

Advice to decision maker on coal mining project

IESC 2019-108: Russell Vale Colliery Underground Expansion Project (MP 09_0013) – Expansion

Requesting agency	The New South Wales Department of Planning, Industry and Environment
Date of request	26 September 2019
Date request accepted	27 September 2019
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 New South Wales Department of Planning, Industry and Environment to provide advice on the Russell Vale Colliery Underground Expansion Project in New South Wales, proposed by Wollongong Coal Ltd. This document provides the IESC's advice in response to the requesting agency's questions. These questions are directed at matters specific to the project to be considered during the requesting agency's 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 proposed Russell Vale Colliery Underground Expansion Project (the project) is an extension to the existing Russell Vale Colliery, and is located approximately 8 kilometres north of Wollongong, New South Wales. The current proposal is for bord-and-pillar extraction east of Cataract Reservoir, involving only first workings in the Wongawilli Seam and extracting up to 3.7 million tonnes of run-of-mine coal over a five-year period.

Bord-and-pillar (first workings only) extraction will greatly reduce the risk of subsidence compared with other subsurface mining approaches (e.g. longwall mining), and its use is strongly commended by the IESC.

The project is located within the Cataract Reservoir catchment. Cataract Reservoir is a source of drinking water for Sydney and lies within the Metropolitan Special Area, a restricted-access area designated to protect Sydney's drinking-water catchments. The project is on the Woronora Plateau which supports groundwater-dependent ecosystems (GDEs) such as Coastal Upland Swamps in the Sydney Basin Bioregion. These swamps are listed as Endangered Ecological Communities (EECs) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *New South Wales Threatened Species Conservation Act 1995* (TSC Act).

The proponent states that there is a “negligible risk” of pillar failure (Umwelt, 2019, p. 9), but they have not quantitatively assessed the residual risks. If the likelihood of pillar failure is “extremely rare” (less than 0.01% per year; Australia Institute for Disaster Resilience, 2015) and does not result in the catastrophic loss of a single swamp, then the IESC would not regard this proposal as being of material concern. However, if multiple assets are threatened or the likelihood increases, then the risks are of greater material concern.

This legacy mining environment requires a quantitative assessment of the risks of pillar failure that is independently reviewed by a recognised expert in multi-seam geomechanical stability. The assessment should include an empirical analysis of mining failures in the area since the 1880s and should recognise the risks posed by mining a third seam under the already mined Bulli and Balgownie seams. The assessment should also quantify the potential magnitude and extent of impacts to water resources should these pillars be destabilised by the project. Without such an assessment, a “negligible risk” cannot be fully ascribed.

Accordingly, for the purposes of this advice, the IESC have considered two scenarios:

1. a “negligible risk” scenario (as assumed in the Revised Preferred Project Report (RPPR)) in which it is expected that the likelihood of pillar failure is less than 0.01% per year; and,
2. a “worse case” scenario in which the likelihood of pillar failure is materially greater than 0.01% per year.

The decision as to which scenario is appropriate depends on the outcomes of the quantitative risk assessment, noted above, which is recommended to be undertaken and provided by the proponent. The responses below address both scenarios.

Key potential impacts

Under the “negligible risk” scenario:

- long-term impacts to groundwater levels and ground and surface water quality post-mining predominately due to discharge from adits that may occur in perpetuity.

Under the “worse case” scenario, in addition to the above impact:

- ground movement with fracturing near the surface resulting in:
 - irreversible changes to EPBC Act-listed swamps;
 - loss of surface waters from streams or storages within the Metropolitan Special Area; and,
 - degradation of in-stream and riparian environments.

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.

Under the “negligible risk” scenario:

- the IESC strongly recommends that an independent peer review be completed to ensure that pillar designs are conservative according to leading practices of mine design and that the implications for surface and hydrological systems are adequately considered. This independent review should be based on the most comprehensive local and international databases of pillar failure that are currently available.
- analysis of the uncertainty of the influence of the adits on long-term groundwater levels, flow and quality should be provided. This is needed to understand if local groundwater flow paths will differ post-mining, whether some aquifers will remain dry due to discharge from the adits, and whether there may be reduced water quality due to adit discharge that might have impacts on receiving environments.
- updated ecological surveys of swamps (including appropriate unimpacted reference swamps) are needed to understand their current biodiversity and condition. These updated data will serve as a baseline against which to confirm no impacts as a result of the “negligible risk” scenario.
- water level and quality monitoring at groundwater and surface water sites during and after mining will be needed for comparison with pre-project conditions to determine whether additional impacts have occurred.

Under the “worse case” scenario, in addition to the above work:

- an ecohydrological conceptual model of the swamps is required which has been verified through field investigations and monitoring data. This model should identify all potential impact pathways, and is needed to guide a comprehensive risk assessment to determine appropriate monitoring and management measures for any swamps or streams identified to be at risk from pillar destabilisation.
- quantification of the potential changes to groundwater and surface water resources, and groundwater-dependent ecosystems (GDEs) under this scenario. Feasible mitigation and management measures should be proposed to remediate the impacts of these changes.

