Mining & Petroleum Gateway Panel

Spur Hill Underground Coking Coal Project

Technical Report Accompanying A Gateway Certificate

19 March 2014

Contact

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1 Contents and Terms of Reference

On 20th December 2013, NSW Department of Planning accepted the Gateway Application from the Spur Hill Underground Coking Coal Project (Application No. GA 13_6335) which is located within the Muswellbrook Area of the Hunter Valley and hereafter is referred to as "the Project".

As per Section 17I of The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007, the Gateway Panel must determine an application within 90 days of it being made, this being 19th March 2014 in this particular case.

This report has been prepared to accompany the Gateway Certificate issued to the Project so as to provide suitable explanations to allow the proponent to fully understand the basis of any conditions included in the Gateway Certificate and any other panel opinions.

The Gateway Certificate has been issued and this accompanying report compiled taking full cognisance of Section 17H of The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 which outlines the methodology and relevant criteria by which the Project application must be evaluated.

1.1 Methodology

1.1.1 The Panel

Three members of the full Gateway Panel have evaluated this Gateway Application and co-authored the Gateway Certificate and accompanying technical report. Those members are:

Dr. Russell Frith - (mining discipline and Chair of the Spur Hill panel)

Professor Garry Willgoose – (surface water and hydrogeology disciplines)

Associate Professor Brett Whelan – (agricultural and soil science disciplines)

1.1.2 Panel Meetings

The Panel has held the following meetings directly relevant to the Project:

- General discussion as to a suitable assessment process on 11th February 2014 at Department of Planning offices in Bridge Street, Sydney.
- Detailed discussion on Project particulars on 5th March 2014 at Department of Planning offices in Newcastle, NSW.

1.1.3 Document Review

The Gateway Certificate and this accompanying technical report have been based on a detailed assessment of the following documentation:

- Spur Hill Management Pty Ltd (SHM), 2013. *Application for a Gateway Certificate - Technical Overview.* Proponent report submitted to the Gateway Panel.

- McKenzie Soil Management Pty Ltd, 2013. *Agricultural Resource Assessment: "Spur Hill Underground Coking Coal Project, Denman, NSW".* Submitted as Appendix A of SHM, 2013.

- Mine Subsidence Engineering Consultants (MSEC), 2013. *Gateway Application – Subsidence Assessment. Spur Hill Underground Coking Coal Project.* Submitted as Appendix B of SHM, 2013.

- HydroSimulations, 2014. *Gateway Application Preliminary Groundwater Assessment. Spur Hill Underground Coking Coal Project.* Submitted as Appendix C of SHM, 2013.

- Short, T. And Thomson, T. 2013. *Agricultural Impact Assessment to Support a Gateway Application for the Spur Hill Underground Coking Coal Project.* A report prepared for Spur Hill Management Pty Ltd by La Tierra Pty Ltd, Brisbane, Australia, December 2013.

- IESC, 2014. *Advice to Decision Maker on Coal Mining Project: Spur Hill Underground Coking Coal Project.* Report to NSW Gateway Panel.

- NSW Office of Water, 2014. *Spur Hill Underground Coking Coal Project: Application for Gateway Certificate.* Advice prepared for the NSW Minister of Primary Industries.

The Panel has, through its own enquiry, also considered the following relevant documentation:

- Ditton, S. Frith, R, 2003. *Review of Industry Subsidence Data in Relation to the Influence of Overburden Lithology on Subsidence and an Initial Assessment of Sub-Surface Fracturing Model for Groundwater Analysis.* Final Report on ACARP Project C10023.

- DPI, 2012. *Upper Hunter Strategic Regional Land Use Plan*. DPI, NSW Government.

- NSW Government, 2012. *An Explanation of the Mining SEPP and EP&A Regulation Draft Amendments.* Copy dated November 2012.

- OEH, 2012. *The land and soil capability assessment scheme – second approximation*. NSW Government.

- OEH and OASFS, 2013. *Interim protocol for site verification and mapping of biophysical strategic agricultural land*. NSW Government.

- Tammetta, P. 2013. *Estimation of the Height of Complete Groundwater Drainage Above Mined Longwall Panels.* Ground Water, 51(5), pp 723-734.

- Zipper, C. Balfour, W. Roth, R. and Randolph, J. 1997. *Domestic water supply impacts by underground coal mining in Virginia, USA.* Environ. Geol., 29(1/2), pp 84-93.

1.1.4 Field Inspection

The Panel did not conduct a field inspection specific to this Gateway Application.

1.1.5 Discussions with Third Parties

The Panel did not hold any formal or informal discussions in relation to this Gateway Application with either the Project proponent (SHM Pty Ltd) or any stakeholder who may have an interest in the Project.

1.1.6 Evaluation Logic

The Project evaluation has been undertaken according to the following assessment logic:

(a) Review and provide comment on the proponents identification and verification of BSAL and/or CIC as it relates to the Project and the Gateway process (Section 3)

(b) Review and provide comment on the proponents evaluation of both direct and indirect mining disturbances in general terms (Section 4)

(c) Review and provide comment on the proponents evaluation of both sub-surface ground water and surface water changes using the outcomes of (b) above as an input (Section 5).

(d) Review and provide comment on the proponents assessment of impacts on BSAL and/or CIC using the outcomes from (a), (b) and (c) above as inputs (Section 6).

(e) Determine whether to issue a Gateway certificate or not, including its type (*unconditional* or *conditional*) and any associated conditions.

The outcomes from points (a), (b) and (c) will have a major determining influence as to the credibility of the impact assessment from (d). The assessment logic is also amenable to a feedback loop whereby any concerns or issues raised in (d) and associated Gateway conditions from (e) result in the process logically re-starting at (a), (b) or (c) as appropriate.

2 The Proposed Project

The Spur Hill Underground Coking Coal Project (the Project) is a proposed development of an underground coal mining operation with a mine life of up to 25 years. The Project is located east of Denman and south-east of Muswellbrook in the Upper Hunter Valley of NSW.

The Project area is fully contained within Exploration Licence EL 7429.

The Project involves:

- Longwall mining from three primary coal seams within the Wittingham Coal Measures (Whynot, Bowfield and Warkworth seams), the seams being directly above and below each other such that the proposed underground mine can be described as a "multi-seam longwall operation".
- ROM production of up to 8 million tonnes per annum (MTPA) for a period of up to 25 years.
- Development of mine access drifts and other mine infrastructure.
- Development of ventilation surface infrastructure and gas drainage infrastructure.
- Construction and operation of a coal handling and preparation plant (CHPP).
- Development of coal transportation infrastructure.
- Construction and operation of a train load-out facility including rail spur and loop.
- Emplacement of waste rock excavated during the construction of access drifts/shafts and CHPP coarse rejects and fines generated during the initial processing of ROM coal.
- Progressive development of sumps, pumps, pipelines, water storages and other water management equipment and structures.
- On-going exploration activities within EL 7429.
- Surface monitoring, rehabilitation and remediation of surface subsidence effects.

The general Project arrangement and indicative underground mining area is shown in Figure 1 with the mine infrastructure area being located at the northern extremity and the underground mining area being largely located to the western side of the Project area.

The primary source of potential impact on BSAL, equine CIC and viticulture CIC as they relate to the Gateway Application process, is the manifestation of mining-induced surface and sub-surface subsidence as a direct result of longwall mining. As a multi-seam longwall operation whereby more than one seam is extracted, subsidence related ground movements are predicted to be high (i.e. maximum final vertical subsidence at surface of 5.3 m and many areas being characterised by final vertical subsidence in the range of 4 m to 5 m).

