

Advice to decision maker on coal mining project

IESC 2021-125: Boggabri Coal Mine Modification 8 (EPBC 2021/8875, MP 09_0182 MOD 8) – Expansion

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment The New South Wales Department of Planning, Industry and Environment
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Advice stage	Assessment

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) provides independent, expert, scientific advice to the Australian and state government regulators on the potential impacts of coal seam gas and large coal mining proposals on water resources. The advice is designed to ensure that decisions by regulators on coal seam gas or large coal mining developments are informed by the best available science.

The IESC was requested by the Australian Government Department of Agriculture, Water and the Environment and the New South Wales Department of Planning, Industry and Environment to provide advice on Boggabri Coal Pty Limited's Boggabri Coal Mine Modification 8 in New South Wales. This document provides the IESC's advice in response to the requesting agencies' questions. These questions are directed at matters specific to the project to be considered during the requesting agencies' assessment process. This advice draws upon the available assessment documentation, data and methodologies, together with the expert deliberations of the IESC, and is assessed against the IESC Information Guidelines (IESC 2018).

Summary

The Boggabri Coal Mine Modification 8 Project (the project) is an extension to the Boggabri Coal Mine (BCM), located within the Gunnedah Basin, NSW. The BCM is the central mine in the Boggabri, Tarrawonga and Maules Creek Mining Complex (BTM Complex). The extension would deepen the existing mine, allowing mining to increase from the current extraction rate of 8.6 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal to a maximum production rate of 9.1 Mtpa of ROM coal (Hansen Bailey 2021, p. 11).

Although the project is not seeking changes to the Mine Disturbance Boundary, it will contribute to cumulative drawdown within the alluvium, particularly that associated with Nagero, Bollol and Goonbri

creeks. This will alter surface water flows and could also impact an unverified population of Poplar Box Grassy Woodland on Alluvial Plains ecological community, listed as a Threatened Ecological Community (TEC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Key potential impacts from this project are:

- alteration of ecologically important flow components (e.g. numbers of low- and zero-flow days) of ephemeral creeks within the zone of predicted alluvial drawdown;
- reduced water and sediment quality in Nagero Creek due to increased discharges and overflows of sediment-laden water and mine-affected water (MAW) because rainfall patterns changing over the next 20 years may result in more frequent and larger overflows due to insufficient storage volumes; and
- altered groundwater availability and surface water-groundwater interactions that may impact the condition and persistence of groundwater-dependent ecosystems (GDEs) associated with Nagero and Bollol creeks and their tributaries. These GDEs include groundwater-dependent vegetation in the riparian zone as well as stygofauna, particularly in the alluvial sediments of Nagero Creek.

The IESC has identified several areas in which additional work is required to address the key potential impacts, as detailed in this advice. These are summarised below.

- Further interrogation of the current groundwater model is needed to evaluate how predicted drawdown from the project may alter surface water-groundwater interactions in Nagero, Bollol and Goonbri creeks (including the extent and magnitude of reach-specific patterns of groundwater discharge and recharge) and ecologically important flow components.
- The water quality monitoring program should be expanded to include metals and metalloids, such as aluminium, arsenic, copper, lead, molybdenum, selenium and zinc. Water quality objectives for the reuse of MAW should be developed, which may necessitate the treatment of this water.
- Baseline data on sediment quality (e.g., adsorbed contaminants) in receiving waters such as Nagero Creek should be collected for comparison with monitoring data of the sediment quality and water quality of MAW released from the sediment dams.
- The capacity of existing water storages should be assessed with respect to changes in rainfall patterns (i.e. intensity, duration and frequency) that are likely to occur over the next 20 years, to ensure that the frequency and volume of discharges and overflows is not greater than currently predicted.
- Additional data are required on the distribution and abundance of aquatic biota, terrestrial GDEs and stygofauna to better characterise the potential impacts of the project. In particular, field assessments of groundwater use by vegetation (some of which include threatened species) in areas where drawdown is predicted are needed to determine the potential impacts on their condition and persistence. Trigger action response plans (TARPs) should also be developed to detect and mitigate these potential impacts.

