

Advice to decision maker on coal mining project

IESC 2023-141: Ulan Coal Mine Expansion Modification 6 (EPBC 2022/09292 and MP08_0184 Mod 6) – Expansion

Requesting agency	The Australian Government Department of Climate Change, Energy, the Environment and Water and the New South Wales Department of Planning and Environment
Date of request	25 January 2023
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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 Climate Change, Energy, the Environment and Water and the New South Wales Department of Planning and Environment to provide advice on the Glencore's Ulan Coal Mine Expansion Modification 6 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 Ulan Coal Mine Expansion Modification 6 Project (the 'project') is a proposed expansion of longwall operations in the northern extent of the existing mining lease and exploration licence areas of the Ulan Coal Mine Complex. The Ulan Coal Mine Complex is owned by Glencore Coal Pty Ltd and is located 38 km north-east of Mudgee, NSW. The proposed project will allow an additional 25 million tonnes (Mt) of thermal coal to be extracted within the currently approved rate for the Ulan Coal Mine Complex of 20 Mt

per annum. The proposed project would extend the life of the mine by two years to 2035 (Umwelt 2022a, p. 1).

The proposed project will extend currently approved longwall panels LWW9, LWW10 and LWW11 to the west and LW9, LW10, LW11 and LW12 to the north. LWW11 will also be widened by 30 metres (m). The proponent will also construct additional surface infrastructure, including three vents, five dewatering bores, and a service borehole south-west of Ulan West operations (Umwelt 2022a, p. 2).

The Ulan Coal Mine Complex is located within the headwaters of the Goulburn and Talbragar rivers which are separated by the Great Dividing Range (Engeny 2022, p. 8). The proposed project area is located wholly within the Mona Creek catchment (Umwelt 2022a, p. 59). Mona Creek is a fourth-order stream in the headwaters of the Talbragar River which forms part of the Murray-Darling Basin and is considered to be a high-potential groundwater-dependent ecosystem (GDE) (BoM 2022). Along the cliffs that line areas of Mona Creek are caves, overhangs and crevices which are habitat for *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)-listed vulnerable species of Large-eared pied-bat (*Chalinolobus dwyeri*) and Corben's long-eared bat (*Nyctophilus corbeni*) (Umwelt 2022b, p. 116).

Key potential impacts from this project are:

- permanent changes to local catchment topography of Mona Creek from vertical subsidence of up to 2.1 m (SCT 2022, p. 4) leading to ponding and altered surface runoff and infiltration. These changes are likely to impact ecologically important components of the flow regime (e.g., durations of low- and zero-flow periods) of Mona Creek. The magnitude of these impacts has not been clearly defined and their potential effects on aquatic and riparian ecology have not been adequately described;
- groundwater drawdown and baseflow reduction initially, followed by long-term effects of subsidence and connected fracturing above the coal seam on groundwater and surface water, which could further alter flows in Mona Creek and reduce access to groundwater by riparian vegetation including Blakely's Red Gum;
- predicted groundwater drawdown below and near the Talbragar River, a headwater catchment in the Murray-Darling Basin, may have impacts on this high-potential GDE;
- changes in groundwater level (groundwater drawdown followed by up to 10 m of mounding (AGE 2022, p. 87)) which may have impacts on vegetation vulnerable to waterlogging and may alter the direction and magnitude of groundwater-surface water exchanges along Mona Creek; and
- contributions to cumulative impacts on aquatic and riparian biota of Mona Creek and possibly Talbragar River, arising from additional changes in baseflow, flow regime and groundwater access for GDEs.

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

- An integrated assessment of groundwater, surface water and ecological responses to subsidence and future mine-influenced groundwater levels is required. This requires the following:
 - improvements to the groundwater modelling (e.g., improved representation of the hydraulic connection between surface water and groundwater to better predict potential changes to ecologically important flow components, further consideration of climate-change impacts through an analysis using RCP8.5) and the model's interpretation (e.g., estimation of timing and extent of maximum drawdown and subsequent mounding);

- additional field surveys to characterise the current condition of Mona Creek and Talbragar River, targeting the location of persistent pools, the aquatic biota and any potential GDEs such as riparian vegetation;
 - collection of field data to determine the potential groundwater-dependence of riparian vegetation of Mona Creek and Talbragar River in the area of predicted drawdown;
 - assessment of directions and magnitudes of surface water-groundwater exchanges within and alongside the channels of Mona Creek and Talbragar River; and
 - the integration of these improvements into a more detailed assessment of the potential cumulative impacts on downstream environments.
- If controlled releases occur in future into the Talbragar River, aquatic biota and a broader suite of water quality parameters (e.g., dissolved metals and dissolved organic carbon) should be monitored.
 - Development of the subsidence management and monitoring plan to include potential impacts to aquatic and riparian ecosystems of Mona Creek within and downstream of the proposed project area.