SHM Pty Limited (the proponent) has lodged an application for a Gateway Certificate as the Project area has been stated to include land verified as Biophysical Strategic Agricultural Land (BSAL) and

land mapped as equine critical industry cluster (equine CIC) and viticulture critical industry cluster (viticulture CIC) – see Section 1.1 of SHM, 2013.

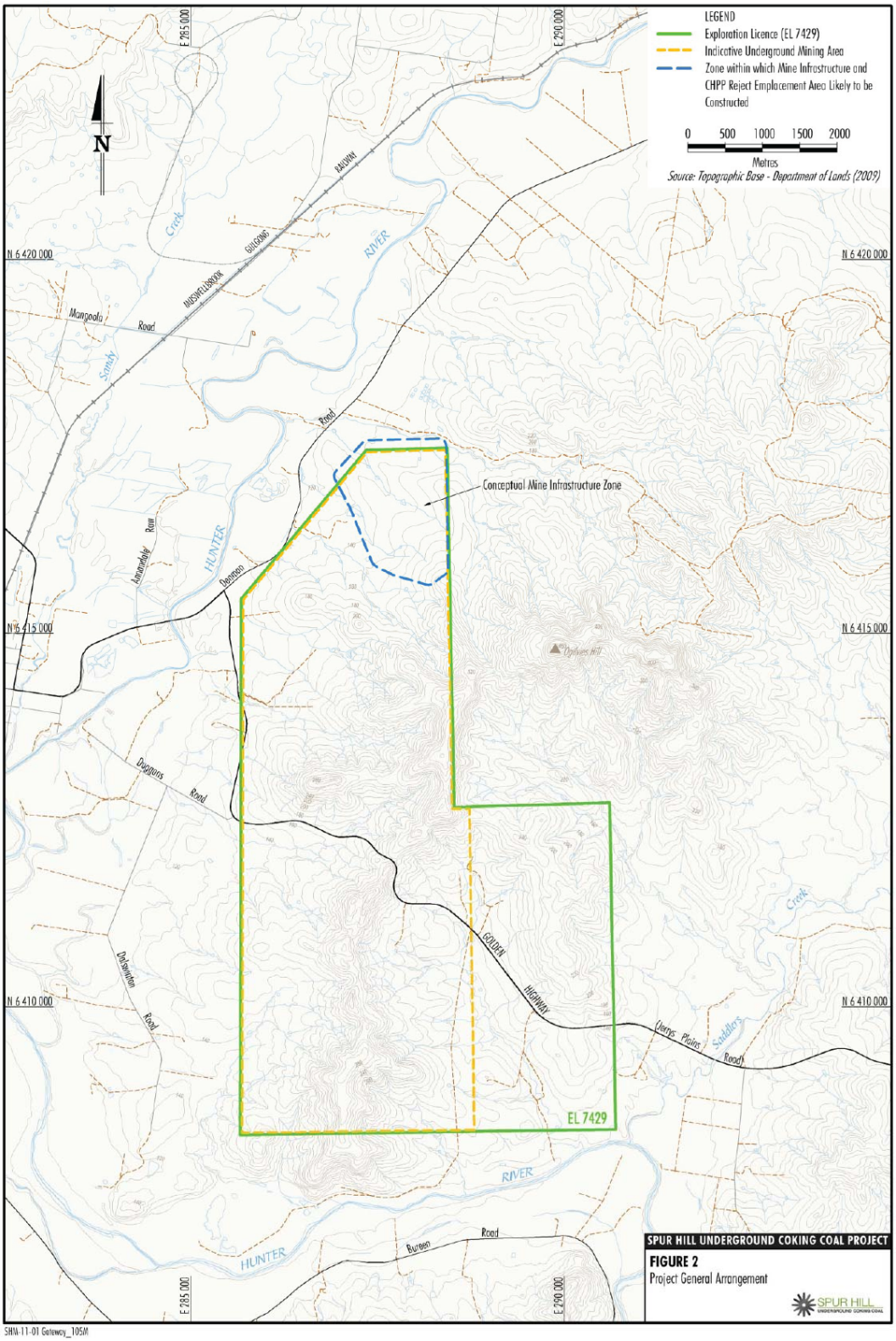

FIGURE 1. General Project Arrangement and Indicative Underground Mining Area (SHM, 2013)

However within the main body of SHM 2013 the following features relevant to the Gateway Application process are identified:

(i) The land within the Project area is primarily used for agriculture (pre-dominantly cattle grazing) and rural residential purposes.

(ii) Some 86 ha of verified BSAL is located directly above an area of proposed longwall extraction in the north-west section of the Project area (see Figure 2).

(iii) A small vineyard containing 26 ha of vines is located on a property in the north-west of the Project area (see property 9 in Figure 3) which is owned and operated by a subsidiary of the proponent.

(iv) Approximately 100 ha of irrigated cropping land is located with the exploration licence area but is outside of the proposed underground mining area (see property 13 in Figure 3).

(v) No equine enterprises are located within the Project area.

Therefore in contrast to that stated in Section 1.1 of SHM, 2013, it appears to be correct to state that the Project area contains:

- a relatively small amount of verified BSAL in one single location,
- an area of irrigated cropping land that has not been studied in detail by the proponent on the presumption that it is outside of the proposed mining disturbance or subsidence area,
- one small vineyard that is part of the Upper Hunter Viticulture CIC and is owned and operated by a subsidiary of the proponent, and
- no equine CIC interests.

As part of the Agricultural Impact Assessment (AIA) reported by Short and Thomson, 2013, the estimated annual gross value of agricultural production from within the Project area is $1.25 million, this representing 3.7% of the agricultural production with the Muswellbrook LGA, 0.6% of agricultural production within the Upper Hunter region and 0.01% of NSW agricultural production.

The Project area is located within a large bend of the Hunter River which is in close proximity to the proposed underground mining area in the north-west and south-east corners as is clearly evident in Figure 2.

It is finally noted that within the surrounding locality but outside of the Project area, there are beef cattle, dairy cattle, horse breeding and viticulture interests. However these do not fall within the defined remit of the Gateway Process, as specific criterion contained within The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 and also the Explanation of the Mining SEPP and EP & A Regulation Draft Amendments (NSW Government, 2012), consistently state that the Gateway process relates to certain State significant mining and petroleum proposals located <u>on</u> Strategic Agricultural Land. A literal interpretation leads to the inevitable conclusion that any BSAL or CIC land that is located adjacent to and in close proximity to the Project area or proposed mining disturbance area, is therefore not covered by the Gateway process. As

such, any nearby agricultural interests have not been considered by the Spur Hill Gateway Panel in undertaking this assessment, other than to recognise their presence to ensure that they are covered within any DGR's and/or a full Agricultural Impact Assessment that may be submitted as part of a future development application.