Context

Mining has occurred at the project site since the 1880s using various underground mining methods. The original underground proposal in 2009 sought a major expansion in the Wonga West area (a total of seven longwall panels) and the Wonga East area (a total of 11 longwall panels). At the existing mine, multi-seam extraction had led to subsidence and cracking, with the full extent of environmental consequences unclear. As the implications of these uncertainties for catchment water quality and quantity were a major issue, the original proposal was reviewed in 2014 by the Planning Assessment Commission (PAC). They concluded that there was insufficient information available to make a planning decision. The project was then amended, proposing extraction from eight longwalls east of Cataract Reservoir. This proposal was reviewed by the PAC in 2016, which concluded that social and economic benefits of the project were likely outweighed by potential environmental impacts. The project was then significantly revised to the current proposal for bord-and-pillar mining east of Cataract Reservoir, involving only first workings in the Wongawilli Seam.

The project will require the construction of a coal processing plant; however, no coal washing will occur at the site. Existing water management infrastructure will be used with some minor changes to the water management system. Discharges of treated mine-affected water will continue to Bellambi Gully Creek and will be managed under the existing environment protection licence EPL 12040.

The IESC previously provided advice to the Australian Government Department of the Environment and the New South Wales Department of Planning and Environment on the project on 11 September 2014. Further advice was provided to the New South Wales PAC on 11 March 2015. Advice was also provided to the Australian Government Department of the Environment on the Russell Vale Longwall 6 Project (23 September 2014), which was approved by the NSW PAC and the Department of the Environment.

In response to the current request, the advice below considers the proponent's RPPR and Response to the Second PAC Review. The predictions of impacts provided in the RPPR are based on no subsidence occurring ("negligible risk" scenario). As noted above, there is some risk of pillar destabilisation in the historical workings as a result of the project ("worse case" scenario), although the spatial extent of impacts is likely to be highly localised.

Response to questions

The IESC's advice in response to the requesting agency's specific questions is provided below and is divided into two sections. For each question, the first section deals with the "negligible risk" scenario; the second section is for the "worse case" scenario. Responses to the "negligible risk" scenario always apply to the second scenario.

Water Losses

Question 1: The RPPR provides predictions of cumulative water losses from current and proposed mining at Russell Vale. Does the IESC consider that the decision makers can have confidence in these predictions, particularly given the:

- a) multi-seam mining environment; and
- b) presence of the Corrimal Fault and Dyke 8 in the mine area?

"Negligible risk" scenario

1. The IESC considers that confidence in the predictions of cumulative water losses from proposed mining could be increased to better understand potential impacts. This should include an analysis of the uncertainty of the current model simulations for both groundwater and water balance models.
2. The proponent should clearly identify and distinguish the individual contributions from the project to cumulative losses. Differentiation of the sources of cumulative losses are needed to understand the potential impacts from the proposed project and to confirm the proponent's assertions of negligible impacts to water resources.
3. As the Corrimal Fault and Dyke D8 are stated to be dry (Umwelt 2019, p. 70), they are unlikely to have an effect on the cumulative water losses. The IESC is confident that these two geological features are unlikely to contribute to increased cumulative water losses.

"Worse case" scenario

4. Potential cumulative water losses are likely to be exacerbated in this scenario (see Paragraph 12).
5. If there is an increase in water losses due to the "worse case" scenario, this will slightly impact surface water flows and water balances, especially in the long term given projected climatic changes. Potential impacts to water resources and cumulative water losses, should streams flowing into Cataract Reservoir be affected, are discussed further in response to Question 3.

Upland Swamps

Question 2: Have the impacts of the Revised Project on upland Swamps been adequately described and assessed?

“Negligible risk” scenario

6. The likely additional impacts of the revised project on upland swamps have been adequately described and appropriately assessed as negligible under this scenario.

“Worse case” scenario

7. If pillar destabilisation were to happen directly beneath an EPBC Act-listed swamp and fracturing occurred near the surface, the consequences for that swamp are likely to be severe and irreversible. The proponent should consider the potential impacts of such an event on upland swamps, particularly those located east of Mt Ousley Road where mining is proposed below two already-mined seams. This consideration should include an ecohydrological conceptual model (e.g. CoA 2015a) that identifies all potential impacts and causal pathways. Identification of these pathways and their potential effects could then be used to guide a comprehensive risk assessment to inform the selection of management and mitigation strategies, mindful that complete remediation of swamps, whose bases have been damaged, may not be possible (CoA 2014, CoA 2015b). The ecohydrological conceptual model should also identify relevant ecological variation among swamps (see Paragraph 18b) and how this variation would influence inferences drawn from reference swamps in a targeted monitoring program.
8. The proponent states that the upland swamps in the project area differ significantly from other upland swamps on Woronora Plateau in that they are predominantly drier, generally smaller with shallower soils, have less humic material, have more interspersed sandstone outcrops within their outlines and are less spatially continuous than a “typical” humic, saturated swamp (Umwelt 2019, p. 87). It is not clear whether some of these differences may reflect changes resulting from previous mining, and if so, whether these changes may limit the ecological resilience of these swamps to a “worse case” scenario. Further assessment of the possible causes of these differences and their implications for ecological resilience would be desirable.

