



OUT21/4438

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Dear Mr Nevill

Narrabri Underground Mine groundwater model review

DPIE Water has reviewed the information provided by the proponent about the groundwater model for the Narrabri Underground Mine (requirement under Schedule 4, Condition 9 in the current Stage 2 Modification 5 (MOD5)) and the Narrabri Underground Mine Stage 3 Extension Project.

This advice is in addition to our correspondence regarding the Extension Project EIS (OUT20/13350) where we indicated that advice on the groundwater model would be provided separately.

This advice includes:

- a post approval review of the adequacy of information prepared relating to the updated model under Condition 9; and
- advice on the updated groundwater model relating to the assessment of the proposed expansion

We believe that the groundwater model requires further work before we will have confidence in its ability to predict impacts relating to the Extension Project. We also believe that the report prepared by the proponent may not address the requirements in Condition 9 due to the lack of information provided.

Please note our detailed advice in Attachment A. We are also able to provide additional information on request.

Any further referrals to DPIE Water and NRAR can be sent by email to:
landuse.enquiries@dpie.nsw.gov.au.

Yours sincerely

Mitchell Isaacs,
Chief Knowledge Officer
Department of Planning, Industry and Environment: Water
19 April 2021

Attachment A

Advice to DPIE Planning & Assessment regarding the groundwater model for the Narrabri Underground Mine and the Stage 3 Extension Project (SSD-10269)

Narrabri Underground Mine – Advice regarding Schedule 4, Condition 9

Schedule 4, Condition 9 in the current Stage 2 Modification 5 (MOD5) Mine Approval (PA 08_144) requires that the Mine's groundwater model be updated within two years of the commencement of longwall coal extraction and every five years thereafter. The proponent is to undertake a transient calibration of the groundwater model in consultation with DPIE Water.

To meet this requirement, the Proponent presented a report titled '*Report on Narrabri Coal Operations Groundwater Model Five Year Calibration Report Update Prepared for Narrabri Coal Operations Pty Limited*', (August 2020) prepared by Australian Groundwater and Environmental Consultants Pty Ltd (AGE). We will refer to this as the 'Model Calibration Report' and the model which it refers to as the '2020 Model'.

While the Model Calibration Report is expected to be related to model calibration, the report does not deliver any information on the model's calibration. Issues include:

- no information is provided on the model calibration metrics, model sensitivity, parameter identifiability, calibrated parameters values and ranges, water budgets, groundwater level predictions¹, and predictions of uncertainty.
- Most of the content in the Model Calibration Report (August 2020) is a repeat of content provided as part of the Groundwater Assessment Narrabri Mine Stage 3 Extension Project (EIS Model Report (October 2020)).

DPIE Water notes that the recent groundwater model update was not undertaken in consultation with DPIE Water. Future updates must be undertaken in consultation with DPIE Water and future reports must provide evidence on this. Subsequently, and without prejudice to the 2020 Model fitness for other purposes, it appears that the Model Calibration Report does not satisfy Development Approval (PA 08_144) Schedule 4 Condition 9.

Recommendation

1. The Model Calibration Report should be revised to make it fit for the purpose of meeting Schedule 4, Condition 9 in Stage 2 Modification 5 (MOD5) Mine Approval (PA 08_144). This must be done only after revising the 2020 Model as described in recommendation 2 below.

Advice relating to the assessment of the Stage 3 Extension project

The 2020 Model is considered by DPIE Water as a totally new build rather than a straightforward enhancement to the earlier 2019 Model.

With respect to the Stage 3 Extension Project groundwater impact assessment, the model does not support decision making to better understand the impacts of the project. The documentation does not provide the field data used to support the model or the choice of model parameters. The model conceptualisation requires a consistent explanation. We recommend that the following risks are better addressed:

- Risk of the potential impact on the alluvium aquifer, with impact potentially up to 10 m of drawdown.
- The impact from the extension in addition to the operating mine should be presented in the model report.

¹ Basic drawdown predictions are presented.

- The water balance needs review. The model appears to suggest that mining will result in increased surface water flows, and increased groundwater (aquifer) storage.

