

CADIA

HOLDINGS

PTY LIMITED

TRADING AS
CADIA VALLEY OPERATIONS

ABN 95 062 648 006

17 April 2018

Steve O'Donoghue
Team Leader - Resource and Energy Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Dear Steve

RE: Cadia Hill Tailings Modification - Statement of Environmental Effects

On 28 March 2018, Cadia Holdings Pty Ltd (CHPL) lodged the Cadia Valley Operations (CVO) Cadia Hill Tailings Modification (Modification 11 - the Modification). The Modification would involve deposition of some tailings within the completed Cadia Hill open pit and associated minor alterations to infrastructure.

As part of its review of the Modification, the Department of Planning & Environment (DP&E) has obtained comments from regulatory authorities, namely:

- Department of Industry – Water (DI – Water).
- Environment Protection Authority (EPA).
- Division of Resources and Geoscience.
- Office of Environment and Heritage.
- Dams Safety Committee (DSC).
- Department of Planning & Environment (Resources Regulator).

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It is noted that no material issues were raised in the majority of comments received. Of note, the EPA concluded:

The Environment Protection Authority (EPA) has reviewed the SEE and supporting documents and concurs with the conclusions of those assessments that the deposition of tailings within the Cadia Hill open cut pit to 420 m Australian Height Datum (AHD) will have negligible environmental impact. The open pit provides guaranteed containment and has low inherent permeability due to the nature of the host rock.

Notwithstanding, the DSC and DI – Water raised some matters regarding aspects of the proposal and, as requested by DP&E, responses to specific queries raised by these authorities relevant to the modification are provided below.

Dams Safety Committee

The DSC noted the following:

The DSC has no objections for deposition of tailings into the Open Cut Pit, as it is a void below the natural ground level. However, a formal application should be submitted to the DSC for its determination of non-prescription.

Formal application for determination of prescription / non-prescription of the containment bund wall also needs to be submitted to the DSC for its consideration.

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CHPL Response

CHPL confirms that it will make the required application to allow the DSC to confirm that the Cadia Hill open pit is non-prescribed.

Department of Industry – Water – Groundwater Comments

DI – Water provided the following comments on groundwater matters:

Based on the presence of fault shatter zones and associated fractures within the disused Cadia Hill Pit and groundwater inflows, it is understood there is groundwater connectivity with the Cadia Hill Pit. Placing tailings into the pit therefore poses a risk of groundwater contamination. To fulfil the NSW Aquifer Interference Policy requirement “any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity” the baseline groundwater quality (metals and nonmetals) at the bottom of the pit must be established and continually monitored against the water quality (metals and non-metals) of the tailings during and after the pit in-fill.

The Model simulation reports very low hydraulic conductivity of the whole bulk Ordovician rock which is acknowledged for the purpose of accounting for the measured inflows into both the Cadia Hill Pit and Cadia East workings. However it seems inappropriate to apply the same low hydraulic value to the areas of groundwater inflow through the fault shatter zone and associated fractures. The pit is intersected by numerous faults and fractures (some 20 metres wide shatter zone) which may form preferred pathways over time for the tailing leachates to migrate into adjoining groundwater systems; given the pit will be placed with aqueous material (approx. 200 meters thick in one year, to approx. 420 m AHD) which may create adequate hydraulic head to push the leachates into the groundwater system.

The groundwater monitoring network, although adequate spatially, is inadequate in monitoring the deeper aquifer systems near the pit bottom. There are no details of any deep monitoring bores to establish the hydraulic head at or near the bottom of the pit or within the vertical zone of the proposed tailings fill in the pit. Observations from existing bores deem the pit to be a groundwater sink. It is acknowledged that this assumption applies when the pit fills up with water to the modelled equilibrium level at 670 m AHD. However, the probable existence of another groundwater level near the base of the pit indicates there may be another groundwater system at depth. Deep monitoring bores needs to be established to verify this.

CVO has acknowledged the need to carry out groundwater monitoring (hydrodynamics + water quality) during the in-pit deposition of tailings at Cadia Hill open pit.

CHPL Response

CHPL commissioned Dr Noel Merrick to provide a response to DI – Water’s groundwater comments (Attachment A). Dr Merrick’s response states:

In my opinion, the DoI Water Groundwater Comments, and subsequent itemised issues, are based on a false premise, which is that deep groundwater levels are at about the same elevation as the pit lake. There is no feasible mechanism for groundwater heads being so depressed, given the presence of tight host rock and the absence of large inflows. It is conceptually infeasible for this premise to hold. Furthermore, there is a very steep drawdown cone already demonstrated by measurement and also by calibrated modelling.

Dol Water claims that, due to the presence of fault shatter zones and established groundwater connectivity, "placing tailings into the pit therefore poses a risk of groundwater contamination". However, risk is the product of likelihood and consequence. The "consequence" is groundwater contamination, but the "likelihood" of this event is negligible due to the conceptual and demonstrated hydraulic gradient towards the pit. Therefore, the risk is negligible. "Groundwater connectivity" is not a sufficient condition for the claimed risk.

