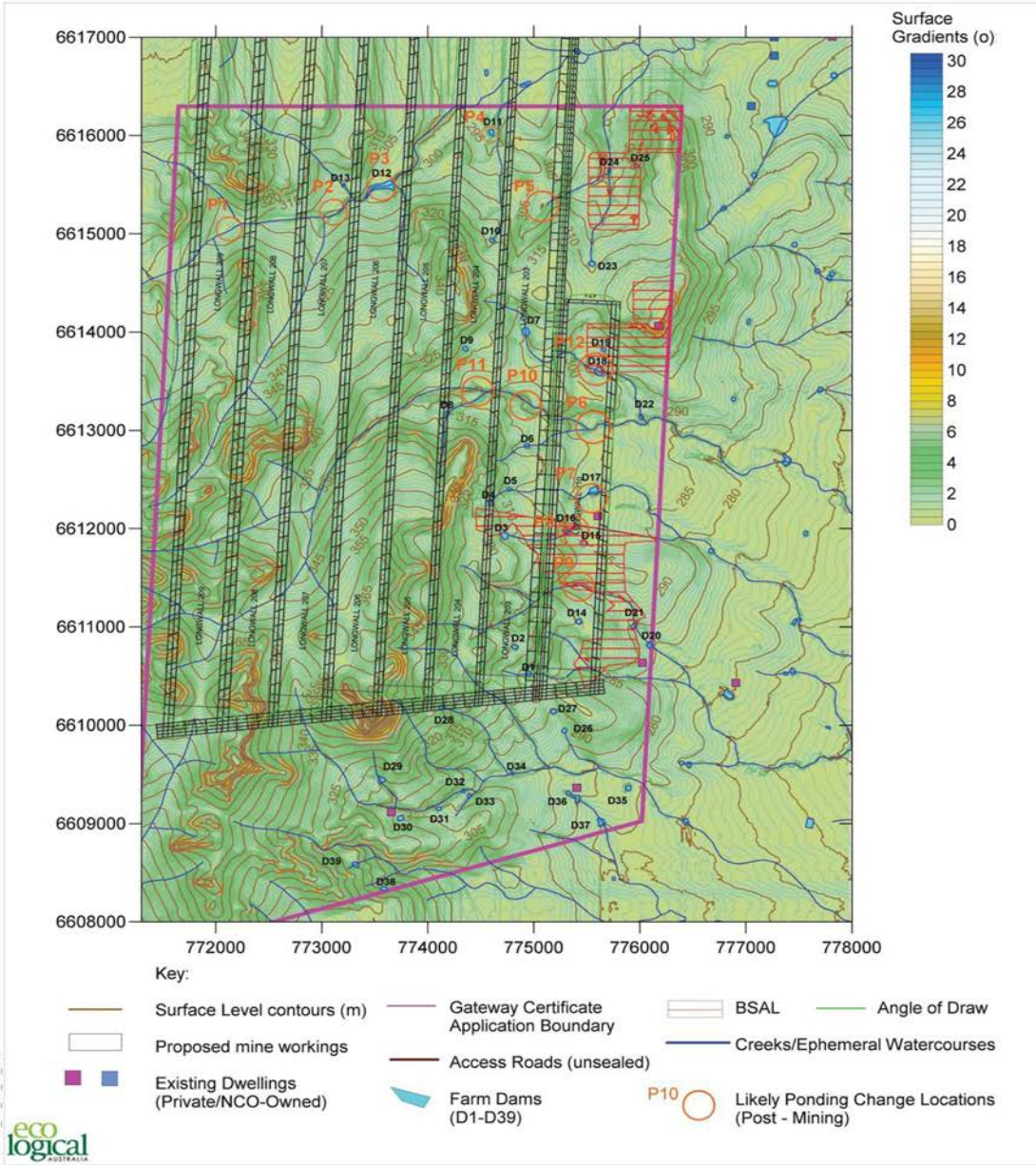
As discussed above in 5.1.1 and 5.1.2 the expected subsidence will increase land surface micro-relief but is not expected to increase soil salinity, rock outcrops, slope and surface rockiness or any significant changes in soil pH.

### 5.1.4 Any impacts on highly productive groundwater (within the meaning of the Aquifer Interference Policy)

Dewatering during longwall mining will cause depressurization of the Hoskissons Coal Seam and to a lesser extent the overlying interburden (Permian to Jurassic strata), the effects of which will extend tens of kilometers for the deeper formations and a smaller distance (1 to 2 km) for the upper stratigraphic layers

There are two important groundwater sources in the vicinity of the mine that are considered as ‘highly productive’ under the AIP. They are the Quaternary Upper Namoi Alluvial aquifer and the Jurassic Pilliga Sandstone aquifer. The latter has been combined with the underlying Purlawaugh formation and the Garrawilla Volcanics and assigned to the Great Artesian Basin Southern Recharge Groundwater Source in WSPs.