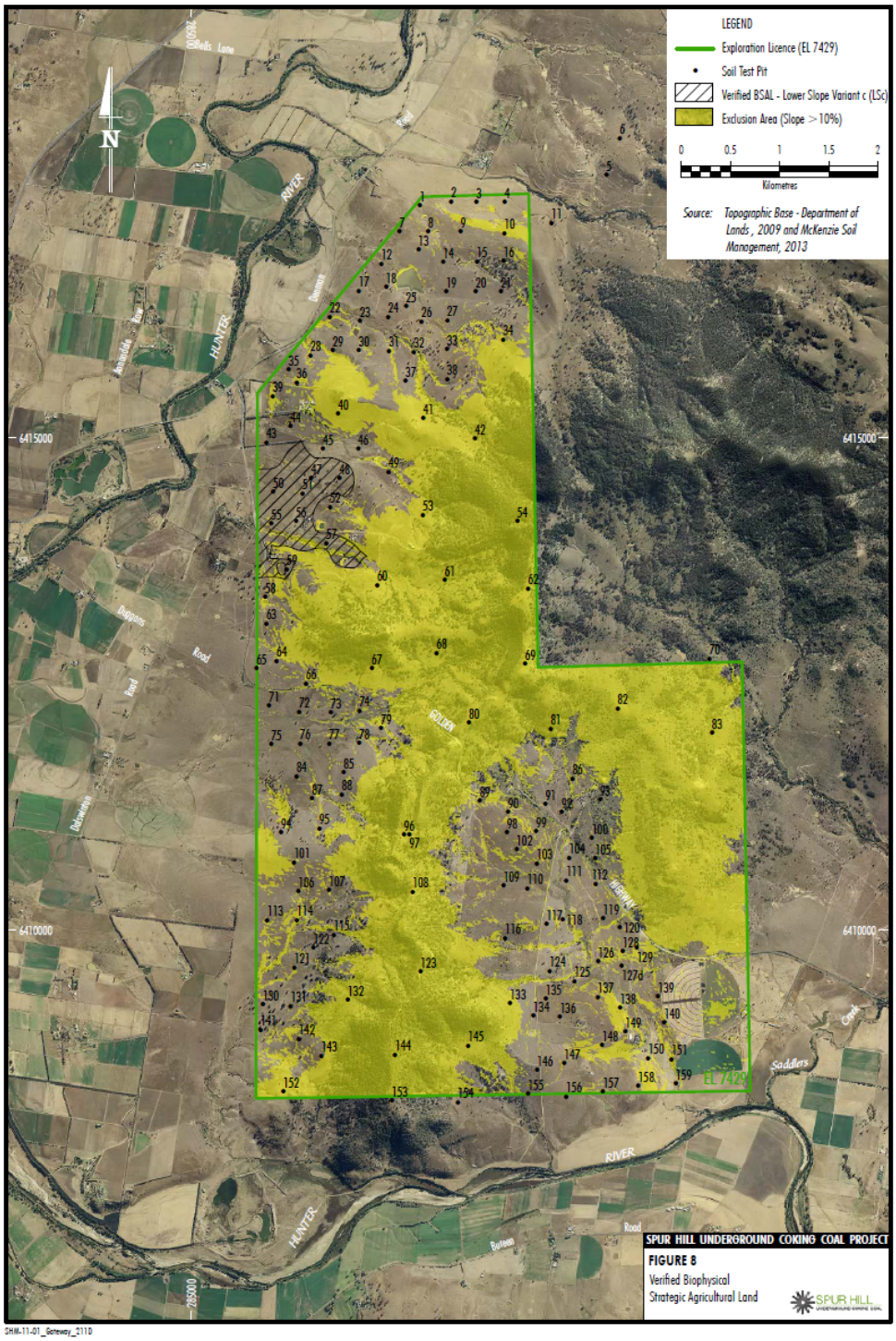

FIGURE 2. Verified BSAL within the Project Area (SHM, 2013)

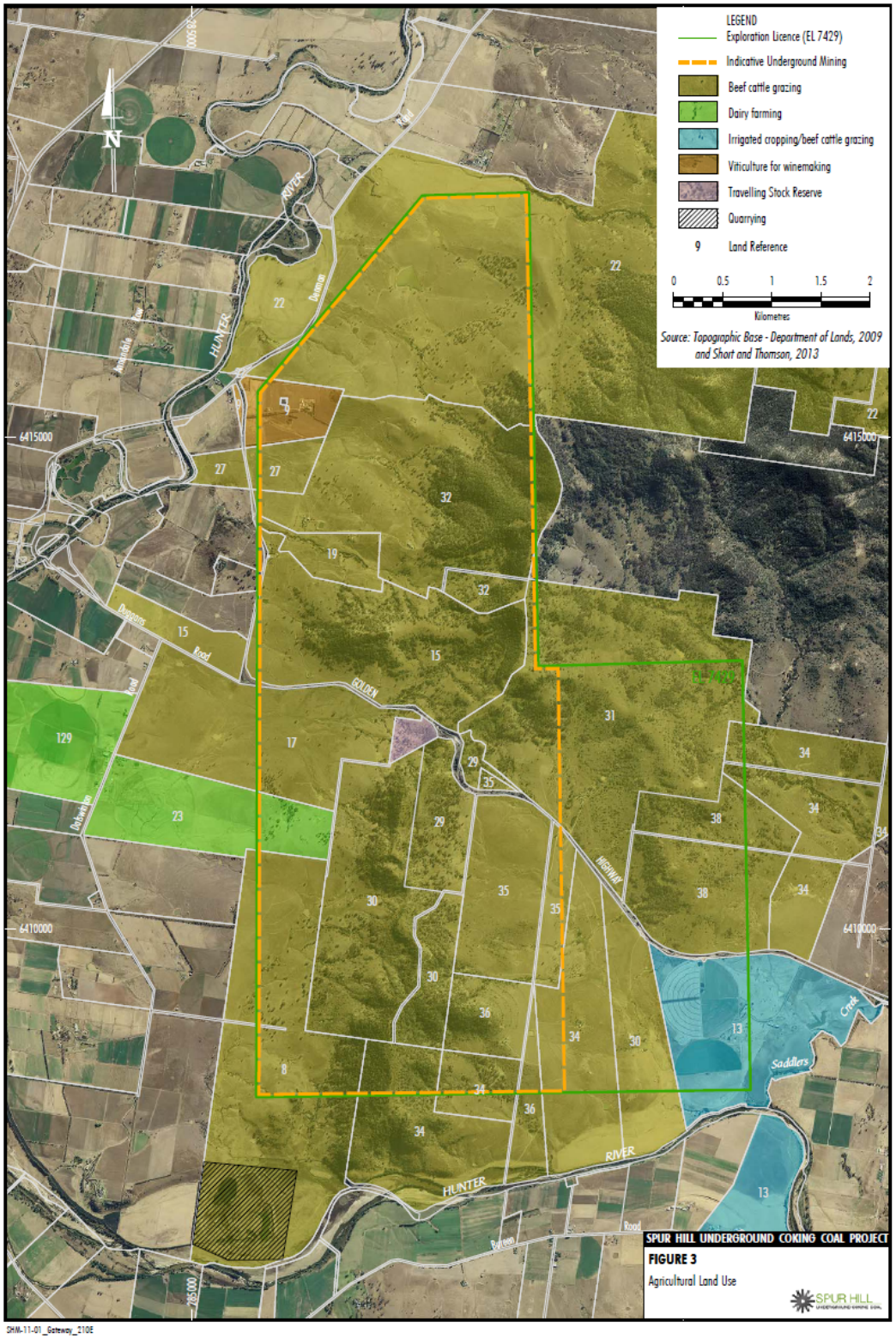

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FIGURE 3. Agricultural Land Use (SHM, 2013)

3 Biophysical Strategic Agricultural Land (BSAL) Verification

The Panel advises that:

1. The verification process of BSAL on the *indicative underground mining area* is compliant with requirements.

2. Verification of BSAL was not completed across the entire *project exploration licence area* (EL7429).

3. The magnitude and spatial extent of potential impact on off-site BSAL along the western and southern boundaries of the proposed project area, as identified in the Strategic Agricultural Land (SAL) Map in the Mining SEPP (Sheet STA_04), requires further study, albeit accepting that such BSAL falls outside the remit of the Gateway Process as previously discussed.