Context

The Ulan Coal Mine Complex has underground longwall operations and open-cut pit operations within the mining lease. The Ulan Coal Mine Expansion Modification 6 Project is proposing the expansion of the underground longwall operations in the northern extent of the mining lease in Ulan Seam within the Illawarra Coal Measures. The proposed project will extract an additional 25 Mt of thermal coal over two years. It will cover approximately 853 ha underground and include the extension of longwall panels LWW9, LWW10 and LWW11 to the west, LW9, LW10, LW11 and LW12 to the north, and widening of LWW11 by 30 m (Umwelt 2022a, p. 2). Additional surface infrastructure will include three vents, five dewatering bores and a service borehole south-west of Ulan West operations (Umwelt 2022a, p. 2). The proposed project will result in surface disturbance of 27.4 ha through vegetation clearing, which includes 9.5 ha of the Critically Endangered Ecological Community (CEEC) of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Umwelt 2022a, p. v).

The Ulan Coal Mine Complex is surrounded by Durrigere State Conservation Area, Goulburn River National Park and Cape State Forest (Umwelt 2022a, p. 11). Biodiversity surveys undertaken in 2020 and 2022 identified 11 species of fauna, three of flora and one CEEC listed under the EPBC Act, and 20 NSW *Biodiversity Conservation Act 2016* (BC Act)-listed species within the survey area (Umwelt 2022b, Appendix A, pp. A-1 – A-5).

Mona Creek flows through the proposed project area and then into the Talbragar River, a headwater of the Murray-Darling Basin (Engeny 2022, p. 8). There are three main groundwater systems identified within the project area: unconsolidated sediments associated with creeks, rivers and their tributaries; shallow regolith and near-surface weathered rock; and hard rock aquifers including Triassic, Jurassic and Permian-age geology (Umwelt 2022a, p. 53). Multiple NSW Water Sharing Plans apply across the site for the aquifers associated with the project area and surrounds (AGE 2022, p. 94).

There are existing approvals for mining activities at the Ulan Coal Mine Complex under the EPBC Act and NSW legislation. As part of these approvals, there are existing management plans and an Environmental Protection Licence (EPL 394) issued by the NSW Environment Protection Agency.

Response to questions

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

Question 1: Groundwater

To what extent can decision makers have confidence in the predictions of potential impacts on groundwater resources, paying particular attention to predicted direct and indirect water take from various groundwater sources, key water features in the project's vicinity (ie 'the Drip'), groundwater dependent ecosystems and other water users.

- a) Has an appropriate model been selected and used by the Applicant? Are the assumptions used in the model reasonable, appropriately conservative and appropriately justified?
- b) Has the model been calibrated with sufficient monitoring data to provide meaningful predictions, including worst-case impacts on groundwater resources?
- c) Has the model been appropriately conceptualised?
- d) Has an appropriate sensitivity and uncertainty analysis been undertaken, including consideration of the potential effects of climate change?
- e) Has the groundwater assessment sufficiently assessed surface and groundwater interactions?

1. Confidence in the predictions of potential impacts on groundwater resources from the project is limited by several issues with the groundwater impact assessment and modelling as discussed below.
2. Predicted takes, either direct or indirect, from various groundwater sources have been outlined (AGE 2022, Table 2.1, p. 11), and the model has been updated to enable takes from relevant sources to be identified and estimated (AGE 2022, p. 96). The accuracy of the predicted takes will be affected by the issues discussed in Paragraphs 5-11.
3. The IESC agrees that this project is unlikely to impact The Drip, unless the cumulative changes in groundwater level exceed model predictions.
4. The proponent has provided limited information about Unnamed Spring (basalt) and Kelly's Spring (Jurassic sandstone), which are located 6 km north of the project area, beyond stating that these springs are recharge-fed (AGE 2022, p. 51). The IESC suggests that the proponent verifies that these springs are fed by perched aquifers and will not be affected by drawdown in the underlying Triassic sandstone aquifers.
5. The adequacy of the assessment of potential impacts to key water features, GDEs and other water users in the project's vicinity varies. The assessment of these impacts to Mona Creek and any associated GDEs is limited, and additional work and information are required.
 - a. Up-to-date field surveys to enable characterisation of potential GDEs in the vicinity of the project. The proponent has stated that "no significant GDEs were identified" (AGE 2022, p. 51); however, the data to support this have not been provided. Impacts to GDEs could arise through subsidence, groundwater drawdown, and groundwater mounding post-mining. More detailed consideration of the individual stressors, and cumulative impacts from multiple stressors, is needed.