Context

The proposed project is an open-cut extension to the existing BCM approximately 15 km north east of Boggabri, NSW. BCM currently mines coal from the Herndale Coal Seam to the Merriown Coal Seam within the Permian Maules Creek Formation. The project entails increasing the depth of mining to the

Templemore Coal Seam to mine an additional 61.6 Mt of ROM coal for the export market within the currently approved Mine Disturbance Boundary. This will extend the mine life by six years to 2039.

The proposal also includes construction of a crossing over the existing haul road to improve the movement of fauna from the Leard State Forest through the Southern Rehabilitation Area (Hansen Bailey 2021, p. 14).

The local region has been heavily modified by agriculture (cropping and grazing), coal mining and forestry. Despite this, the Leard State Forest adjacent to the project area is known to contain Koala (*Phascolarctos cinereus*; listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Squirrel Glider (*Petaurus norfolcensis*; listed as Vulnerable in NSW under the *Biodiversity Conservation Act 2016 (NSW)*). There is at least one unverified population of the Poplar Box Grassy Woodland on Alluvial Plains TEC within the project area. Other Plant Community Types (PCT), some listed as Critically Endangered Ecological Communities (CEEC), also occur in the area and partly comprise high-quality riparian habitat along reaches of the area's ephemeral streams where drawdown is predicted.

Response to questions

The IESC's advice in response to the requesting agencies' specific questions is provided below.

Question 1: To what extent can decision makers have confidence in the predictions of potential impacts on water resources provided in the Modification Report, including in regard to surface water quality, groundwater drawdown, and potential impacts on groundwater dependent ecosystems and other users?

1. The IESC considers that additional justification and evidence are required to improve confidence in some of the predictions of potential impacts on water resources provided in the Modification Report as outlined below.

Groundwater

2. Potential impacts of the project were assessed using the BTM Complex's AGE (2020) MODFLOW-USG (MFUSG) model. This model is currently being revised to address the outcomes of a NSW Natural Resources Access Regulator (NRAR) (2021) review. Until this revision is completed, the IESC has limited confidence in the magnitude and extent of predicted impacts. Work that should be undertaken to increase confidence in the predictions of the numerical groundwater model include the following.
 - a. Justification and clarification of the potential influence of boundary conditions on groundwater fluxes because the current ones may lead to an overestimate of predictions of drawdown extent and magnitude.
 - b. Cumulative impacts are likely to have been underestimated because the model provides an assessment of the impacts of the BMT Complex only. Of particular concern are potential cumulative impacts associated with the Tarrawonga Modification 7 Project (not included as the Tarrawonga Modification 7 Project was approved after the AGE (2020) model was finalised) and the Vickery Mine (whose cumulative impacts of the Vickery Mine were considered unlikely by the proponent (Hansen Bailey 2021, App. H, App. A, p. 4)). In addition, the IESC notes that the Maules Creek Modification 7 Project was approved in August 2021, which allows for an increase to the existing out-of-pit rock emplacement landform. It is recommended that all relevant projects be included in the groundwater model to improve predictions of the cumulative impacts of the project.

- c. Geological structures are known to occur in the area, and both the Hunter-Mooki Fault System and the Conomos Fault are included in the model. However, localised faults are not included in the model as they are conceptualised to not significantly impact regional flow (Hansen Bailey 2021, App. H, p. 20; Hansen Bailey 2021, App. H, App. A, p. 12). Monitoring is required to justify this conceptualisation.
 - d. Further interrogation of the groundwater model is needed to evaluate how predicted drawdown from the project may alter surface water-groundwater interactions in Nagero, Bollol and Goonbri creeks (including the extent and magnitude of reach-specific patterns of groundwater discharge and recharge) and ecologically important components of their flow regimes (Paragraph 14).
3. Although the project is not expected to result in a pit lake, the area is predicted to act as a long-term recharge source to the alluvial tongue of Nagero Creek (Hansen Bailey 2021, App. H, p. 78). To improve confidence in prediction of the potential impacts (Paragraph 7) of alterations to the magnitude and extent of this long-term recharge to GDEs, the proponent should discuss how recharge will vary during and after the project and how this might alter groundwater levels in the alluvium in addition to the predicted drawdown.