3.1 Definition

The NSW Government (OEH and OASFS, 2013) defines BSAL as follows.

> *"Land with a rare combination of natural resources highly suitable for agriculture. These lands intrinsically have the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management practices to maintain this high quality. BSAL is able to be used sustainably for intensive purposes such as cultivation. Such land is inherently fertile and generally lacks significant biophysical constraints."*

BSAL has been mapped at the regional scale for the SLURP using a more quantitative approach that encompasses the above description (DPI, 2012). Areas that are included in the regional BSAL map are characterised by both:

(a) Properties with access to a reliable water supply, defined by:

- Rainfall of 350mm or more per annum (9 out of 10 years), OR
- A regulated river (maps show those within 150m), OR
- A 5th order or higher unregulated river (maps show those within 150m), OR
- An unregulated river which flows at least 95 per cent of the time (maps show those within150m), OR
- Highly productive groundwater sources, as declared by the NSW Office of Water. These are characterised by bores having yield rates greater than 5L/s and total dissolved solids of less than 1,500mg/L and exclude miscellaneous alluvial aquifers, also known as small storage aquifers.

(b) Land that either falls under soil fertility classes 'high' or 'moderately high' under the Draft Inherent General Fertility of NSW (OEH), where it is also present with land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH) OR falls under soil fertility classes 'moderate' under the Draft Inherent General Fertility of NSW (OEH), where it is also present with land capability classes I or II under the Land and Soil Capability Mapping of NSW (OEH).

3.2 BSAL Potentially Affected by the Project

The identification of BSAL in the ARA (McKenzie, 2013) followed the Interim Protocol for Site Verification of Biophysical Strategic Agricultural Land (OEH and OASFS, 2013) with the soil and landscape verification being based on a soil survey incorporating physical and chemical assessments of 159 soil pits and subsequent soil landscape unit identification within the *project exploration licence area* (EL7429).

In the ARA (McKenzie, 2013), 86 hectares (ha) of BSAL are identified within the *indicative underground mining area*. The BSAL is located in the north-west of the *indicative underground mining area* and is classified as a 'Lower Slope Variant c' soil landscape unit (McKenzie, 2013), having a moderate fertility Dermosol as the predominant soil type (with Kandosol and Vertosol as the sub-dominant soil types) existing within an area of Class II and Class III land capability.

A further five individual soil test pits were identified in the ARA (McKenzie, 2013) as fulfilling Steps 1-12 in the flow chart for site assessment of BSAL included in Section 6 of the Interim Protocol for Site Verification of Biophysical Land (OEH and OASFS, 2013). These sites are classified in the ARA as representing landscape areas of <20ha and so have been deemed non-BSAL (McKenzie, 2013).

One of these sites (soil pit 139) is on the south-eastern edge of the soil survey boundary (see Figure 2) and borders a substantial section of the *project exploration licence area* (EL7429) that was not physically surveyed in the ARA (McKenzie, 2013). This area, which is identified in Figure 4, has had the land and soil capability mapped using archival regional-scale landscape mapping only.

Given that the proponent includes in the Project Technical Overview (SHM, 2013) a project activity of 'ongoing exploration activities within EL7429', the panel considers that the potential for the presence of BSAL in this section of the *project exploration licence area* (EL7429) needs to be considered in more detail by the proponent.

The Panel also notes that the *project exploration licence area* (EL7429) is bordered by substantial areas of potential BSAL along the western and southern boundaries as identified in the Strategic Agricultural Land (SAL) Map in the Mining SEPP (Sheet STA_04) and documented in Figures 1 and 2 of the proponents AIA (Short and Thomson, 2013).

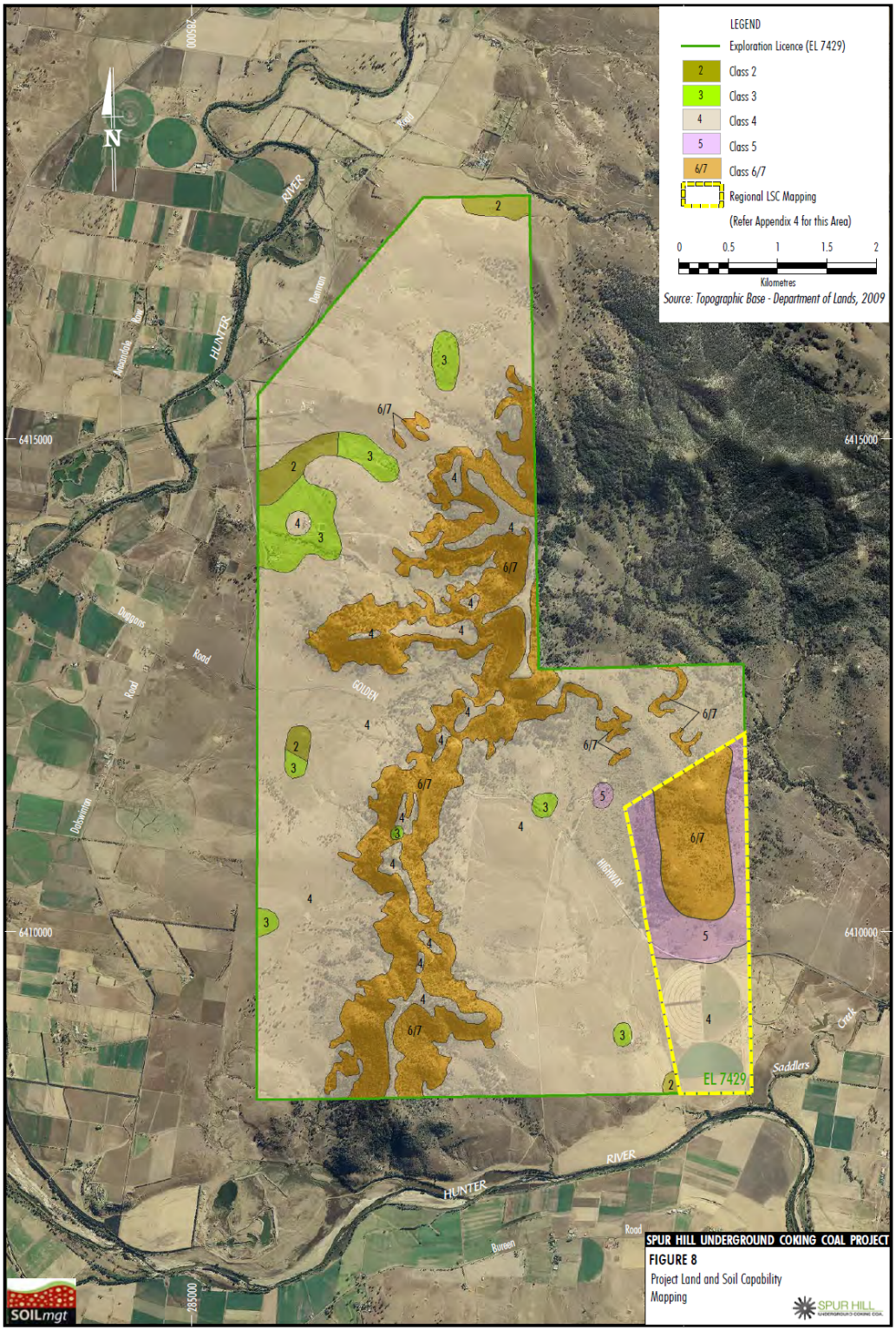


FIGURE 4. Land and Soil Capability Map for the Project Exploration Licence Area (McKenzie, 2013)

4 Assessment of Mining Disturbances

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

(a) a direct mining effect whereby part or all of a BSAL or a CIC is either removed, worked upon or subsided, OR

(b) an indirect mining effect whereby the state of either surface water or sub-surface ground water is significantly altered by mining which then has a direct impact on BSAL and/or a CIC.