- b. Clear presentation of data collected from the Mona Creek bores is required to establish the baseline groundwater conditions, particularly the depth to groundwater, the extent of the aquifer and groundwater quality.
 - c. Identification and mapping of persistent pools (AGE 2022, p. 29) and the CEEC (Umwelt 2022a, p. 114) that occur within the Mona Creek area.
 - d. Mapping of the current depth to the water table, overlain with persistent pools and any potential groundwater-dependent vegetation to help understand the likely groundwater dependence as recommended by the peer review of the groundwater model (AGE 2022, App. C1, p. 2).
 - e. Field-based assessments of groundwater dependence (see Doody et al., 2019 for possible methods) of potential GDEs such as Blakely's Red Gum (*Eucalyptus blakelyi*).
 - f. Assessment of potential impacts to stream flow and persistent pools where connected fracturing (or desaturation) reaches the unconsolidated sediments of Mona Creek. Clarification is required of the magnitude of uncertainty that connected fracturing intersects the alluvium below Mona Creek. A hydraulic connection between the dewatered coal seam and the alluvium of Mona Creek is plausible given uncertainty in predictions of the height of connected fracturing above the coal seam (AGE 2022, EPBC Assessment requirements response, Table 3, p. 10). The uncertainty in height of connected fracturing is not shown in Figure 5.24 (AGE 2022, p. 63) (Cross-section B-B).
 - g. Predicted groundwater drawdown needs to show the maximum drawdown and mounding (spatial extent, magnitude and timing) so that potential impacts can be identified as recommended by the peer review of the groundwater model (AGE 2022, App. C1, p. 2).
 - h. Assessment of the potential impacts of post-mining groundwater mounding on Mona Creek and associated GDEs and vegetation. This is required as the proponent has predicted that groundwater levels in parts of the Mona Creek area may rise by 10 m (AGE 2022, p. 87). Although current groundwater levels have not been clearly mapped, a rise of 10 m could result in the water table being above the ground surface in some areas as well as posing a risk of adverse effects of waterlogging on vegetation. This rise in groundwater level may also alter the direction and magnitude of surface water-groundwater exchanges in Mona Creek, impacting on hyporheic processes such as carbon processing (Paragraph 18) and nutrient cycling in the saturated sediments.
6. The groundwater model used by the proponent is suitable for the purpose of assessing regional drawdown and take due to the project. However, it is not able to adequately represent the complexity where subsidence and connected fracturing occur beneath Mona Creek or simulate local surface water-groundwater interactions. Issues that need to be addressed are outlined below.
- a. The implementation of connected fracturing from subsidence in the groundwater model, and the assessment of potential impacts from this on Mona Creek and potential GDEs within the area of groundwater depressurisation, require further discussion and justification. The current predictions indicate that there will be no constrained zone above the longwall panels and that groundwater depressurisation will be extensive (AGE 2022, p. 87). Further assessment of the uncertainties in the timing and extent of full depressurisation is needed to help ensure that all potentially impacted GDEs can be clearly identified and assessed, including those occurring beyond the project area. Further information to support the parameterisation of the groundwater model and the selection of hydraulic parameters to replicate connected fracturing is also needed.
 - b. There are no field-derived data for the parameterisation of the Mona Creek sediments. Mona Creek is the key area potentially impacted by this project. Current parameterisation appears to be

based on observations from the Talbragar River alluvium and the Goulburn River alluvium (AGE 2022, p. 35) with limited justification provided for this extrapolation.