Surface water

4. The proponent has concluded that the project will not cause appreciable changes to the surrounding catchment areas, final landform, flooding, watercourse stability or downstream flow regimes compared with the approved mining activities (Hansen Bailey 2021, pp. 100 and 102; Hansen Bailey 2021, App. J, p. 27). However, the IESC considers that insufficient data and modelling have been provided to justify this assertion, as described below.
- a. As a result of drawdown from the approved activities in the BTM Complex, a loss of baseflow to Namoi River of approximately 2 ML/year on average, with a maximum reduction of 7.5 ML/year, is expected from 2020 (Hansen Bailey 2021, p. 92). It is stated that “this loss in baseflow is only significant during periods of no river flow” (Hansen Bailey 2021, p. 92). Given the importance of alterations of the zero- and low-flow components of flow regimes to in-stream and riparian communities of ephemeral creeks, these impacts need to be evaluated in terms of predicted alterations to ecologically relevant components of the flow regime rather than just changes in annual averages. It would be expected that any such evaluation should cater for the large uncertainty associated with the modelling used to estimate the impacts resulting from altered groundwater-surface water interactions.
 - b. The proponent states that Bollol and Nagero creeks are losing streams (Hansen Bailey 2021, App. H, p. 34); however, limited data have been provided to support this assertion. Although monitoring indicates that a section of Bollol Creek (at REG7) is losing to the alluvium (AGE 2020, pp. 55 – 56), sections of Maules Creek have been found to be gaining groundwater (AGE 2020, pp. 56 – 60). It is unclear whether gaining sections and groundwater recharge occur further downstream in Bollol Creek, Goonbri Creek (a tributary of Bollol Creek) or in Nagero Creek. The IESC, therefore, considers that the proponent’s predicted likelihood of impacts on flow regimes is uncertain and reductions in baseflow could be greater than expected. As changes in flow regimes in ephemeral creeks can have major repercussions for biodiversity and the composition of their aquatic and riparian communities (Datry et al. 2017), the proponent should conduct appropriate tests (e.g., Brodie et al. 2007) to determine the extent, magnitude and direction of surface water-groundwater exchange within the potentially impacted watercourses. Hydrological modelling (e.g., Rassam et al. 2013), which incorporates predicted drawdown extents, should be undertaken to confirm that impacts on low-flow regimes are consistent with those expected from the approved project. This modelling should consider all local watercourses, including Nagero, Bollol and Goonbri creeks.

5. The proponent monitored water quality in Nagero Creek between 2008 and 2016 (upstream of the site) and between 2015 and 2020 (upstream and downstream) (BCOPL 2017, p. 20; Hansen Bailey 2021, App. J, p. 8). Only a limited number of parameters were measured (pH, electrical conductivity, nitrate, nitrogen, oil and grease, phosphorus, reactive phosphorus and total suspended solids) consistently throughout this period. The IESC considers that these data are insufficient and should include metals and metalloids. These data would provide a more reliable baseline dataset for assessing the impacts of the project. Other considerations include that:
 - a. although the water balance model has been updated for the proposed project, no salt balance or water quality analysis has been provided. These should be undertaken to confirm that no additional impacts are likely and that the proposed monitoring and management measures are effective;
 - b. discharges of sediment-laden water are expected to decline over time as rehabilitation of the catchment areas will decrease the volume of water collected within the dirty water management system (Hansen Bailey 2021, App. J, App. B, p. 23). Although water quality objectives for discharged water have been listed (BCOPL 2017, p. 39) and treatment suggested (Hansen Bailey 2021, p. 21), specific details regarding water treatment to achieve these objectives have not been provided. The proponent should provide details on the water treatment strategies and consider expanding the water quality objectives to include a broader range of physico-chemical parameters including metals and metalloids, and include these in the water quality monitoring;
 - c. MAW will be preferentially used for dust suppression and coal handling and preparation plant (CHPP) demands (Hansen Bailey 2021, App. J, App. B, Fig. 2.2). No water quality objectives have been specified for the reuse of the MAW and it is unclear whether the water will be treated prior to use. The IESC notes that contaminated runoff from the CHPP, rail loop area, stockpiles and train load areas is directed to the sediment dams (Hansen Bailey 2021, App. J, App. B, Fig. 2.2). This could further reduce the quality of the water contained in the sediment dams and water discharged from these dams. Therefore, the proponent should develop water quality objectives for the reuse of MAW and clarify how these will be met; and
 - d. it is not clear whether this project will have impacts on the quality of sediment (e.g., adsorbed metals or other contaminants on sediment particles) within the sediment dams and potentially released downstream. No information on sediment quality has been provided. Potential impacts on the sediment quality of receiving waters due to discharges of MAW into Nagero Creek should be evaluated, particularly because the pulsed nature of ephemeral streamflow means that there are likely acute impacts of deposited contaminants when flow resumes (Gómez et al. 2017). Baseline data of sediment quality in receiving waters such as Nagero Creek should be collected for comparison with monitoring data of the sediment quality and water quality of MAW released from the sediment dams, and of in-stream sediment quality downstream of all release points.
6. Climate change impacts on rainfall events and evaporation were not considered in the surface water modelling relevant to the final void or associated mine water infrastructure, which is problematic because the estimates relate to a period 20 years hence. The modelled discharge and overflow volumes are smaller for the proposed project than the existing project (Hansen Bailey 2021, App. J, App. B, Tab. 4.1 – 4.2). However, the IESC notes that specific details regarding flow rates and duration for each controlled discharge have not been provided. More details are needed on the potential for discharges to cause erosion and incision.