Additional information

Question 3: Are there any significant impacts or risks to water resources that have not been adequately identified and / or assessed, particularly in regard to Sydney’s drinking water supply?

“Negligible risk” scenario

9. The proponent has not adequately assessed the potential long-term influence of the adits on water resources. The adits may impact groundwater levels and flow paths, and discharge from the adits could impact surface water quality. The potential influence of the adits should be investigated further, including through an uncertainty analysis using the groundwater model.
10. The estimate of catchment runoff undertaken for the water balance modelling is only 0.2% of mean annual rainfall and appears unreasonably low (this may be because the Farm Dams calculator used in the analysis provides estimates of “permitted harvestable runoff” not mean annual runoff). Further clarification is required regarding the assumptions relating to the water balance estimates as these have implications for dilution requirements, catchment yields in Bellambi Gully Creek and the sizing of water management infrastructure.
11. If it is assumed that pillar destabilisation does not occur, then the flood risks are negligible.

“Worse case” scenario

12. The potential for reduced inflows to Sydney’s drinking-water reservoir should localised subsidence-related impacts occur has not been fully assessed. Further information to identify and assess potential impacts and risks to water resources in the “worse case” scenario is needed and should include:
- a. the potential reduction in baseflows to streams from drawdown and surface cracking;
 - b. predicted losses of water from Cataract Reservoir due to depressurisation;
 - c. predicted changes to surface water flows both into and out of swamps;
 - d. an assessment of potential changes to in-stream and riparian biodiversity and ecological processes arising from changes to flows and water regimes, including changes to the number of low- and zero-flow days under different rainfall scenarios; and,
 - e. discussion of the potential for impacts of inflows to the reservoir to water quality
13. There have already been changes to flow regimes due to historical mining activities. Whilst the proponent sees the estimated ‘take’ of the project as low, consideration is needed of the cumulative impact and the potential for drying of upland areas. Drying could lead to changes in vegetation cover that may be irreversible. Altered vegetation and drying may increase the risk of wildfires which could threaten the integrity of upland swamp EECs and potentially impact water quality of inflows to the reservoir.

Monitoring

Question 4: Are there any additional mitigation, monitoring or management measures that should be considered by decision makers to address residual impact of the project on water resources in conditions of consent?

14. The IESC strongly recommends that the pillar design is independently peer-reviewed by experts who are suitably qualified in multi-seam geomechanics stability, to ensure that it meets current leading practice in mine design, and that all implications for water resources are adequately considered. The review should be based on the most comprehensive local and international databases of pillar failure available at the time of the review.

“Negligible risk” scenario

15. Further monitoring is essential for the proponent to demonstrate that the effects of the proposed project are negligible as stated in the RPPR.
16. The IESC suggests the following subsidence monitoring.
- a. A plan should be developed for each section of bord-and-pillar extraction, especially sections located east of Mount Ousley Road. Each extraction plan should review all subsidence monitoring data from previous sections to confirm that no ground movements have occurred from the project before the next section is commenced. The review should also assess pillar stability nearby, including in overlying historic workings.
 - b. To achieve the above, the proponent should consider using various recently developed subsidence monitoring measures (e.g. InSAR (Interferometric Synthetic Aperture Radar) or LIDAR (Light Detection and Ranging)) in addition to conventional subsidence monitoring lines. InSAR and LIDAR give greater spatial coverage and should identify localised areas of subsidence above destabilised pillars that are not on a conventional monitoring line.

