

Advice to decision maker on gold mining project

IESC 2023-143: Cadia Valley Operations Gateway Application – Expansion

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| Requesting agency | The New South Wales Mining and Petroleum Gateway Panel |
| Date of request | 14 June 2023 |
| Date request accepted | 19 June 2023 |
| Advice stage | Gateway Application |

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. Additionally, at the request of a relevant New South Wales, Queensland, South Australian or Victorian Minister and with the written agreement of the Australian Government Environment Minister, the IESC can provide advice on any other matter within the expertise of the IESC. The advice is designed to ensure that decisions by regulators on coal seam gas or large coal mining developments or any other matter within the expertise of the IESC are informed by the best available science.

The IESC was requested by the New South Wales Mining and Petroleum Gateway Panel through the New South Wales Minister for Planning and Public Spaces to provide advice on the Newcrest Mining Limited Cadia Valley Operations Gateway Application in New South Wales. The request has been approved in writing by the Australian Government Environment Minister. 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 consideration of the IESC Information Guidelines (IESC, 2018).

Summary

Cadia Valley Operations Gateway Application Expansion Project (the project) is a proposed expansion of the existing Cadia Valley Operations (CVO) located in central New South Wales. The project is currently being reviewed by the New South Wales Mining and Petroleum Gateway Panel as it requires a Gateway Certificate due to permanent impacts to Biophysical and Strategic Agricultural Land (BSAL). The Mining and Petroleum Gateway Panel has requested IESC advice as required under the *State Environmental Planning Policy (Resources and Energy) 2021* (SEPP). The Gateway Application encompasses work

proposed to address damage that occurred to the Northern Tailings Storage Facility (NTSF) and Southern Tailings Storage Facility (STSF) in 2018. As presented for the Gateway Application, the project only includes enlarging the footprint of the STSF embankment, as recommended following technical and engineering reviews at CVO (Newcrest Mining Limited 2023, p. 6).

The project will temporarily impact 28.2 ha of land to enable construction of the modified embankment of the STSF and will permanently impact up to 2 ha (Minesoils 2023b, pp. 1-2), of which 0.8 ha is verified BSAL (Newcrest Mining Limited 2023, p. 6). Environmental impacts arising from the work on the embankment alone are likely to be limited, although the provided documentation lacks specific details because the Gateway Certificate assessment occurs prior to project referral and assessment under the New South Wales *Environmental Planning and Assessment Act 1979* (EP&A Act). It is unclear whether any clearing of native vegetation is required. The IESC notes that the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community, listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), may occur in the project area.

No changes are proposed to the mining method, processing rate, mine life, the footprints of the Cadia East and Ridgeway Mines, the maximum approved heights of the tailings storage facilities, or of waste rock management at CVO (Newcrest Mining Limited 2023, p. 5). The proponent is not proposing any additional take of groundwater, with minimal, if any change to water access licensing expected (Minesoils 2023b, p. 29). The documentation provided for the Gateway Application suggests that the project will be part of a larger and more complex modification application (Modification 15) when referred and assessed under the EP&A Act (Newcrest Mining Limited 2023, pp. 3-5). Little information was included in the documentation provided on the details of the changes proposed under Modification 15.

This advice applies only to the works to enlarge the STSF embankment footprint and not the full range of changes to potentially be proposed in Modification 15. The IESC understands that the potential impacts from this project and any other changes proposed under Modification 15 will require further investigation with additional impact assessment documentation to be prepared and submitted for assessment under the New South Wales EP&A Act.

Key potential impacts from this project are:

- embankment failure which could have severe and irreversible impacts for downstream surface waters, groundwaters and groundwater-dependent ecosystems (GDEs);
- changes to tailings storage facilities (TSFs) seepage which could alter the quality, rate and/or direction of leakage impacting on nearby GDEs, surface water systems and local groundwater; and
- increases in groundwater levels in the areas adjacent to the embankment works from compaction and loading that could result in waterlogging of nearby GDEs, increased discharge to surface water systems and potentially extend leakage flowpaths.

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

- More information on the proposed embankment works is needed. Details of the design, construction and predicted performance of the modified embankment, including how the existing and new works will be keyed into the bedrock base and valley sides, operation of the TSFs, and tailings volumes to be stored, are essential to understanding the risks posed by the project. The project needs to be designed to minimise the risk of failure and subsequent impacts on downstream water resources.