- c. The representation of surface water features in the groundwater model requires further justification. Currently, river cells are stated to be able to discharge groundwater but not recharge the groundwater system (AGE 2022, App. A, p. 8) which does not appear consistent with alluvium being identified as a primary source of groundwater recharge (Umwelt 2022a, p. 56). Consideration should also be given to improving the model's spatial discretisation around Mona Creek and its confluence with Talbragar River, given the reported current cell size is 200 m by 200 m (AGE 2022, p. 72). Model results, supported by characterisation and monitoring data (refer to Paragraphs 5b, 5c, 5d, 5e and 6b) should be reported specifically for the Mona Creek area.
7. Model calibration has appropriately utilised the available groundwater level and pressure monitoring data. The IESC suggests that the calibration results be presented to identify any trends in calibration adequacy spatially or within hydrostratigraphic layers. Additionally, where available, existing baseflow data should be used as a calibration check for groundwater-surface water connectivity. If measured underground mine inflows are available for different sections of the mine (AGE 2022, p. 163), these could be used in the calibration process as a check on flux predictions.
 8. Conceptualisation of the groundwater system at the project site appears consistent with previous versions of the groundwater model (AGE 2022, p. 59). However, further information is required on the following points:
 - a. the conceptualisation of the Mona Creek perched groundwater system occurring in a series of disconnected lenses which are charged following rainfall (AGE 2022, pp. 28-29);
 - b. the applied recharge rates specific to hydrostratigraphic units, using approaches such as environmental water tracers (OWS 2020). Evidence should be provided to justify the large differences in assumed recharge rates in different areas (e.g., to alluvium and colluvium and through spoil); and
 - c. the adopted hydraulic conductivity values and ranges, especially vertical hydraulic conductivities, to demonstrate consistency with the presented conceptualisation.
 9. Uncertainty analysis was undertaken using a calibration-constrained Monte Carlo approach (AGE 2022, p. 101). The IESC notes that the reported uncertainty analysis has not fully explored potential worst-case impacts on groundwater resources. The following improvements to the uncertainty analysis are suggested:
 - a. parameter ranges for storage and recharge should be explored and reported;
 - b. the range of results for baseflow changes and mounding should have been reported as recommendation by the peer review of the groundwater model (AGE 2022, App. C1, p. 2). These are some of the key impacts associated with this project and the range of potential outcomes should be clearly communicated; and
 - c. there should be justification for the number of realisations and whether they are sufficient, noting also that there is some inconsistency in reporting the number of adequately calibrated realisations.
 10. Potential effects of climate change were explored through additional model runs using different recharge rates derived from predicted changes to precipitation under the selected climate change scenario of RCP4.5 (AGE 2022, EPBC Assessment requirements response, p. 2). The IESC recommends that this analysis be expanded with reference to RCP8.5. Understanding the potential effects of climate change on the predicted impacts of this project is important given the long time over

which impacts will continue to be observed (potentially thousands of years, e.g., AGE 2022, Table 8.6, p. 99), and that climate change is likely to have an effect on the magnitude of mounding, the key long-term potential impact of this project.

11. The groundwater assessment predicts changes to surface water and groundwater interactions. However, the IESC has identified several limitations of this assessment.
 - a. The project is predicted to increase baseflow losses in the Talbragar River and its tributaries, including Mona Creek, above the levels already approved (Umwelt 2022a, p. 56). These losses are likely to affect ecologically important components of the flow regime (e.g., increases in the number of low- or no-flow days), with subsequent impacts on aquatic and riparian biota, especially if refugial pools (AGE 2022, p. 59) are lost. However, as discussed in Paragraph 7, these baseflow losses are not adequately simulated by the current model. Furthermore, the proponent should quantify the ecological effects of these impacts.
 - b. There are areas where the Ulan Seam sub-crops to the Talbragar River Alluvium (AGE 2022, p. 73). These areas should be identified, mapped and potential impacts discussed further given that it is predicted that drawdown in the Ulan Seam will extend under large areas of the Talbragar Alluvium (see AGE 2022, Figure 7.5, p. 81).
 - c. Limited discussion has been provided on the effects of the predicted long-term groundwater mounding (post-mining) on surface water. The ecological impacts of reducing baseflow during operations, followed by increasing baseflow post-mining require further assessment.
12. As stated in Paragraph 6a, an integrated approach to surface water and groundwater assessments is required.
13. The proponent has provided limited groundwater quality monitoring data (pH, EC, major ions) for this assessment. The IESC notes that additional monitoring (e.g., metals) has occurred in line with the proponent's Groundwater Monitoring Plan and suggests that the proponent provide these data. This will enable pre-project conditions to be established and facilitate understanding of any potential changes to groundwater quality that may occur associated with subsidence and predicted post-mining mounding.

