



Department of Primary Industries

OUT14/35922

Mr Matthew Sprott
Mining Projects
NSW Department of Planning and Environment
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Dear Mr Sprott,

Wambo Coal Mine (DA 305-7-2003 Mod 14) Proposed Modification

I refer to your email dated 3 October 2014 requesting advice from the Department of Primary Industries (DPI) in respect to the above matter.

Comment by NSW Office of Water

The NSW Office of Water has reviewed the Environmental Assessment (EA) for the proposed modification to the North Wambo Underground Mine and provides the following recommendations and comments regarding potential groundwater impacts (**Attachment A**), and potential impacts to surface water resources (**Attachment B**) for consideration in assessment of the proposal.

The Office of Water's key concerns relate to the risk of connective cracking from surface and alluvial water sources through to underground workings, particularly given the lack of cumulative assessment of the subsidence impacts from the proposed longwall 10A and the future approved extraction proposed in two underlying seams, the Arrowfield and Bowfield Seams.

Recommendations

- Provide further detail on the fracturing heights from mining the Wambo Seam in longwall 10A. The proponent should identify whether the proposed Wambo Seam extraction was considered as a multi-seam operation given the existing approval for the underlying Arrowfield and Bowfield Seams. If a correction is required, the influence on the re-equilibrium recovery times and final piezometric heads should be evaluated.
- Provide diagrammatically a series of slices in both horizontal and lateral extent of the various model layers displaying how the fracturing heights and hydraulic conductivities have been applied.

- Provide further assessment and commentary to qualify the conclusions drawn on potential long term salinity within Wambo Creek and associated alluvium. This will need to draw on the following points:
 - the land surface has subsided to a lower elevation,
 - higher Permian pressure heads relative to the alluvium water table (pre mining, mining & post mining),
 - connected fracturing extending across all 4 coal seams and the interburden up to the base of Wambo Creek Alluvium, and
 - small volumes of water gain/loss will make up significant percentages of change to total baseflow and resulting water quality.
- Provide additional assessment of the depth and saturation of the alluvium close to the junction of Wambo and Stony Creeks.

Given the uncertainty relating to extent of likely fracturing, a cautionary approach, avoiding undermining the Wambo and Stony Creek alluvium and channels is recommended. This is consistent with past regulatory actions and management of mining in the Hunter Valley including the precautionary approach taken to North Wambo Creek and Wollombi Brook.

This precaution is warranted, in order to avoid the risk of interconnection between the Whybrow Seam fracture zone and the additional Wambo Seam fracture zone and drainage into the mine workings, which is increased should high flows occur during extraction in any of the three target seams.

For further information please contact Rohan Macdonald, Water Regulation Officer, Major Projects (Newcastle Office) on 4904 2642 or at rohan.macdonald@water.nsw.gov.au.

Comment by Office of Agricultural Sustainability & Food Security

In accordance with procedures for mining projects that affect agricultural lands the Office of Agricultural Sustainability & Food Security has responded direct to your Department by letter dated 16 October, 2014.

For further information please contact Rob Williamson, Leader Land Use Planning (Orange office) on 6391 3166, or at: rob.williamson@dpi.nsw.gov.au.

Yours sincerely



Kristian Holz
Director Policy, Legislation and Innovation

Attachment A

Wambo Coal Mine (DA 305-7-2003 Mod 14) Proposed Modification Additional Comment NSW Office of Water - Groundwater Impacts

Caving zone and fracture heights

The approved North Wambo Underground Mine layout consists of 10 longwall panels within the Wambo Seam, which underlie the previously extracted Whybrow Seam. The Modification proposes the development of an additional longwall panel within the Wambo Seam, referred to as longwall 10A. Previous extraction has been undertaken in the overlying Whybrow Seam, and future approved extraction is proposed in two underlying seams, the Arrowfield and Bowfield Seams.

The scope of the assessment was to include the need for cumulative impact assessment (including existing and proposed mining operations). The modelling assessment for understanding the impacts of the activity and aquifer recovery period should be strongly influenced by the extent of fracture height above the seam. The proponent presents a position that the application of fracture height used in the model is highly conservative. The groundwater model incorporates a fracture height estimate of 0.67 times the panel width. This is contrasted with an alternative estimated ratio of 0.4 times the panel width derived in the groundwater assessment for a multi seam operation (Whybrow and Wambo Seams).