Therefore, the assessment of mining disturbances must consider both direct and indirect impacts as defined above, noting that the proponent has commissioned independent studies from highly credible experts that cover both surface subsidence (MSEC, 2013) and hydrogeological effects (HydroSimulations, 2013) due to the proposed longwall mining.

4.1 Direct Mining Disturbances

4.1.1 Removal or Working Upon BSAL/CIC

As the Project is solely an underground mine rather than an open cut, there is no direct removal of BSAL or CIC related land due to the coal extraction process.

The only area of identified and verified BSAL within the Project area (see Figure 2) is not understood to be associated with any of the proposed surface works or other mine infrastructure that would cause it to be either removed or temporarily disturbed by such works.

Similarly, the single vineyard that is part of the Upper Hunter Viticulture CIC (see property 9 on Figure 3), which does not coincide with the verified BSAL, is not associated with any of the proposed surface works or other mine infrastructure. Therefore the Project does not intend to either permanently remove or temporarily disturb this CIC component.

4.1.2 Disturbance Due to Mining Subsidence

Both the area of identified and verified BSAL and also the single vineyard are located directly above the area of proposed longwall extraction such that they will inevitably be affected by surface subsidence due to mining.

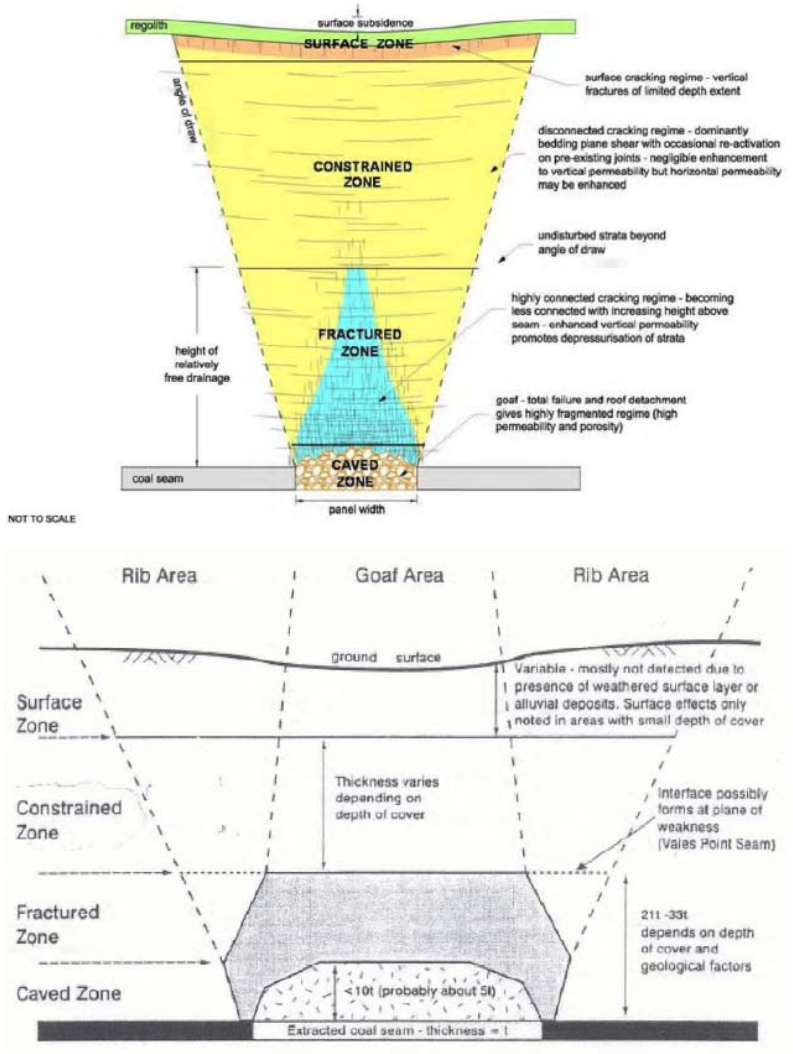
The mining subsidence study results as reported by MSEC, 2013 have subsequently been used as inputs into the AIA undertaken by Short and Thomson, 2013, which is judged to be proper process.

4.2 Indirect Mining Disturbances

4.2.1 Sub-surface Fracturing due to Mining

Sub-surface fracturing due to coal extraction, particularly above wide longwall panels as in this case, has a major potential impact upon sub-surface groundwater, particularly if fractures formed as a direct result of mining provide for a direct connection between the mine workings and sub-surface aquifers or other large bodies of water such as lakes, rivers and oceans. Figure 5 (taken from HydroSimulations, 2013) shows a commonly accepted general conceptual model for the extent and

type of mining-induced fracturing that occurs above a longwall panel, this being a critical hydrogeological consideration when evaluating the impact of a specific longwall mining layout on sub-surface aquifers.



Sources: Forster (1995); New South Wales Government Department of Planning (2008).

FIGURE 5. General Conceptual Model of Longwall Mining-Induced Rock Deformations and Associated Fracturing (taken from HydroSimulations, 2013)

There are many historical examples of substantial water inflows into underground coal mines due to mining induced fractures intersecting large, highly permeable water bodies, noting that as a direct result of these occurrences, mine design guidelines to prevent such inflows have been developed in almost every major underground coal industry. As a result, underground coal extraction is able to be undertaken beneath such water bodies, albeit that the extraction layout design will usually be far more restricted than in cases whereby no such water bodies exist.

The layered hydrogeological modelling reported in HydroSimulations 2013 takes account of sub-surface fracturing by reference to what is stated to be a "conservative" assumption whereby connected fracture heights (i.e. those that represent a direct hydraulic connection into the mine workings) up into the overburden above the extracted seam are estimated using 60% of the longwall extraction width as a typical value with 40% and 80% being used as presumably best and worst-case scenarios. Such considerations are judged to be mandatory inputs into the hydrogeological modelling process.

4.3 General Comments on the Assessment of Mining Disturbances

The Panel advises the following in relation to the assessment of mining disturbances provided by the Project proponent as part of this Gateway application:

(i) Given the small and localised nature of BSAL and CIC land within the Project area, there are no obvious deficiencies in the proponents assessment of direct mining impacts relating to either removing or disturbing them due to surface operations.

(ii) Given the significant cover depth and working height ranges involved, maintaining a constant chain pillar width of 35 m throughout the entire mine is almost certainly a gross simplification of what will occur in practice. On the basis that longwall chain pillar and near-seam strata compression have a controlling influence on surface subsidence at high cover depths, the surface mining subsidence predictions as reported by MSEC, 2013 are likely to be limited by this assumption.

(iii) The surface subsidence study has been limited to the prediction of vertical subsidence effects only. However it is well-established that the development of extensive and deep surface subsidence troughs can give rise to what are termed as "far-field" effects whereby horizontal movements occur well outside the limits of vertical subsidence, such movement inevitably resulting in changes to the horizontal stresses. Given that reducing ground stress and increasing strata permeability are inextricably linked, in combination with the close proximity of the Hunter River and associated alluvium to parts of the proposed mining disturbance area, the need to consider far-field horizontal movements and associated ground stress changes is identified by the panel.

(iv) Having reviewed the sub-surface mining-induced overburden fracturing estimates as described in HydroSimulations, 2013, it is not clear as to how the cumulative impact of multi-seam longwall mining has been assessed. In particular, the connectivity between longwall workings in different seams thereby potentially producing a connected fracture system from the lower extracted seam up to or close to the surface has not been described or addressed in the report.