DPIE Water's main conclusions are as follows:

- The EIS Model Report (October 2020) requires some amendment to provide confidence in the modelling work and efficiently inform decisions on the proposed extension.
- There is currently a risk of up to 10 m drawdown impact on the alluvium. The model-based assessment of the Project's impacts on the Namoi Alluvial aquifer and associated groundwater sources requires revision, including reduction in conceptual and numerical modelling uncertainties.
- The model parameters are required to be based on a justified dataset. For example, the extremely strong assumed vertical anisotropy (five orders of magnitude for some layers, i.e. $KH = 100,000 \times KV$) will skew the results as it will force flow to be totally in the horizontal direction, without any allowance for vertical flow. This is critical to impact prediction and requires supporting field data (generally the order of accepted anisotropy would be 100).
- There are apparent inconsistencies between groundwater models for different developments in the area (e.g. Narrabri Coal Mine, Narrabri Gas Project, BTM Complex), particularly with regards to the peripheral (lateral) boundary locations and types. This issue must be reconciled in the 2020 Model to give confidence in the model's ability to predict the Project's sole and cumulative impacts.
- The water balance appears to say modelling will increase surface water flows and groundwater storage. This is counter intuitive. Surface water gauging suggests that the surface water in the area mainly loses flow to groundwater, some of which may be returned downstream. Ephemeral water is expected to be fed by surface (or near-surface) flow. Representation of ephemeral surface water in the model needs to be reviewed and justified. At the moment it doesn't allow surface water losses into the underlying aquifer.
- The report does not include a model scenario for the extension only. As such it is not possible to ascertain how much added impact the extension is responsible for.

Recommendation

Several outstanding issues need to be addressed to the satisfaction of the Department to manage the potential environmental risks. DPIE Water recommends the following:

2. The 2020 Model, the EIS Model Report (October 2020) and the groundwater assessment should be revised to resolve issues identified above and provide confidence in the modelling work and efficiently inform decisions on the proposed extension. These improvements should include, but not be limited to:
 - a. Provision of data supporting the development of the conceptualisation and model parameters. This should include justification of the very high level of vertical hydraulic anisotropy for some layers and choice of modelling to represent surface water-groundwater interactions. Hydrogeological cross sections showing vertical groundwater head gradients and flow directions are required for conceptualisation.
 - b. Confirmation whether or not the mine area includes alluvium and regolith as there are discrepancies between maps in the report. Corrections on impacts may be necessary.
 - c. Confirm the impact and probability of impact on the alluvium aquifer, Great Artesian Basin aquifer and on surface water flows using the extension only scenario and cumulative worst case scenario (Narrabri Gas + existing Narrabri Coal + proposed extension).
 - d. Reviewing the completeness of the rationale for model layers. With respect to the Namoi Alluvium represented as a single layer, consider whether this may constrain the sensitivity of the model to its vertical hydraulic conductivity. Consider adding information on the choice of the variable layering of the Napperby Formation.

- e. Consideration on consistency between modelling approaches in the area, especially on boundary locations and types.
 - f. DPIE Water notes that the model does not include the brine injection activities. The reason of the omission needs to be transparent.
 - g. Model calibration requires clarifications. Information need to be more transparent and complete especially with respect to calibration metrics for steady state calibration. The model may require adjustments.
 - h. A review of the initial assumption for the transient model is required. The report indicates a positive value for the change in groundwater system's storage (7.9 ML/day, the equivalent to ~2.9 GL/year or a total increase in groundwater storage of 30.3 GL over the transient modelling period 1 January 2009–30 June 2019). This appears inconsistent with the rainfall conditions during that period.
 - i. A review of the assumption resulting in an apparent gain in surface water systems from groundwater. DPIE Water finds the outcome counter-intuitive and suggests field data may indicate the opposite relationship. Evidence needs to be shown to support the current assumptions.
 - j. Finally, the modelling report would benefit with improved formatting and better presentation. It is a difficult document to navigate. The report should also be stand alone. Inconsistent definition of parameters like hydraulic conductivity vertical anisotropy makes it hard to undertake comparisons. It is defined as 'Kh:Kv' in the model calibration section whereas it is defined as 'Kv:Kx' in the uncertainty analysis section.
- 3. The Proponent should simulate and assess appropriate scenarios to inform decisions on the project.
 - 4. The Proponent should prepare and implement field investigation program/s to fill the data gaps identified in the EIS Model Report.
 - 5. DPIE P&A should retain Schedule 4, Condition 9 in the current Stage 2 Modification 5 (MOD5) Mine Approval (PA 08_144) in all future approvals relating to the Mine.

End Attachment A