Water-dependent ecosystems

7. The IESC considers that further field data are required to increase the confidence in the proponent's predictions of likely impacts of the project on water-dependent ecosystems. In particular, additional

information is needed on how predicted drawdown may affect potential groundwater-dependent vegetation along Nagero, Bollol and Goonbri creeks, stygofauna (especially in alluvial sediments), and flow regimes and in-stream aquatic habitat for fish and other biota. Direct field measurements of groundwater use by vegetation in areas where drawdown is predicted would also increase confidence in assessment of the project's potential impacts. Further details are provided in Paragraphs 13 – 16.

Question 2: Would the IESC recommend any additional monitoring or management measures to address any potential impacts on water resources?

8. The proponent plans to continue monitoring in accordance with the currently approved mitigation, monitoring and management plans. However, the IESC considers that the current monitoring and management programs are insufficient to adaptively manage some of the changes in water resources which may occur due to the proposed modification. Suggestions for improving the mitigation, monitoring and management plans are outlined in the following paragraphs.

Groundwater

9. Monitoring and management are proposed to continue in accordance with the approved BCM Water Management Plan (WMP) and Groundwater Management Plan (dated 2017), as well as a joint BTM Complex WMP (dated 2019) (Hansen Bailey 2021, App. H, p. 85). The IESC notes that:
 - a. additions to the current WMP include site testing to characterise a potentially impacted bore (GW002523), additional monitoring bores to be installed in the alluvium tongue southwest of the project, and deeper groundwater monitoring within the approved disturbance boundary and east of the project (Hansen Bailey 2021, App. H, p. 85). The IESC commends this intended additional monitoring and recommends that the results are used to update the model; and
 - b. additional mitigation measures are not proposed for the project, because impacts are expected to be minimal in comparison to the existing approved project (Hansen Bailey 2021, App. H, p. 85). Timeframes for implementation and potential mitigation measures, including examples of where mitigations have been successfully applied in similar environments, should also be provided to increase confidence in the likely outcomes, especially for ecological responses (Paragraph 13).

Surface water

10. It is commendable that site-specific water quality objectives have been developed for a range of analytes (BCOPL 2017, pp. 19 – 23). However, the IESC considers that the current surface water monitoring program is insufficient for detecting potential environmental impacts and assessing the effectiveness of mitigation strategies. Additional monitoring is required to address the following limitations.
 - a. The IESC notes that the geochemical assessment (Hansen Bailey 2021, App. O, p. 23) recommends that several metals and metalloids should be included in the monitoring program, including aluminium, arsenic, copper, lead, molybdenum, selenium and zinc . However, this recommendation does not seem to have been addressed in the proposed updates to the Surface Water Management Plan. The IESC considers that the water quality monitoring program be expanded to include the full range of physico-chemical parameters for monitoring the on-site water storages and all local watercourses whose water quality may be affected by the project. This will allow potential impacts to be adequately detected and managed.
 - b. Under the current monitoring regime, streamflow and water quality are measured only in Nagero Creek. Given the uncertainty associated with the effects of drawdown on ecologically important components of stream flow regimes in and near the project area, the IESC suggests that streamflow should be monitored in Nagero and Bollol creeks.