(v) The hydrogeological study identifies the presence of what is termed as the Mount Ogilvie "fault" or "structure" just to the east of the proposed underground mining area. This structure has a 100 m throw associated with it and HydroSimulations, 2013 state that "*SHM site geologists regard the Mount Ogilvie fault as a monocline with some associated faulting (an interpretation supported by seismic information), with continuity*

of the coal seams rather than a major truncation and throw of the seams". The opinion of the Gateway Panel is that irrespective of the actual form of this significant geological structure, the precautionary principle requires that it must be regarded as a zone of potentially increased permeability as compared to typical background conditions, which will inevitably be influenced by the extensive longwall mining being planned just to the west of it. Therefore, in terms of being able to predict the regional hydrogeological impact of mining (which by definition also includes the Project area), there is a need to consider how the permeability of this major structural zone may change as a result of the planned longwall extraction.

The extent to which any of the identified limitations, related to the assessment of mining disturbances, are of significance to the Agricultural Impact Assessment submitted by the proponent, will be discussed in Section 6 of this report.

5 Assessment of Groundwater and Surface Water Changes due to Mining

5.1 Sub-Surface Groundwater

The assessment of groundwater impacts is based on Part A and Part B of the Preliminary Groundwater Assessment (HydroSimulations, 2013) as provided by the proponent in the Gateway Application documents.

1. Table 16 (in Part B) indicates how the proponent's consultants propose to extend the modelling work in the Gateway Application for the final EIS. The Gateway Panel appreciates that such a table is provided in the Gateway Application. Table 16 in the groundwater report (termed "the Report" in this section) is generally supported with the following caveats:

    a. In the uncertainty analysis it was noted that some of the simulations had groundwater heads that were impacted by boundary conditions. Therefore the boundary of the modelled domain should be extended to ensure that all uncertainty simulations have results that are not unduly impacted by boundary conditions. This will require that the modelled region be larger than the 34km x 34km region adopted in this Report.

    b. The discussions in the main part of the Report should be more explicit about what parameters have been varied in the uncertainty analysis and what have been held as constants. The uncertainty analysis should include the uncertainty in the geology and potential hydraulic connections indicated in the points below.

2. Following on from point 1(b) it appears that the vertical and horizontal extent of the region of modified groundwater conditions above the longwalled area has been fixed with a mid-range value from literature studies with values for the extent up to twice those quoted in the studies that the Report has referenced. Other papers not considered by the Report (e.g. Zipper et al, 1998; Tammetta, 2013) provide evidence that the impacted area vertically above longwall extraction may in fact be significantly higher than that assumed by this study. In addition to varying model parameters, the sensitivity study should also vary the vertical extent of this region. Given that there are nominal impacts on the Hunter River floodplain even for the assumed mid-range vertical extents, this would suggest increased impacts on the floodplain over those indicated in the Report should this assumption be included in the model.

3. The Report indicates that significant groundwater changes occur out to 7km from the lease boundary (e.g. Figure 32 reproduced herein as Figure 6) for some of the deeper layers of the model (hereafter referred to as the broader impact zone). However, the Report has not addressed the risk of interconnection between these deeper layers and the surface. Both the IESC and NSW Office for Water advice reports indicate concerns about potential interconnection between the deeper layers and the surface and between the deeper layers and other aquifers covered by the groundwater sharing plan. The IESC has also identified the possibility of potential impacts on BSAL land in this broader impact zone. Explicit

consideration is required of the potential for interconnection between groundwater layers, and the potential impact of such interconnection. Any such interconnection (currently unrecognised in the modelling) might conceivably result from unmapped faults and dykes, but also from any significant inaccuracies in the definition of lithology in the deep geology maps for the broader impact zone.

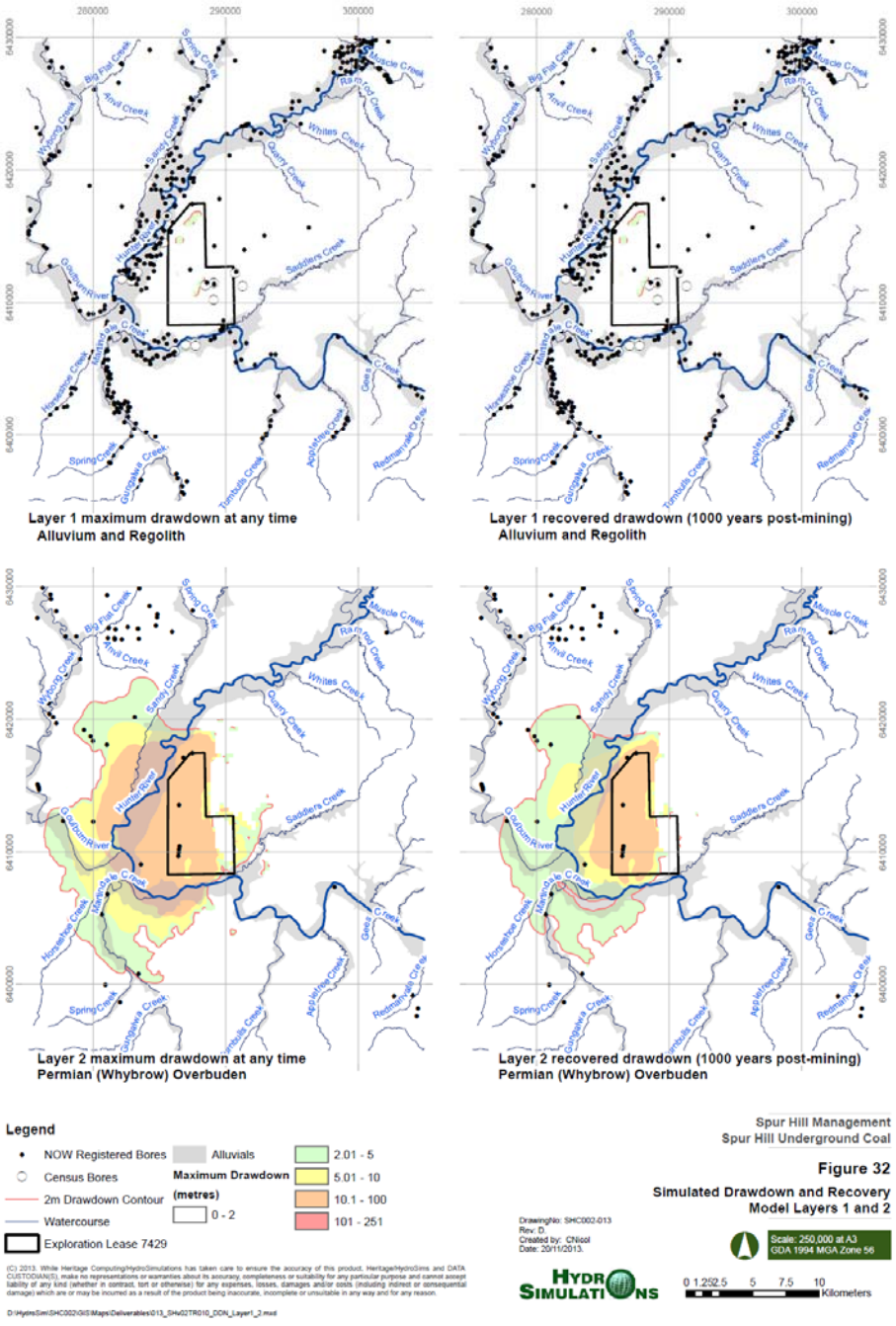


FIGURE 6. Predicted Shallow and Deep Far-field Groundwater Changes due to Mining (HydroSimulations, 2013)