- An improved understanding is required of the potential leakage pathways from the TSFs, the quantity and quality of leakage, and the potential receptors that could be impacted by the leakage. Although the proponent intends to design the embankment to limit leakage through it (Minesoils 2023b, p. 31), compaction and loading arising from the modified embankment may change the volume, rate and/or flowpaths of seepage currently occurring beneath the TSFs via Rodds Creek and the Cadiangullong Fault and its associated weathered and damage zone. These leakage pathways require more detailed evaluation (e.g., internal erosion pathways or those associated with faulting) to ensure that the embankment works are designed to minimise leakage.
- The likely extent and magnitude of groundwater level increases from the project and their potential impacts on nearby GDEs and surface waters have not been quantified. Historical increases in groundwater levels have been observed but only limited explanation is provided. The source of these increases needs to be comprehensively examined with consideration of tailings deposition (e.g., timing, volumes) to understand how the TSFs are affecting groundwater levels and risks to downstream water resources during and after construction and post-closure.

Context

The Cadia Valley Operations Gateway Application Expansion Project (the project) is located approximately 25 km southwest of Orange in central New South Wales (Newcrest Mining Limited 2023, p. 1). CVO is a gold and copper mine with current operations approved by the state (PA 06_2095 and subsequent modifications) and under the EPBC Act (EPBC 2006/3196 and subsequent variations). The existing approvals cover current operations at the Cadia East Underground, Cadia Hill Open Pit and Ridgeway Underground mine sites (Newcrest Mining Limited 2023, p. 1). Mining has occurred at the site since 1998 (AGE 2021, p. 8). Other land uses in the region include sheep and cattle farming, cropping and plantation forestry (Newcrest Mining Limited 2023, p. 9).

The project is in the Belubula River catchment, a tributary to the Lachlan River (Minesoils 2023a, p. 7), and part of the Murray Darling Basin. Cadiangullong Creek is the major watercourse at the site and is joined by Rodds Creek whose bed sediments occur beneath the NTSF and STSF. Sections of Flyers Creek to the east of CVO are perennial, receiving discharges from groundwater-fed springs (AGE 2021, p. 5). Groundwater discharge is also likely to enter Shallow, Cadiangullong and Rodds creeks (AGE 2021, p. 36). Low-flow discharges from CVO occur to Cadiangullong Creek (AGE 2021, p. 5).

The main groundwater sources at CVO include the Orange Basalt, a highly productive aquifer under the *Aquifer Interference Policy* (AIP), and the Lachlan Fold Belt Murray-Darling Basin Fractured Rock groundwater source (AGE 2023, Figure 2.2, p. 8). The extent of the Orange Basalt aquifer, and the fracture networks which are key for groundwater flow, are not well understood at CVO (AGE 2023, p. 6).

The IESC notes that there are indications of leakage from the TSFs into the shallow groundwater system due to currently approved activities, with potential for discharge to local surface waters and GDEs. The potential for these to be affected by the modification of the embankment needs to be clearly identified and quantified in future impact assessments undertaken in relation to the project, and the larger Modification 15.

Response to questions

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

Question 1: Does the IESC consider that the surface water resources, groundwater resources and dependent ecosystems, and their interactions (including the nature of hydraulic connections within the underlying fractured rock aquifer system) have been adequately described and the impacts assessed?

1. The documentation provides only limited descriptions of the surface water resources, groundwater resources and groundwater-dependent ecosystems (GDEs). Some connectivity between the underlying fractured rock aquifer system and the surface water resources was identified, although the description was primarily qualitative. Impact assessment was not rigorous and does not explicitly consider potential stressors, their interactions and likely impact pathways from the proposed activities to the surface and groundwater water resources and dependent ecosystems.
 - a. None of the GDEs or surface water systems were adequately characterised (see Doody *et al.* 2019), nor were potential project impacts considered in sufficient detail. High-priority GDEs were identified, including the vegetation along the Belubula River, Cadiangullong Creek and Flyers Creek. Potential impacts from the project would most likely occur in areas of GDEs along Cadiangullong Creek from compaction and loading raising groundwater levels. Some Cadiangullong Creek GDEs are within 200 m of the embankment works (AGE 2023, p. 16) and the proponent's impact assessment has asserted that groundwater level increases may occur at distances of up to 200 m (AGE 2023, p. 11). Future impact assessment should characterise the nearby GDEs and surface water resources to assess their likely responses to changes in groundwater levels. The potentially affected GDEs may include groundwater-dependent components of the EPBC Act-listed White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community.
 - b. Potential leakage pathways from the TSFs occur through to the Rodds Creek bed sediments and through fractures in the bedrock underlying the TSFs. It is unclear from the project documentation whether the proposed changes to the STSF embankment will alter groundwater flowpaths, leakage rates and/or leakage volumes. Changes to leakage from the TSFs could alter the likelihood of groundwater discharge and/or the quality of the discharge to nearby GDEs and surface water systems, altering the extent and magnitude of potential impacts. The hydraulic connections within the underlying fractured rock aquifer system and their interactions with surface water resources and GDEs therefore require further analysis. This could include analysis of data from multi-level piezometers to characterise vertical hydraulic gradients, geophysics surveys to identify areas where enhanced leakage pathways could occur, and detailed analysis of relevant groundwater quality parameters (e.g., ion ratios, metals and other toxicants).
2. Impacts to groundwater were assessed qualitatively and the proponent concluded that there would be only limited changes to water levels and quality (Minesoils 2023b, p. 29). Insufficient information to support these conclusions was provided. A more detailed and quantitative assessment is needed in future impact assessments for the proposed project.