The Office of Water believes the application of fracture height is not as conservative as presented. With each additional coal seam mined the extent of fracture height increases for each overlying seam. In this case the fracture height ratio above the Whybrow Seam went from 0.3 to 0.38 once the underlying Wambo Seam was added. The proponent has not included the fact that the two underlying seams have an existing approval for mining and thus there will be a reactivation of the fracture height once these deeper seams are mined. Hence the process becomes reiterative and the fracture height of each overlying seam would be enhanced from the sequential mining of the underlying seams. Hence any conservative aspect in the fracture zone estimate is rapidly diminished and may upon recalculation be greater than the 0.67 ratio presented.

North Wambo Longwall 10A would undermine Homestead first workings for Longwalls 9 and 9A in the Whybrow Seam, the Homestead-Wollemi Mains, approximately 20% of the Homestead Longwall 9 panel, and minor extents of the Homestead Longwall 1 and 2 panels. Where Homestead Longwall 9 is to be undermined, the depth of cover for the Whybrow Seam is 60-75 m and the depth of cover for the Wambo Seam is 143-173 m (both increasing to the southwest). The separation distance between the two seams is about 80-95 m. As this depth is within the range of depth for shallow tensile cracking, connective fracturing would be essentially to the surface where Homestead Longwall 9 overlies North Wambo Longwall 10A. The lateral extent of direct connective fracturing from coal seam to surficial aquifers is likely to be as much, if not more, than presented.

The proponent should provide further detail on the fracturing heights from mining Wambo Seam in longwall 10A, in particular with respect to whether the proposed extraction was considered as a multi-seam extraction for the purpose of deriving fracture zone extent given the existing approval for the underlying Arrowfield and Bowfield Seams. If a correction is required, i.e. reconsider Wambo Seam as multi-seam as opposed to single seam, the influence on the predicted take of water, re-equilibrium recovery times and final piezometric heads should be presented. Given the complexity in the textural description the Office of Water also request a series of slices (diagrammatically) in both horizontal and lateral extent for the various model layers displaying how the fracturing heights and hydraulic conductivities have been applied.

Pre and post-mining aquifer levels

Section 5.2 of the Groundwater Impact Assessment highlights the key features of the pre-mining hydrogeological environment relevant to the impact assessment, including:

- the general flow direction within the Permian strata is to the east and north-east, flowing from elevated areas on the western side of the study area / model domain, through to the older Permian strata (the Wittingham Coal Measures) to the east;
- because of the general lack of vertical hydraulic connectivity, potentiometric head in the Permian strata was higher than the alluvium groundwater levels, and was above ground level in some low-lying areas; and
- North Wambo and Wambo Creeks, Wollombi Brook and the Hunter River would have been generally gaining water courses in the pre-mining hydrogeological environment (i.e. groundwater would have discharged as baseflow into the creeks and river).

The modelled recovery of groundwater levels indicates the water level will be at the pre-mining elevation after a few decades for the alluvium, and stabilisation at or slightly above levels that occurred pre-mining for overburden.

Upon re-equilibration, it is modelled and anticipated that final Permian aquifers water levels will be similar to pre-mining levels, albeit with a much more enhanced vertical hydraulic conductivity between the deep coal seam and shallow alluvial aquifer of Wambo Creek.

Baseflow

As described in the Groundwater Impact Assessment, "predicted baseflow capture represents about 15% of the modelled 2010 baseflow, and would be incremental above the predicted 30-35% reduction in baseflow that would be caused by the approved mine plan. Gaining conditions are predicted to persist on Wambo Creek." The discharge rates from the deeper hard rock aquifers to some surface water features is limited due to the low vertical permeability of the Permian strata.

Wambo Creek is an ephemeral stream where relatively small volumes of stream losses/gains represent significant percentage changes in baseflow. Hence small changes in discharge in water quality from the Permian aquifers to the alluvium in the longer term as a consequence of the enhanced vertical permeability noted above would similarly be significant.

Aquifer Interference Policy (AIP) assessment

The Groundwater Impact Assessment indicates the alluvium associated with Wambo Creek is classed as 'less productive' and thus separated from the main Wollombi Brook Alluvium. It is unclear of the reference used to draw this conclusion. The Lower Wollombi Brook Water Source, which includes several tributary creeks (e.g. Wambo Creek) and the alluvium associated with those creeks, is understood to be categorised collectively as highly connected and highly productive groundwater source.