4. Both the Report and general research literature indicate that given the current state-of-the-art, it is difficult to credibly predict the region of groundwater impact for multi-seam longwall mining. Therefore~~.~~ a staged approach should be adopted in the mine plan that will allow the collection of groundwater impact zone data and allow modification of the mine plan if results indicate larger regions of impact than otherwise predicted. Specific advice includes:

    a. While currently predicted settlement impacts for the nominal simulation do not impact significantly on the Hunter River itself, there are impacts on the alluvial floodplain and presumably the alluvial aquifer in the floodplain. This suggests the possibility of vertical cracking underneath the floodplain with the possibility of vertical connectivity between the alluvial aquifer and cracked regions above the longwall goaf.

    b. The first longwall panels should be ones that do not encroach close to the floodplain (i.e. longwalls away from the north-west or the south-east corners of the mining disturbance area). The surface settlement and groundwater head impacts from the surface to the goaf should be monitored for 12 months and the groundwater models and simulations updated using these data as they become available.

    c. If these updated groundwater simulations show that there is a greater risk in future longwall panels of impacts on the floodplain alluvial groundwater than that shown in the EIS, then the mine plan in the development application may need to be adjusted (e.g. modified setbacks from the floodplain of the longwall panels) to ensure that impacts are no greater than that approved based on figures provided in the EIS.

5. The groundwater simulations (p17 of the Report) indicate that the region around the Mt. Ogilvie Fault is a source of water to the alluvial floodplain (even without the model actually modelling the structure as a fault). This suggests that the Mt. Ogilvie fault (if it exists and is subsequently disturbed by adjacent longwall extraction) could be a significant conduit for water from the underlying Permian to the alluvial aquifers (or vice versa). This directly contradicts the statement on p18 of the Report that "*the Mt. Ogilvie fault is not considered a major hydraulic barrier or conduit to groundwater flow*". Therefore, the proponent needs to directly address the possibility of the Mt. Ogilvie fault providing a hydraulic connection between the Hunter River (and/or its floodplain) and the mined regions in the groundwater modelling. This will involve groundwater simulations of fracture connectivity, potential impacts on groundwater catchments for the various seams being modelled, and an estimate of, or bounds on, possible discharges from the Hunter River into the mine.

6. While impacts on adjacent mining operations are outside the remit of the Gateway Panel, the panel agrees with the NSW Office of Water concerns about potential impacts on, and potential changes in the water balances of, adjoining mining operations.

7. On p87 of the Report there is an assessment of groundwater take and an assessment of how many groundwater licences would be needed to legally meet this requirement. However, the net groundwater takes from the river all occur post-closure rather than during the

period of active mining. The proponent should therefore indicate how they propose to manage groundwater licences post mine closure.

5.2 Surface Water

With respect to surface water resources, the main mining impact will be that of vertical surface subsidence on surface drainage patterns. At a minimum the proponent should prepare a pre- and post-mining high resolution (e.g. 30m resolution has been shown by research to be appropriate) digital terrain map for the site showing the drainage paths and how they will change, highlighting areas where drainage lines are broken (and local internal drainage subsequently occurs), and any impact on the area of catchment draining to downstream sensitive sites (e.g. the Endangered Ecological Communities identified by IESC, 2014 and any groundwater dependent ecosystems) both on- and off-site.

6 Review of Predicted Impacts on BSAL and CIC Within the Project Area

The relevant criteria by which the Gateway Panel must evaluate potential impacts within the Project area are listed in Section 17H(4) of The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 as follows:

(a) In relation to BSAL – that the development will not significantly reduce the agricultural productivity of any BSAL 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 BSAL

(b) In relation to CIC land – that the proposed development will not have a significant impact on the relevant CIC 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

The proponents Gateway Application in terms of relevant impacts on BSAL and CIC will be evaluated by both reference to the information provided and also the suitability of the various inputs that have been used by the proponent when determining those impacts.

6.1 Biophysical Strategic Agricultural Land

6.1.1 Any impacts on the land through surface area disturbance and subsidence

The proposed mine is an underground longwall operation with identified surface subsidence issues. According to MSEC, (2013) the Project will cause a maximum vertical subsidence of up to 4 metres on the 86 ha of BSAL identified within the *indicative underground mining area*.

The panel believes this subsidence has the potential to change surface water dynamics, including altered drainage patterns, areas where ponding may increase and the scouring of ephemeral drainage lines. The proponent has proposed a number of potential mitigation strategies for the impact related to the predicted subsidence that include regrading drainage lines downstream of any areas of ponding or constructing bunds to contain drainage water movement.

As the potential for the largest ground depressions has been identified in the northern section of the *indicative underground mining area* (Short and Thomson, 2013), the potential for change to surface water dynamics is high in the 86 ha of identified BSAL. To improve the prediction of areas with high risk of subsidence-induced changes to surface water dynamics, the modelled change in landform provided in the Subsidence Assessment (MSEC, 2013) should be used with landscape, soil and vegetation information describing the characteristics of the current drainage lines, to construct a targeted and effective subsidence monitoring and remedial management plan

The panel cannot determine the significance of any impacts on potential BSAL within the south eastern section of the *project exploration licence area* (EL7429) where the Interim Protocol for Site Verification of Biophysical Land (OEH and OASFS, 2013) was not implemented by the proponent.

6.1.2 Any impacts on soil fertility, effective rooting depth or soil drainage

The 86 ha of BSAL identified by the proponent in the *indicative underground mining area* is classified as Class II and III land capability. The predominant soil in the identified BSAL has been classified by McKenzie, (2013) as Dermosol of moderate fertility. The panel believes that the impact of the Project on soil fertility, effective rooting depth and soil drainage will be minimal in the BSAL if changes to surface water dynamics induced by subsidence are effectively planned for and managed by the proponent as discussed in Section 6.1.1.

The panel cannot determine the significance of any impacts on potential BSAL within the south eastern section of the *project exploration licence area* (EL7429) where the Interim Protocol for Site Verification of Biophysical Land (OEH and OASFS, 2013) was not implemented by the proponent.

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

The salinity of the BSAL soil should not be adversely impacted by the mining operation. The panel notes that increases in land surface micro-relief, rock outcrop, slope or surface rockiness within the BSAL may occur following remedial land reforming outlined by the proponent. The Panel recommends that the present land surface micro-relief, rock outcrop, slope and surface of the BSAL in the *indicative underground mining area* be documented and used to inform the subsidence monitoring and remedial management plan described in Section 6.1.1

The panel cannot determine the significance of any impacts on potential BSAL within the south eastern section of the *project exploration licence area* (EL7429) where the Interim Protocol for Site Verification of Biophysical Land (OEH and OASFS, 2013) was not implemented by the proponent.

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

Due to the uncertainty in the mining subsidence estimates and the lack of an uncertainty analysis on the height of fracturing over the goaf, the panel cannot determine the significance of any mining induced interconnection between the deeper impacted layers (not highly productive groundwater) and the alluvial aquifers (highly productive groundwater) underlying the BSAL in the Hunter River floodplain on the north-west boundary of the project areas. Furthermore without this information, the panel is also unable to reliably determine the significance of any impacts on the irrigated farm land within the south-eastern part of the Project area, which, as previously discussed, despite being outside the *indicative underground mining area*, may also contain BSAL that is yet to be verified.