Question 2: Regarding groundwater

- a. are the uncertainties relating to the extent and/or distribution and properties of the Orange Basalt highly productive groundwater resource adequately understood?
- b. has the quantity and quality of seepage from the Southern TSF been adequately investigated, including in terms of the likely incremental and cumulative impacts on groundwater and/or surface water systems and dependent ecosystems, and existing users?
- c. noting that the project is characterised as not exceeding the AIP Level 1 Minimal Impact criteria, have impacts been accurately assessed, including the uncertainties influencing the range impacts, such as climate change and hydrogeological uncertainties?
- d. is the level of assessment of impacts on groundwater levels, flow and quality and dependent values adequate to assess the potential impacts on water resources?

3. Improvements are needed in understanding the extent and properties of the Orange Basalt highly productive groundwater resource. The potential leakage pathways from TSFs at CVO should be identified, including how the embankment works may alter leakage. Given that groundwater flow in this aquifer is strongly influenced by the location, extent and connectivity of the fracture network on a relatively local scale (AGE 2023, p. 3), inherent uncertainties will remain.
4. The proponent estimates the current quantity of seepage from the TSFs at approximately 0.6 ML/day and does not expect the project will materially change this value (AGE 2023, p. 11). This value is derived from modelling which was not provided to support this conclusion. Possible incremental or cumulative impacts to groundwater or surface water systems, GDEs or other water users are not reported.
 - a. The water quality of seepage from the TSFs has not been thoroughly investigated, with only limited attempts based on absolute increases in sulfate concentrations (AGE 2023, p. 11). The proponent concluded that the proposed changes to the TSFs would not be expected to result in a “notable change in seepage water quality” (AGE 2023, p. 11). This conclusion has not been supported, nor is it clear whether chronic and/or sublethal effects on groundwater and/or surface water systems and dependent ecosystems are possible.
 - b. Modifying the embankment of the STSF may increase compaction and loading in the vicinity of the works and this could alter the rate and/or direction of leakage. This in turn could change the quality of water being discharged at GDEs and to surface water systems. Further information is needed to demonstrate whether the current management system (pump-back/underdrainage) is sufficient and will continue to be, to manage the impacts of leakage.
5. Assessment of potential impacts against the *Aquifer Interference Policy* Level 1 Minimal Impact criteria has been qualitative with no consideration of climate change or hydrogeological uncertainties. Given that there will be no increased take (Minesoils 2023b, p. 29), it is likely that groundwater drawdown will not exceed these criteria. However, as outlined in paragraphs 1a and 1b, there is uncertainty as to whether compaction and loading could result in groundwater level rises at GDEs along Cadiangullong Creek and altered groundwater discharge to surface water systems. Additionally, it is unclear whether the project may alter leakage from the TSFs and potentially affect shallow groundwater quality. Further evidence and analysis of this are needed in future impact assessments to confirm that *Aquifer Interference Policy* Level 1 Minimal Impact criteria will be met.
6. The level of assessment of impacts to groundwater levels, flow and quality and dependent values provided in the Gateway Application is limited. The IESC acknowledges that this probably reflects the early stage in the impact assessment process at which the Gateway Assessment occurs. Although the potential impacts to water resources from modifying the STSF embankment are likely to be of limited magnitude and spatial extent, the information currently provided is not sufficient to confirm the proponent’s conclusions. As outlined in this advice (Paragraphs 1a, 1b, 2-3, 4b, 5, 7a-7f), additional work will be needed in future impact assessment documentation to fully understand potential risks and impacts, and to confirm that these can be adequately managed.

Question 3: Regarding mitigation, monitoring, management and offsetting measures:

- a. does the assessment propose reasonable strategies and measures to avoid, mitigate or reduce, to a practicable extent, the likelihood and significance of impacts to significant water-related resources?
- b. are there additional strategies, mitigation or offsetting measures that should be considered to address any residual impacts of the project on water resources and related GDEs?