The current modelling predictions indicate that the impacts on both the water table and pressure surface of the ‘highly productive’ Upper Namoi alluvial aquifer will be minimal. The Panel considers that this is the likely outcome. Two registered bores, GW067626 (privately owned) and GW966836 (NCOL owned), occur within the Purlawaugh formation and the Garrawilla Volcanics respectively, that are predicted to experience a drawdown impact of greater than 2 m. This is considered a greater than minimal impact (Level 2) for the pressure level in the Great Artesian Basin Southern Recharge Groundwater Source. NCOL have stated “they would implement “make good” provisions to privately owned bores”. The predicted impact level (Level 1) on the water table in the Great Artesian Basin Southern Recharge Groundwater Source is considered by DoI Water to be questionable. DoI Water seeks clarification.



**Figure 5.** Projected subsidence ponding from longwall subsidence and potential location of surface infrastructure (DGS, 2019).

The effects of dewatering the coal seam will result in some predicted movement of water towards the mine from the Pilliga sandstone aquifer, the Upper Namoi alluvium and the Namoi River, both during

and post mining. Groundwater modelling predicts the loss of water from the Namoi River to be 0.5 ML/day. The model predictions are that the proposed mine will result in a maximum additional groundwater take of 0.38 ML/d from the Upper Namoi alluvium and 0.85 ML/d from the Great Artesian Basin Southern Recharge Groundwater Source.

The Panel accepts the proponents' predictions that there will be minimal water quality impacts to the Upper Namoi alluvial aquifer and the Pilliga Sandstone caused by mining, and there will also be no significant change in the salinity of the Namoi River. No high priority groundwater dependent ecosystems have been identified in the project area.

The Panel considers that mine dewatering for the Narrabri Underground Mine Stage 3 Extension Project, is unlikely to have a significant indirect impact on both the verified and potential BSAL due to depressurisation impacts on nearby and overlying 'high priority' aquifers.

The Panel requires more geological detail and baseline data acquisition in any upgraded groundwater model that is to be used in an EIS. Also, any future groundwater flow modelling should be independently peer reviewed and include cumulative impact studies of the nearby (proposed) Santos Coal Seam Gas Project. Additional studies are required to more fully identify and evaluate cracking formed from the effects of mining and the possible loss of water in ephemeral streams due to surface cracking.

#### 5.1.5 Any fragmentation of agricultural land uses

The underground longwall nature of the mining proposed in the GCAA is not likely to result in any significant fragmentation of agricultural land uses. As described in the application the land within the GCAA is predominately used for extensive cattle and sheep grazing with some opportunistic cropping. The modelled subsidence from proposed mining and the actual subsidence from current mining operations appear to be less than 2.8 meters, which should be manageable with an appropriate mine land management plan in place to immediately address surface cracking and livestock fencing impacts of subsidence. The proposed new surface infrastructure to service the proposed mining operations may require modifications to the existing livestock fencing to ensure agricultural land uses are not disruptively fragmented. These measures should be addressed in the EIS.

#### 5.1.6 Any reduction in the area of biophysical strategic agricultural land (BSAL).

A temporary reduction of BSAL within the GCAA is proposed because it is planned to locate some surface infrastructure on approximately 11.2ha of verified BSAL. It is proposed to stockpile the surface soils from this area for use in the re-establishment of this BSAL during the end of mine rehabilitation process. Detailed plans of the procedures proposed to rehabilitate these BSAL soils should be discussed in the EIS. The potential reduction in area of total BSAL within the GCAA cannot be determined because of the presence of potential and unverified BSAL in part of the GCAA where the applicant has been denied access. Irreversible subsidence is expected to occur beneath the proposed longwalls that intersect with verified and potential BSAL within the GCAA. On the basis of the current literature and current experience at the Narrabri mine this subsidence is not expected to affect agricultural productivity provided details provided procedures for addressing surface cracking and water ponding outlined for implementation within the EIS.

## 6. Conditional Gateway Certificate

The Gateway Application for the proposed Narrabri Underground Mine Stage 3 Extension proposes underground coal mining within EL 6243. The Gateway Certificate Application Area (GCAA) of 2,134 ha contains 15 ha of presently verified BSAL and 60 ha of potential BSAL which will have direct impacts caused by subsidence and possibly surface cracking.

It is the opinion of the Gateway Panel that;

- the Project could have direct but not significant or irreversible impacts on the agricultural productivity of verified BSAL within the proposed GCAA;
- the Project could have indirect but not significant impacts on the agricultural productivity of verified BSAL within the GCAA;
- the Project is unable to determine the full extent of BSAL in the GCAA due to lack of access (in part) and hence the potential for reduction in BSAL (be that of limited size) cannot be fully determined;
- the Project will not have significant impacts on ‘highly productive’ aquifers within the meaning of the NSW Aquifer Interference Policy (DITRIS, 2012);
- additional geological detail and baseline data is required to upgrade the model of the impact of mining on groundwater. Also, groundwater modelling should be independently peer reviewed and include cumulative impact studies of this and the combined impact of any nearby major project(s).
- Additional studies are required to more fully evaluate fracturing above the mining level, if this penetrates into the near-surface level, and potential loss of water in ephemeral streams due to surface cracking.