- c. The deposition of fine sediments and attached contaminants (e.g., metals) may have impacts on in-stream habitats and aquatic biota. However, baseline monitoring of sediment quality in Nagero Creek does not appear to have been undertaken (Paragraph 5). The IESC recommends appropriate sediment monitoring to assess whether sedimentation and contamination may occur, especially where creeks are important for fish habitat or movement.
11. Although the proponent indicated that water contained within the sediment dams is treated, it is unclear whether MAW is treated. The proponent should clarify the details surrounding treatment of sediment water and MAW, including water quality objectives for the reuse of MAW.
 12. Regulating the flow-rate of discharged water can mitigate the extent of erosion and incision in the channel as well as allow some dilution of the discharged water during natural flow events. The proponent should develop a discharge regime that specifies the flow-rate and likely duration of discharges under high-, medium- or low-/no-flow scenarios in Nagero Creek.

Water-dependent ecosystems

13. Drawdown of up to 5 m is predicted adjacent to Nagero and Goonbri creeks, and up to 1 m adjacent to Bollol Creek (Hansen Bailey 2021, App. H, Fig. 8.3). This drawdown could impact terrestrial GDEs in the area (Hansen Bailey 2021, App. Q, p. 41), including *Melaleuca bracteata* and *Eucalyptus populnea* (a Koala feed-tree species) (Hansen Bailey 2021, App. Q, p. 35). In addition, the proponent notes that the study area may be used as a wildlife corridor through the broader landscape (Hansen Bailey 2021, App. P, p. 102). Several additional monitoring and/or mitigation measures are suggested to improve the assessment of potential effects of drawdown associated with the project.
 - a. Direct field measurements of groundwater use by vegetation should be undertaken in areas of predicted drawdown, especially for riparian vegetation associated with Nagero, Bollol and Goonbri creeks (e.g. Doody et al. 2019). In particular, groundwater dependence of vegetation in PCT 599 (Blakely's Red Gum-Yellow Box grassy tall woodland) lining part of Nagero Creek should be assessed because this potential GDE is EPBC Act-listed as critically endangered. Where these measurements indicate dependence on groundwater, appropriate monitoring and mitigation measures should be developed.
 - b. The IESC notes that an unverified population of Poplar Box Grassy Woodland on Alluvial Plains (listed as Endangered under the EPBC Act) occurs on the alluvial tongue of Nagero Creek and may be impacted by the project (Hansen Bailey 2021, App. Q, p. 42). This population's identity should be field-verified and its groundwater-dependence assessed.
 - c. Terrestrial GDEs were identified in Bollol and Goonbri creeks in 2011 (Hansen Bailey 2021, App. Q, p. 41). The IESC considers that more recent surveys of community composition, canopy cover and tree condition should be undertaken to determine whether changes in populations have occurred since the approved project commenced and provide a more recent baseline against which to assess potential impacts from the proposed project.
14. The Namoi River, Maules Creek and Bollol Creek are acknowledged by the proponent as containing threatened aquatic habitat for EPBC Act-listed fish such as the Eel-tailed Catfish (*Tandanus tandanus*), Olive Perchlet (*Ambassis agassizii*), Purple-spotted Gudgeon (*Mogurnda adspersa*) and Silver Perch (*Bidyanus bidyanus*) (Hansen Bailey 2021, App. P, p. 92). Given the potential extent of groundwater and surface water impacts (discussed in Paragraphs 2 and 4 – 5), the IESC recommends targeted surveys of fishes and other aquatic biota in the creeks likely to be impacted by the project and assessment of habitat values that may be compromised by altered flow regimes or water quality. These surveys will provide useful baseline data against which to assess any impacts of the project, individually or cumulatively, on water quality and ecologically important components of flow regimes and to evaluate the effectiveness of proposed mitigation measures.