Question 2: Surface Water

To what extent can decision makers have confidence in the predictions of potential impacts on surface water resources, having regard to the proximity of the project to local watercourses including Mona Creek and the Talbragar River.

- a) Have appropriate models been selected and used by the Applicant? Are the assumptions used in the models reasonable?
- b) Has the model been calibrated with sufficient monitoring data to provide meaningful predictions, including worst-case impacts on surface water resources?
- c) Has an appropriate sensitivity and uncertainty analysis been undertaken, including consideration of the potential effects of climate change?

14. Although the water resource model selected by the proponent is appropriate and sufficient data have been used in its calibration, the modelling of predicted impacts on the flow regime (i.e., on overall runoff volumes, low flows and cease-to-flow characteristics) depends on the adequacy of the estimated impacts on subsidence and baseflows. Given the IESC's concerns about the assessment of subsidence and groundwater interaction (Paragraph 6), it is not possible to have confidence in the conclusions drawn about the likely impacts on surface water resources.

15. Little consideration has been given to exploring the sensitivity (or uncertainty) of the surface water modelling on the key assumptions related to the impacts of subsidence or changed baseflow exchanges with the surrounding groundwater system. The water resource model has not been used to assess worst-case impacts on surface water resources. The investigation into impacts of climate change on surface water resources only considers changes to baseflow as predicted by the groundwater model and does not consider changes in rainfall or evaporation amounts on catchment runoff. Potential effects of climate change on the site water balance also do not appear to have been considered.
16. Appropriate models have been selected for estimating flood impacts and these have been adequately verified and parameterised. The flood models have been used to estimate worst-case events and include an assessment of the impacts of climate change using approaches that are consistent with current national guidelines (Ball et al., 2019).

Question 3: Cumulative impacts

Does the Modification Report provide an adequate assessment of cumulative impacts to surface and groundwater resources during the mining operations and during the post-mining recovery phase. Do these assessments adequately consider surface and groundwater interactions?

17. The proponent has, in the context of the groundwater impact assessment, provided some conceptual and impact pathway information (AGE 2022, pp. 59-71). However, this analysis could be expanded through the inclusion of suitably geo-referenced ecohydrological conceptual models and associated impact pathway diagrams. These would provide a useful overview of potential impacts, including cumulative ones, that may potentially occur due to this project, and clearly link groundwater, surface water and subsidence impacts to potential ecological responses (e.g., adverse effects on GDEs, persistent pools, aquatic biota, riparian vegetation). These conceptual models would also help to identify and justify where further monitoring and mitigation measures are required.

Groundwater

18. The groundwater model has included approved mining at Ulan Coal Mine Complex and the adjacent mines of Moolarben and Wilpinjong. However, the assessment of cumulative impacts is limited and does not adequately consider surface and groundwater interactions.
 - a. The impacts on water-dependent ecological assets from the combination of drawdown and subsidence are not considered. There is also no adequate assessment of the cumulative impacts of an initial reduction in water levels followed by long-term and potentially considerable increases (mounding) in water levels, especially on vegetation that may experience waterlogging and substantially altered redox conditions in the root zone.
 - b. Potential cumulative impacts to surface water and groundwater interactions, and changes to these, are not assessed, particularly in the context of effects on ecologically important components of flow regimes or changes to directions and/or magnitudes of surface water-groundwater exchanges in the hyporheic zone of Mona Creek when it is flowing or a string of pools. The hyporheic zones of ephemeral streams have been shown to be active zones for carbon processing (Burrows et al., 2017) and may also support diverse invertebrate and microbial communities that contribute to ecosystem resilience (Bruno et al., 2020).
 - c. The cumulative drawdown predictions for the Ulan Seam extend beyond the boundaries of the groundwater model (AGE 2022, Figure 7.9, p. 86), which reduces confidence in these predictions as they are likely to be influenced by the boundary conditions.

Surface water

19. Modelled impacts to flood depths and velocities do not extend beyond the area predicted to be impacted by subsidence (Engeny 2022, p. 29), and thus it is reasonable to assume that the cumulative impacts on downstream reaches are negligible.
20. The proponent does not intend to extract water from nor release water to Mona Creek, and intends to undertake erosion and sediment control measures in line with the existing Water Management Plan (Engeny 2022, p. 46). However, there is uncertainty around the potential local impacts on baseflow from groundwater drawdown, subsidence and post-mining mounding. The IESC suggests that the proponent reassess cumulative impacts once adequate assessment of potential local impacts is conducted as suggested within this advice.