The AIP assessment presented in the Groundwater Impact Assessment outlines that the mine impacts are Level 1, with the exception of 3 private bores within the porous rock aquifer that potentially could be impacted by a water level decline of more than 2m.

The proponent indicates that with respect to water quality within Wambo Creek, "there are no simulated risk of reduced beneficial uses of the highly productive alluvium". This conclusion is based on a downward flux of water from the alluvium to the Permian aquifers. There are however, some inconsistencies with other statements that allude to a potential discrepancy with this conclusion. This includes the information regarding:

- i. water levels recovering to pre-mining conditions,
- ii. direct fracturing to surface beneath the alluvium of Wambo Creek giving enhanced hydraulic conductivity,
- iii. Wambo Creek is a gaining stream, and
- iv. relatively small volumes of baseflow make up a significant percentage of baseflow.

These combined elements highlight the elevated risk of a long term beneficial use change in the alluvial aquifer. There is no detailed assessment provided within the Groundwater Impact Assessment that qualifies or quantifies the conclusion drawn by the proponent.

It should also be noted that the impact assessment at the time the underlying Arrowfield and Bowfield Seams were approved did not consider extraction in four seams. It is understood that following previous impacts on Wambo Creek from the Whybrow Seam extraction, extraction was excluded from the Wambo Seam in this location due to elevated risks of interaction with the Wambo Creek watercourse and alluvium.

The proponent has proposed to maximise coal recovery and presents a position of compliance with AIP category 1 impacts. However, taken collectively the above points create reservations with the proponent's conclusions drawn as to potential long term salinity and water take within Wambo Creek and associated alluvium.

End Attachment A

Attachment B

Wambo Coal Mine (DA 305-7-2003 Mod 14) Proposed Modification

Additional Comment NSW Office of Water - Impacts to surface water resources

Geomorphic impacts

The approved North Wambo Underground Mine layout consists of 10 longwall panels within the Wambo Seam. The Modification proposes the development of an additional longwall panel within the Wambo Seam, referred to as longwall 10A. Previous extraction has been undertaken in the overlying Whybrow Seam, and future approved extraction is proposed in two underlying seams, the Arrowfield and Bowfield Seams.

The proposed longwall 10A underlies two watercourses, being Wambo and Stony Creeks. Wambo and Stony Creeks were severely affected by combined mining-induced subsidence and connective fracturing in 1996-8. The watercourses are badly degraded as a result of clearing and unrestricted cattle access over many decades of grazing and opportunistic cropping. Remediation of degradation and mining-induced subsidence due to the above impacts has been partly successful, but has not returned expected flows to the watercourses. No estimation of sub-surface flows through the sand sheet infill to the channels of either watercourse has been presented.

Both Stony and Wambo Creeks have been categorised as being highly fragile watercourses, in poor geomorphic condition and with low recovery potential. The risk of physical disturbance category to a river reach with these characteristics is very low risk – score of 3 of 18. The likelihood of degradation (i.e. bed incision and channel expansion) is weighted against the current state of the two watercourses, which have adjusted to previous incision and bank scour and collapse by significantly expanding in width and channel capacity to retain flows to well above the 1:5 ARI flood event (the standard channel forming flow event).

Cumulative subsidence is expected to exceed 4.2 metres to the combined Whybrow and Wambo Seam extraction, and increase to over 7.5 metres total subsidence after the lower seams are taken. This represents a significant risk of further incision and expansion of the channel. However, it is mitigated to some extent by the enlargement of the channel capacity which has already occurred. Remediation of the impacts to both channels resulting from additional, cumulative subsidence is required. This should avoid the use of rip rap and other 'hard' engineered structures in favour of 'flexible' options for rehabilitation. This should incorporate large woody debris works, which should be embedded in the sand bed to below the depth of activation of scour and incision which is likely to occur. This should generally follow:

- Brooks, A, Abbe, T, Cohen T, Marsh N, Mika S, Boulton A, Broderick T, Borg D, Rutherford I. Design guideline for the reintroduction of wood into Australian streams. River Landscapes series. Land and Water Australia, Canberra.
- Brooks, A. P., Abbe, T. B., Jansen, J. D., Taylor, M. & Gippel, C. J. (2001). Putting the wood back into our rivers: an experiment in river rehabilitation. In I. Rutherford, F. Sheldon, G. Brierley & C. Kenyon (Eds.), *Proceedings of the Third Australian Stream Management Conference: the Value of Healthy Streams* (pp. 1-8). Clayton, Australia: Cooperative Research Centre for Catchment Hydrology.
- Brooks, A. P., Abbe, T. B, Howell J, Arthrington A. Confronting hysteresis; Wood based river rehabilitation in highly altered riverine landscapes of south-eastern Australia. *Geomorphology* 79(2006) 395-422.