15. One stygofauna species was identified from a groundwater monitoring bore (MW6) in the Nagero Creek study area in 2018 (Hansen Bailey 2021, App. Q, p. 19). Given the diverse stygofauna known to occur in the Namoi River Catchment (e.g., Korbel et al. 2013), the proponent is to be commended for proposing additional stygofaunal monitoring in Nagero Creek to gather baseline condition data as well as to monitor potential impacts. However, the limited baseline data available, particularly for the alluvial sediments of Bollol and Goonbri creeks, constrain robust assessment of potential impacts on stygofauna due to drawdown. It is recommended that stygofaunal sampling be undertaken at multiple bores in the alluvium at these sites and Nagero Creek if possible. Furthermore, stygofaunal sampling should be done even in bores where EC > 1500 µS/cm (cf. the current approach where it appears that samples are not collected if conductivity exceeds 1500 µS/cm (Hansen Bailey 2021, App. Q, p. 46)) because some taxa are capable of tolerating water well above this salinity (Glanville et al. 2016). The proponent could consider using environmental DNA to assess whether stygofauna might be present (e.g., Korbel et al. 2017). A current research project by Dr Grant Hose and Dr Kathryn Korbel (Macquarie University) is evaluating this method for stygofauna in the Namoi River Catchment for the IESC. The proponent may wish to contact the Office of Water Science for more details.
16. Although the proponent has previously developed a Rehabilitation Management Plan (BCOPL 2020), specific mitigation measures should be added in case the additional cumulative drawdown and the modified final landform impede or prevent successful revegetation.

Date of advice	5 September 2021
Source documentation provided to, and used by, the IESC for the formulation of this advice	<p>Australasian Groundwater and Environmental Consultants (AGE) 2020. Boggabri, Tarrawonga, Maules Creek Complex Groundwater Model Update. Dated 21 December 2020. Prepared for Boggabri, Tarrawonga, Maules Creek (BTM).</p> <p>Hansen Bailey 2021. Boggabri Coal Mine Modification 8 to SSD 09_0182 Modification Report. Prepared for Boggabri Coal Operations Pty Ltd.</p> <p>HydroSimulations 2018. Boggabri-Tarrawonga-Maules Creek Complex – Groundwater Model Review. Dated 28 August 2018. Prepared for Whitehaven Coal Pty Ltd.</p> <p>Natural Resources Access Regulator (NRAR) 2021. BTM Groundwater Model Update. Natural Resources Access Regulator, NSW Government. Dated 23 March 2021.</p>
Other references cited within the IESC’s advice	<p>Boggabri Coal Operations Pty Ltd (BCOPL) 2017. Surface Water Management Plan. Dated February 2017.</p> <p>Boggabri Coal Operations Pty Ltd (BCOPL) 2020. Rehabilitation Management Plan. Dated April 2020.</p> <p>Brodie R, Sundaram B, Tottenham R, Hostetler S, and Ransley T 2007. <i>An overview of tools for assessing groundwater-surface water connectivity</i>. Bureau of Rural Sciences, Canberra</p> <p>Datry T, Bonada N, and Boulton AJ (Eds.) 2017. <i>Intermittent Rivers and Ephemeral Streams: Ecology and Management</i>. Amsterdam: Elsevier.</p> <p>Doody TM, Hancock PJ and Pritchard JL 2019. <i>Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems</i>. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia. Available [online]: http://iesc.environment.gov.au/publications/information-guidelines-explanatory-note-assessing-groundwater-dependent-ecosystems.</p> <p>Glanville K, Schulz C, Tomlinson M, and Butler D 2016. Biodiversity and biogeography of groundwater invertebrates in Queensland, Australia. <i>Subterranean Biology</i>, 17, 55-76.</p>

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Rassam DW, Peeters L, Pickett T, Jolly I, and Holz L 2013. Accounting for surface-groundwater interactions and their uncertainty in river and groundwater models: A case study in the Namoi River, Australia. *Environmental Modelling & Software*, 50, 108-119.