17. Groundwater and surface water monitoring should focus on multi-seam extraction areas and include the following.
- a. To identify potential changes in connectivity between aquifers and/or surface waters, the pumping rates of mine inflows should be regularly measured and compared to predicted inflow rates.
 - b. The current spatial- and depth-distribution of bores is insufficient. Additional groundwater monitoring bores (including vibrating wire piezometers) should be installed to monitor the propagation of drawdown and to validate groundwater model predictions. These additional bores (including multi-level nested piezometers near swamps) should include targeting areas coincident with surface-water features and swamps. Additional bores are also required in strata below the Scarborough Sandstone, including the coal measures. Testing of hydraulic properties (e.g. hydraulic conductivity and specific storage) should be undertaken at any newly installed bore.
 - c. The proponent acknowledges that there is potential for pillar instability in marginally stable areas to result in additional subsidence of 1 to 2 m (Umwelt 2019, Appendix 1, p. 27). Additional comprehensive groundwater investigations focused on these areas, using multi-level piezometers and other suitable techniques, are required to understand potential risks and impacts.
 - d. The proponent should develop a program for regular review of groundwater and surface water monitoring data which includes updating of relevant models.
 - e. Monitoring of water level and water quality of both surface water and groundwater is required to establish a baseline and to track changes over time including post-mining.
18. The following monitoring measures are suggested to assess whether any impacts to swamps have occurred or are possible due to the project.
- a. Nested monitoring bores and environmental water tracers should be used to identify whether a hydraulic connection exists between the perched aquifers upon which the swamps rely and the Upper Hawkesbury Sandstone aquifers (as suggested in Umwelt 2019, Appendix 2, pp. 115-116).
 - b. Updated surveys of current biodiversity, species distribution and swamp condition are essential due to observed spatial variability and the presence of at least three threatened species (Prickly Bush-pea – *Pultenaea aristata*; Giant Burrowing Frog - *Heleioporus australiacus*; Giant Dragonfly – *Petalura gigantea*) (Umwelt 2019, pp. 87-88). Individual swamps are likely to differ from each other in biodiversity and ecological condition so it is important that each swamp is surveyed separately and that seasonal variation in community composition is recorded to measure natural variation within and among swamps. The IESC recommends swamp-specific ecological monitoring should continue during the life of the mine and for a suitable period afterwards until the risk of any further ground movements can be demonstrated to be negligible.
 - c. Swamp-specific water balances should be calculated based on monitoring data, including for reference swamps. These are needed to differentiate changes caused by mining from those associated with natural and climatic variability and will be required to demonstrate negligible impact from the project.
19. Further consideration should be given to potential downstream impacts in the Bellambi Gully Creek, especially if there is the potential to affect important estuarine processes. This potential remains

unclear as the proponent has not included the downstream Bellambi Gully Creek area in the biodiversity assessment provided in the RPPR.

20. Currently, the EPL 12040 (NSW EPA 2019) specifies discharge limits for pH, electrical conductivity (EC), total suspended solids (TSS) and turbidity in Bellambi Gully Creek. The proponent should undertake the following to address potential risks associated with discharge of treated water into Bellambi Gully Creek:
 - a. monitoring of analytes in addition to pH, EC, TSS and turbidity, such as a broad suite of metals and other contaminants and compare these results with the ANZG Guidelines (2018) for 95% species protection for aquatic ecosystems;
 - b. collating data on the total flow volumes and frequencies of high, median and low flows. Changes to the flow regimes may have direct effects on native biota (e.g. potential breeding and nursery habitats of native fish) and the water quality of the receiving environments; and,
 - c. development of site-specific in-stream water quality objectives for physico-chemical parameters which have considered the ANZG Guidelines (2018) for aquatic ecosystem protection as detailed in Huynh and Hobbs (2019).
21. A quantitative site-specific water balance is needed for Bellambi Gully Creek that accounts for the various sources of uncertainty (e.g. using the Water Accounting Framework for the Australian Minerals Industry, Minerals Council of Australia 2014) and includes:
 - a. the total water supply and demand under a range of rainfall, climatic and water demand scenarios to support the uncertainty analysis;
 - b. the required water infrastructure, including infrastructure capacity and transfers;
 - c. the volumes of water requiring discharge under a range of rainfall scenarios; and,
 - d. the potential water quality impacts caused by one or more of the above water management actions.
22. The IESC suggests that the proponent prepare an updated Rehabilitation Management Plan that considers:
 - a. the geochemistry of any rejects which may be deposited within mine workings and the potential for interactions with groundwater;
 - b. the potential long-term impacts of adit outflows by providing further information on expected changes in outflow quantity and quality, including if this groundwater may interact with rejects deposited within the mine workings. This is needed to guide treatment options; and,
 - c. the potential legacy impacts and costs of long-term (greater than ten years) monitoring and sampling of swamps and surface water.

“Worse case” scenario

23. If the “worse case” scenario occurs, the use of trigger action response plans (TARPs) is unlikely to be successful because these would be unable to provide an early warning of potential subsidence-related movements which are expected to occur rapidly. It is also critical to note CoA (2014 and 2015b) regarding the lack of examples of successful swamp remediation.

Date of advice 19 November 2019

Source documentation provided to the IESC for the formulation of this advice

Umwelt 2019. *Russell Vale Revised Underground Expansion Project. Revised preferred project report and response to second PAC review*. Final. Prepared for: Wollongong Coal Limited. Report No. 3687/R05 July 2019. Available [online]: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=3448 accessed October 2019.

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