The use of woody debris or other bed control structures should be reviewed as each seam is extracted. The adjustment of any large woody debris structures should ensure the structures are progressively buried in the watercourse bed, and they fully span the existing channel width, with sufficient keying to both banks to avoid becoming outflanked. Longitudinal bed gradients should be reduced to below 0.15% between the crest to toe of each upstream bed control structure.

Ongoing monitoring and rehabilitation work must occur, to provide a higher likelihood of success to any intervention to channel form, cross section, long profile gradients, sediment transport relationships and ecological recovery along the affected river reaches.

Volumetric accounting of water take

The accounting methodology to the NSW Aquifer Interference Policy assumes minimal variability of incidental inflows to mining operations following either direct or diffuse (non-connective) fracturing following an impact such as mining subsidence. This assumption may not be applicable as demonstrated by previous impacts to Wambo Creek following extraction of longwalls 9 and 9A in the Whybrow Seam. In that instance, an inrush of over 200 L/s occurred as a high flow event in the watercourse occurred during extraction of the longwall block, forcing an evacuation of the mine workings.

The environmental impact assessment does not appear to have included adequate definition of the surface/alluvial water interaction in South Wambo Creek, nor defined the depth or subsurface flow characteristics in the alluvial body which lies within or adjacent to the longwall block footprint. This may not be a significant issue for extraction of one seam in isolation of previous and approved future extraction. However, it becomes a significant risk should four seam extraction occur, that is, the proposed extraction in the Wambo Seam, previous extraction in the overlying Whybrow Seam and approved extraction of the underlying Arrowfield Seam and Bowfield Seam. The previous impact assessment for extraction in the underlying seams did not consider extraction in the four seams, as extraction from the Wambo Seam was excluded due to risks of interaction with the watercourse and alluvium, following the previous impacts resulting from extraction in the Whybrow Seam.

Should surface water be taken in an inrush event through connective cracking without appropriate water access licences then the Office of Water would consider further regulatory action under the *Water Management Act 2000*, and the proponent is reminded that the maximum penalty for taking water without a water access licence is \$2.2 million plus \$264,000 for each day the offence continues.

Cumulative assessment

A connective drainage estimation from the alluvium of South Wambo Creek has been provided. This estimation appears to be based on a generalised approach to shallow regolithic strata and subsidence profiles. This estimate neglects two significant factors. The distribution of strata will not be even, but will be concentrated at the junction points between the Wambo and overlying Whybrow seam panel boundaries. The concentration of strata at the intersections between the two longwall blocks is likely to create greater fracture potential in the overlying strata. This is most likely to affect the channel of Wambo Creek at the south eastern corner of longwall 10A, but will affect the entire width of alluvium which is connected to the watercourse.

The assessment has avoided the cumulative strain and fracture development which is likely for approved extraction from the Arrowfield and Bowfield seam workings. These workings were approved on the understanding that the interburden thickness to the base of the Whybrow Seam would preclude fracture interconnection between the seams, and no fracturing penetration of Wambo Creek or its alluvium would occur due to the undisturbed interburden thickness between the Arrowfield and Whybrow seams. The cumulative subsidence envelope and enhanced depth of subsidence (7.78 metres maximum) will create severe strains and impart very strong fracture-driving forces to the overburden above both the Wambo and Whybrow Seams. The Office of Water regards this as a significant issue and directs the Department's attention to the lack of definition of the alluvium and interaction between surface and alluvial sub-surface flow and likely and potential impacts to the connected surface/alluvial water source. The Office of Water is of

the opinion that unless this is modelled as part of the overall review, and the consequences of extraction from the Arrowfield and Lower Bowfield Seams are fully incorporated into the surface and shallow groundwater assessment, the cumulative impacts will not be properly assessed.

A cautionary approach, avoiding undermining the Wambo and Stony Creek alluvium and channels is warranted, and is consistent with past regulatory actions and management of mining in the Hunter Valley.

End Attachment B