7. Limited information is provided in the Gateway Application on strategies and measures to avoid, mitigate or reduce the likelihood and significance of potential impacts to significant water-related resources. Given this limited information, it is premature for the IESC to suggest additional strategies, mitigation or offsetting measures that should be considered to address residual impacts of the project on water resources and related GDEs. The IESC suggests that the following be detailed further in future impact assessments.
- a. A geotechnical risk assessment. Further information is needed on the design, construction and monitoring of embankment integrity. Given prior performance of the TSFs, known leakage and the existence of faults and associated weathered zones, it is important that the geotechnical risks of the project are carefully detailed, and the embankment is designed to minimise the risks and ensure long-term integrity of the structure to prevent potential impacts on downstream water resources from catastrophic failure.
 - b. The embankment design and construction. The proponent has stated that the core of the modified embankment will be designed to minimise leakage. Further details are needed on this and other key design components to understand the leakage and failure risks, including details on the base and design of the embankment (including accounting for underlying thin and weak geological strata), consideration of the risks of failure of different design options, and how the embankment will be keyed into the bedrock base and valley sides.
 - c. The monitoring network for identifying leakage from the TSFs. Given that leakage is expected to occur at shallow depths, most likely at the base of weathered materials (AGE 2021, p. 64), and through the weathered zone of underlying faults, multiple bores of suitable depth are required. Multi-level piezometers to monitor changes in vertical hydraulic gradient are also needed. The current network may already include suitable monitoring bores, although this should be confirmed. Additionally, an assessment of whether the compaction and loading may alter localised groundwater flowpaths is needed to determine whether additional monitoring bores are required to the south or east of the TSFs. Justification of the sampling frequency and parameter selection (e.g., specific analytes, including metals and other toxicants) is also needed to confirm the adequacy of the monitoring program.
 - d. The proposed management of leakage from the TSFs. Currently, management appears to rely considerably on a pump-back/underdrainage system (AGE 2023, p. 11); however, minimal detail about this system was provided. To assess its adequacy, more details are needed, including its location, capacity, effectiveness and whether it has the capacity to handle increased leakage that may arise from the project. The risk of leakage and failure of the TSFs can be mitigated by controlling the water level within the TSFs during mine operation. Other mitigation options will need to be considered post-closure.
 - e. Proposed measures to limit impacts to Cadiangullong Creek and associated GDEs from sediment during modification of the STSF embankment.
 - f. Updates to existing monitoring and management plans. Future impact assessment documentation needs to clearly detail the updates proposed to current plans and outline suitable Trigger Action Response Plans (TARPs) that will ensure any leakage from the TSFs is identified and managed in a timely manner to minimise impacts to significant water-related resources. These plans should also describe responses and remedial actions in the event of an embankment failure, particularly if tailings or leachates subsequently enter water resources down-gradient.

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| Date of advice | 1 August 2023 |
| Source documentation provided to the IESC for the formulation of this advice | Newcrest Mining Limited 2023. <i>Cadia Valley Operations – Gateway Application Technical Overview</i> . Prepared for Newcrest Mining Ltd. 15 May 2023. (Including Appendices 1-3). Available [online]: Independent Planning Commission - Cadia Valley Operations Gateway Application (nsw.gov.au) accessed 26 July 2023. |
| References cited within the IESC’s advice | <p>Australasian Groundwater and Environmental Consultants (AGE) 2021. <i>Cadia Groundwater Model Update 2021</i>. Prepared for Newcrest Mining April 2021. Project No. G1383Y. Available [online]: G1383Y Report Cover Apr2021.cdr (caapp.com.au) accessed 26 July 2023.</p> <p>Australasian Groundwater and Environmental Consultants (AGE) 2023. <i>Cadia Groundwater Review to Support Gateway Application</i>. Prepared for Newcrest Ltd. March 2023. (Appendix 3 of Gateway Application).</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 2019. Available [online]: Information Guidelines Explanatory Note - Assessing groundwater-dependent ecosystems iesc accessed 26 July 2023.</p> <p>IESC 2018. <i>Information Guidelines for proponents preparing coal seam gas and large coal mining development proposals</i>. Available [online]: Information guidelines for proponents preparing coal seam gas and large coal mining development proposals iesc accessed 26 July 2023.</p> <p>Minesoils 2023a. <i>Cadia Valley Operations Modification 15 Agricultural Resources Assessment</i>. Prepared for Newcrest Mining Ltd. March 2023. (Appendix 1 of Gateway Application).</p> <p>Minesoils 2023b. <i>Cadia Valley Operations Modification 15 Agricultural Impact Assessment</i>. Prepared for Newcrest Ltd. March 2023. (Appendix 2 of Gateway Application).</p> <p>Newcrest Mining Limited 2023. <i>Cadia Valley Operations – Gateway Application Technical Overview</i>. Prepared for Newcrest Mining Ltd. 2023. 15 May 2023.</p> |