Question 4: Avoidance, Mitigation and Monitoring

Does the Modification Report provide reasonable strategies to effectively avoid, mitigate or minimise the likelihood, extent and significance of impacts, including cumulative impacts, to significant water-related resources?

21. The project did not provide details of avoidance or mitigation strategies in relation to groundwater impacts. The project should aim to return groundwater levels to pre-mining conditions by changing the design of the final landform as discussed in AGE (2022, EPBC assessment requirements report, p. 9). For example, the possibility of groundwater mounding could be mitigated by design of spoil to control recharge rates. Management plans and a trigger action response plan (TARP) are currently in operation for approved mining and will likely be extended to include this project. Potential improvements to these plans are discussed in the response to Question 5.
22. The Modification Report does not provide strategies to effectively avoid, mitigate or minimise potential impacts of 1.7 to 2.1 m (SCT 2022, p. 4) of subsidence.
23. The project poses potential impacts to Mona Creek and associated riparian vegetation (for example, increased ponding, groundwater drawdown and subsidence-related disturbance of caves, overhangs or crevices which are habitat to EPBC Act-listed species of bat). The IESC recommends that the proponent investigate altered mine design options or rehabilitation strategies to avoid or mitigate potential long-term impacts to Mona Creek, EPBC Act-listed species and the CEEC.

Question 5: Avoidance, Mitigation and Monitoring

Are there any additional mitigation, monitoring, management or offsetting measures that should be considered by decision makers to address the residual impacts of the Project on water resources?

24. Monitoring and mitigation actions for groundwater impacts at existing approved operations in the Ulan Coal Complex include the use of a TARP, which is detailed within the Surface Water and Groundwater Response Plan. The IESC notes that the current plan will require review and updating to incorporate the proposed project. This should include:
 - a. an analysis of the current groundwater conditions (level/pressure and quality) to enable the derivation of robust site-specific guideline values (or triggers) for use in the updated TARP; and
 - b. groundwater quality sampling is currently undertaken annually. At bores where site-specific guideline values are used, the frequency of sampling will need to be increased to ensure the associated TARP functions in a timely manner.
25. The proponent states that 'there is predicted to be some drawdown in parts of the Talbragar alluvium, however, the drawdown is not expected to fully desaturate the alluvium therefore no significant

impacts are expected on stygofauna' (AGE 2022, p. 100). The proponent has not provided any data to support this claim, despite being required to provide a stygofauna assessment in the alluvium and colluvium of Mona Creek and the Talbragar River as part of the Department of Climate Change, Energy, the Environment and Water's assessment requirements (Umwelt 2022a, p. 124). If a baseline survey indicates the presence of stygofauna, then the proponent should continue monitoring during operations, particularly targeting the Talbragar River alluvium. The program should include monitoring for changes in groundwater level and species diversity and abundance of stygofauna.

26. The proponent has not adequately characterised the remnant riparian vegetation along Mona Creek or its likely dependence on groundwater. Due to the predicted groundwater drawdown and post-mining groundwater mounding impacts along Mona Creek, the IESC suggests that the proponent conducts field surveys, including ground-truthing for riparian vegetation and potential GDEs (including Blakely's Red Gum which is a component of the EPBC Act-listed CEEC) along Mona Creek. Information from this survey can then be used to inform the development of a monitoring plan to identify any changes to vegetation composition or condition due to impacts from the project.
27. The proponent does not discuss any potential impacts of releases which may occur to the Talbragar River (Engeny 2022, p. 12). It is possible, but not clear from the documentation provided, that the release point on the Talbragar River has been previously approved and conditioned. If the proponent plans to make controlled releases to the Talbragar River, additional parameters including metals, metalloids and dissolved organic carbon should be monitored in Mona Creek and the Talbragar River.
28. Establishment of a biomonitoring program, incorporating algae and macroinvertebrates, will provide essential information on changes in the ecological condition of Mona Creek and the Talbragar River resulting from the project.
29. The proponent has not provided a subsidence monitoring plan with this assessment. The proponent mentioned that there is current monitoring, and a proposed expansion of the subsidence monitoring lines (SCT 2022, p. 6). However, a map and information about the location of the current and proposed monitoring lines were not provided in the documentation. The IESC suggests that the proponent provide an updated subsidence monitoring plan, including maps and information about the locations of subsidence monitoring lines, for further review.
30. Maps clearly showing the hydrostratigraphic target of monitoring bores should be provided to ensure all monitoring bores and cumulative impact monitoring are accurately represented and consistent across relevant figures (see AGE 2022, Figure 5.5, p. 38).