6.1.5 Any fragmentation of agricultural land uses

The Project as described by the proponent should not result in any fragmentation of land use in the BSAL identified within the *indicative underground mining area.*

The panel cannot determine the significance of any impacts on potential BSAL within the south eastern section of the *project exploration licence area* (EL7429) where the Interim Protocol for Site Verification of Biophysical Land (OEH and OASFS, 2013) was not implemented by the proponent.

6.1.6 Any reduction in the area of BSAL

The proponent indicates that any reduction to the area of BSAL identified within the *indicative underground mining area* would be temporary and involve <1ha associated with ventilation and gas drainage infrastructure, service boreholes, exploration and remediation activities. Maintaining an effective subsidence monitoring and remedial management program as discussed in Section 6.1.1 will be required to ensure no permanent reduction in the identified BSAL within the *indicative underground mining area*

The panel cannot determine the significance of any impacts on potential BSAL within the south eastern section of the *project exploration licence area* (EL7429) where the Interim Protocol for Site Verification of Biophysical Land (OEH and OASFS, 2013) was not implemented by the proponent.

6.2 Critical Industry Clusters

The Project area contains one small vineyard (Callatoota Estate) which is part of the Upper Hunter viticulture CIC and is therefore directly subject to the Gateway process. There are no properties that are part of the Hunter Valley equine CIC within the Project area.

6.2.1 Any impacts on the land through surface area disturbance and subsidence

According to MSEC, (2013), the Project will cause a maximum vertical subsidence of up to 4 metres on the Callatoota Estate vineyard located within the *indicative underground mining area.* The panel believes this subsidence has the potential to change surface water dynamics, including altered drainage patterns and areas where ponding may increase. The proponent has proposed a number of potential mitigation strategies for the impact related to the predicted vertical subsidence effects that include in-filling surface cracks and localised reshaping of any areas of ponding.

As the potential for the largest ground depressions has been identified in the northern section of the *indicative underground mining area* (Short and Thomson, 2013), the potential for changes to surface water dynamics is high on the Callatoota Estate vineyard. The panel recommend the construction of a targeted and effective subsidence monitoring and remedial management plan specifically for Callatoota Estate.

6.2.2 Reduced access to, or impacts on, water resources and agricultural resources

Given the comments made in Section 6.1.4 in regards to current uncertainties in the hydrogeological modelling, the panel cannot reliably determine the likely impacts in relation to access to water resources.

The panel appreciates that the Gateway application is a preliminary process, and that consequently there is no structured management plan outlined by the proponent to manage any impacts from subsidence on irrigation infrastructure within the project area. Therefore details of a suitable management plan for The Callatoota Estate vineyard should be provided by the proponent in any further development applications.

6.2.3 Reduced access to support services and infrastructure

There are no equine enterprises located on the *indicative underground mining area.* Surrounding properties identified in the Equine CIC should not be exposed to reduced access to support services and infrastructure as a result of the proposed Project.

6.2.4 Reduced access to transport routes

The proposed Project will be transporting coal by rail from the mine site (SHM, 2013). Vehicular traffic on local roads can be expected to increase during the construction and operational phases of the proposed Project. Furthermore, the proposed project is predicted to cause subsidence to approximately 3.5km of the Golden Highway which transects the *indicative underground mining area.*

Whilst both the above impacts represent changes to local transport routes that require detailed consideration in the planning and execution phase of the Project, the panel can identify no obvious significant impact to the Callatoota Estate vineyard as a direct result.

6.2.5 The loss of scenic and landscape values

Landscape and scenic values are a key aspect of equine CIC properties whereby an *idyllic rural landscape* is a highly desirable attribute. However the Project area contains no equine CIC properties.

In the case of viticulture CIC properties, the general landscape of the surrounding area is important as the need to attract tourists is part of their overall business model. The fact that the Project only contains proposed underground mining is duly noted in this regard.

The Callatoota Estate operates a cellar door operation, the number of which have been decreasing in the Upper Hunter as a direct result of new mining activities over time. Accepting that the Callatoota Estate is now owned by a subsidiary of the proponent, the potential loss of another cellar door

operation in the Upper Hunter viticulture CIC due to nearby mining activities, albeit an underground mine with relatively low visual impact, should be considered and addressed by the proponent.

7 Gateway Certificate Conditions

The Gateway Application submitted by the proponent claims that the proposed underground mining will have insignificant impacts upon both the BSAL and CIC properties that are located within the Project area and in particular, within the *underground mining disturbance area*. Based on the various inputs that have been relied upon by the proponent, the Gateway Panel generally agrees with this assessment, but is unable to issue an *unconditional* Gateway Certificate as a result of a number of concerns that need to be addressed by the proponent as part of any future development application and EIS.

These concerns and therefore Gateway Certificate conditions are as follows:

(a) That BSAL be identified and verified within the entire Project area, particularly in the south-eastern corner which is located in close proximity to the Hunter River and associated alluvium. Once all such BSAL has been identified and verified, it should be evaluated for mining impacts accordingly.

(b) The mine design should incorporate chain pillar dimensions that are tailored to the specific mining conditions and then included within the mining subsidence predictions upon which impact assessments are based.

(c) Mining subsidence predictions should be extended to include the influence of far-field horizontal movements and any associated horizontal stress changes, these being of potential relevance to the impact of mining upon nearby alluvium and also the hydraulic condition of the Mt. Ogilvie structure/fault.

(d) The prediction of connected fracture zones above longwall panels needs to give due consideration to the multi-seam nature of the proposed longwall mining, in particular how such fracture zones may interact between extracted seams to form up a large overall fracture network. The proponent should also ensure that any additional reference sources used by the Gateway Panel in this regard and detailed herein, are given full consideration.

(e) The hydrogeological modelling is a key aspect of the overall impact assessment and needs to be improved based on the following:

    (i) The model boundary needs to be extended to ensure that predictions are not in any way influenced by boundary conditions.

    (ii) In terms of far-field drawdown effects, the modelling must give consideration of and account for the potential of interconnection between individual groundwater layers and the overall impact upon hydrogeological changes due to mining.

    (iii) Include consideration of any horizontal stress changes due to far-field mining subsidence on both the Hunter River alluvium and also the hydraulic condition of the Mount Ogilvie structure/fault system.

(iv) Provide evidence as to the hydrogeological nature of the Mt. Ogilvie structure/fault and as a minimum, conduct a sensitivity study to evaluate the overall change by either including or excluding it from the hydrogeological model.

(v) Include a comprehensive discussion and reasoning for the uncertainty analyses that were undertaken as part of the modelling.

(f) Outline a staged approach within the mine plan and panel sequencing so that hydrogeological predictions can be tested during the mining process and the mine layout/sequence be modified if proven necessary.

(g) Explain how the proponent intends to deal with post mine closure management of groundwater water licenses.

(h) Produce pre- and post-mining landforms to allow the direct evaluation and visualisation of surface drainage changes due to mining, particularly within areas of BSAL and CIC.

(i) Consider the impact on the Upper Hunter viticulture CIC of a potential loss of a cellar door facility at the Callatoota Estate vineyard due to the proposed mining.

(j) Provide details of a suitable management plan for irrigation infrastructure on the Callatoota Estate vineyard when impacted by mining subsidence.

Finally, whilst outside of the direct remit of the Gateway process, the panel notes the presence of potential BSAL and CIC properties (including the Darley stud farm which is at the head of the Hunter equine CIC) as well as the Hunter River and associated alluvium in relative close proximity to the intended mining area and within the currently predicted deep aquifer drawdown areas due to mining. The need to consider hydrogeological impacts outside of the Project area in terms of both these various properties/features and also broader groundwater interactions with existing mines is assessed to be a critical aspect of any full AIS and EIS studies that may be submitted as part of a future mining development application.