Question 6: Significance of impacts

Subject to confidence in the predictions of potential impacts, will impacts to the key surface and groundwater features be significant?

31. The IESC considers that the significance of the impacts to water resources, including surface waters, groundwaters, and water-dependent ecosystems, species and habitats, cannot be determined without the further information outlined in this advice being provided to the regulators.

Date of advice	15 March 2023
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Source documentation provided to the IESC for the	Umwelt, 2022a (and associated appendices). <i>Ulan Coal Mine Modification 6 Underground Mining Expansion Modification Report</i> . Umwelt (Australia) Pty Limited. November 2022.

**formulation of
this advice**

**References
cited within the
IESC's advice**

- AGE 2022. *Ulan Coal Mine Modification 6 Underground Mining Expansion Modification Report Appendix 8 – Ulan Coal Mines Modification 6 (Mod6) Groundwater Impact Assessment*. Australasian Groundwater and Environmental Consultants Pty Ltd prepared for Umwelt (Australia) Pty Limited. November 2022.
- Ball J, Weinmann E, Kuczera G 2019. *Book 3 of Australian Rainfall and Runoff Peak Flow Estimation. Australian Rainfall and Runoff A Guide to Flood Estimation*. Available [online]: [ARR: A guide to flood estimation \(au.s3-website-ap-southeast-2.amazonaws.com\)](http://ARR: A guide to flood estimation (au.s3-website-ap-southeast-2.amazonaws.com)) Accessed 9 March 2023
- Bruno MC, Doretto A, Boano F, Ridolfi L, Fenoglio S. 2020. Role of the hyporheic zone in increasing the resilience of mountain streams facing intermittency. *Water* 12, 2034.
- Bureau of Meteorology (BoM) 2022. Groundwater Dependent Ecosystem Atlas. Available [Online]: [GDE Atlas Map: Water Information: Bureau of Meteorology \(bom.gov.au\)](http://GDE Atlas Map: Water Information: Bureau of Meteorology (bom.gov.au)). Accessed 9 March 2023
- Burrows R, Rutledge H, Bond N, Eberhard SM, Auhl A, Andersen MS, Valdez DG, Kennard M 2017. High rates of organic carbon processing in the hyporheic zone of intermittent streams. *Scientific Reports* 7, 13198.
- Doody TM, Hancock PJ and Pritchard JL 2019. *Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems*. Prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development, Australian Government.
- Engeny, 2022. *Ulan Coal Mine Modification 6 Underground Mining Expansion Modification Report Appendix 9 – Ulan Coal Mines Pty Ltd Surface Water Impact Assessment*. Engeny Water Management prepared for Umwelt (Australia) Pty Limited. October 2022.
- IESC, 2018. *Information Guidelines for proponents preparing coal seam gas and large coal mining development proposals* [Online]. Available: <http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-may-2018.pdf> Accessed 9 March 2023.
- Office of Water Science 2020. *Environmental water tracers in environmental impact assessments for coal seam gas and large coal mining developments – factsheet*. Prepared by the Office of Water Science for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development, Canberra. Available [online]: Fact Sheet - Environmental water tracers in environmental impact assessments for coal seam gas and large coal mining developments | iesc. Accessed 9 March 2023
- SCT, 2022. *Ulan Coal Mine Modification 6 Underground Mining Expansion Modification Report Appendix 7 – Subsidence Assessment for Proposed Modification 6*. SCT Operations Pty Limited prepared for Umwelt (Australia) Pty Limited. November 2022.
- Umwelt, 2022a. *Ulan Coal Mine Modification 6 Underground Mining Expansion Modification Report*. Umwelt (Australia) Pty Limited. November 2022.
- Umwelt, 2022b. *Ulan Coal Mine Modification 6 Underground Mining Expansion Modification Report Appendix 11 – Ulan Coal Mines Complex Modification 6*
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Biodiversity Development Assessment Report. Umwelt (Australia) Pty Limited.
November 2022.