The idea of faults and fractures forming "preferred pathways over time for the tailing leachates to migrate into adjoining groundwater" can only hold if there is an hydraulic gradient away from the pit. For a gradient towards the pit, preferred pathways are irrelevant (as stated in my expert opinion in report HA2018/06). Again, the "likelihood" component of the risk is negligible.

The belief, stated by Dol Water, that an extra 200 m of tailings "may create adequate hydraulic head to push the leachates into the groundwater" is flawed and can only hold if there is an hydraulic gradient away from the pit. This is conceptually infeasible.

Department of Industry – Water – Recommended Condition of Approval

DI – Water provided the following recommended condition of approval:

Recommended Condition of Consent

The proponent must update the Water Management Plan in consultation with Dol Water to ensure adequate groundwater monitoring is in place. The monitoring is to include the following and is to be implemented prior to tailings deposition in the pit:

- *Deep monitoring bore/s should be constructed to establish the baseline hydrodynamics of the groundwater at or near the base of the pit and continually monitored during and after the pit in-fill.*
- *Baseline groundwater quality (metals and non-metals) at the bottom of the pit must be established; and continually monitored against the water quality (metals and non-metals) of the tailings during and after the pit in-fill. Baseline samples of the tailings material would support the identification of potential contaminants of concern.*
- *Develop a contingency plan.*
- *Prepare a report which includes the baseline groundwater quality and level data, and an assessment to verify the hydraulic gradient towards the areas of historical and current mining during the pit infill. A revised assessment would be required on completion of the pit infill.*

CHPL Response

CHPL confirms that the Water Management Plan would be updated in consultation with DI – Water which would address the matters raised by DI – Water. The requirement to install this monitoring prior to tailings deposition occurring in Cadia Hill open pit is not justified with reference to the EPA's submission and Dr Merrick's comments.

Figure 4 of the Modification Statement of Environmental Effects shows the current extensive groundwater monitoring programme, which includes more than 100 sites. In addition, site MB30 is located adjacent to the north wall which has been monitored for water levels and quality since 2004. The results in the last several years indicate that electrical conductivity (salinity) range of 2,000-2,500 microsiemens. For comparison, recent water quality sampling of the Cadia Hill pit lake indicated electrical conductivity of 1,820 microsiemens and tailings supernatant water (which is approved to be transferred to the open pit) is typically 1,500-2,500 microsiemens. The current standing water level at MB30 is at 36 m depth.

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Notwithstanding, subject to confirmation through revision of the WMP, additional monitoring is proposed and would include:

- Additional groundwater monitoring proximal to the Cadia Hill open pit, to verify the ongoing hydraulic gradient towards the areas of historical and current mining and to provide opportunities for groundwater quality sampling. Consistent with Dr Merrick's recommendations, this would include:
 - an initial single deep borehole would be installed on the edge of the pit, or part-way down the pit wall. The borehole would be instrumented with multiple vibrating wire piezometers. This initial borehole would help to inform spatial locations and total depths for the expanded monitoring network; and
 - a single deep standpipe to allow water quality sample near pit lake level.
- Weekly monitoring of tailings water level and quality sampling of the tailings/pit water.
- Annual monitoring of tailings beach profile.
- Daily volumes of water pumped from the pit.

Revision of the WMP would be undertaken in consultation with DI – Water. It is proposed that the revision of the WMP and the above augmentation of the site monitoring system would be conducted concurrently with the commencement of tailings deposition into the Cadia Hill open pit. This is considered to be justified on the basis of: the negligible environmental risk as identified by the EPA and Dr Merrick; the fact that CHPL already has an extensive monitoring system in place; and in recognition of the importance of maintaining CHPL's substantial workforce.

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Yours Faithfully,

A handwritten signature in blue ink, appearing to read 'A Wannan', written over a light blue circular watermark.

ANDREW WANNAN

Approvals Manager – Cadia Valley Operations
Newcrest Mining Limited – Miner of Choice™

Attachment A Response from Dr Noel Merrick

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Attachment A Response from Dr Noel Merrick



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noel.merrick@hydroalgorithmics.com

DATE: 11 April 2018

TO: Andrew Wannan
Manager Environment
Cadia Valley Operations – Newcrest Mining Limited
(via email)

FROM: Dr Noel Merrick

RE: Cadia Hill – Tailings Deposition Modification –
Expert Opinion

OUR REF: HA2018/07

1. Introduction

This report follows my expert opinion in report HA2018/06 of 27 March 2018 on the Tailings Deposition Modification at Cadia Hill, a completed open cut mine adjacent to two underground mines, one completed (Ridgeway) and the other in operation (Cadia East), located about 25 km south-west of Orange NSW. Approval for the Modification is being sought following a limited breakthrough of tailings material from the Northern Tailings Storage Facility on 9 March 2018.

I have been asked to provide a response to comments received from Dol Water on the Modification, with respect to groundwater conditions.

2. Dol Water Comments

Dol Water structured their commentary as follows:

1. Recommended Condition of Consent (four components).
2. Groundwater Comments (four points).
3. Response to Key Assessment Findings (a table of 14 issues).

The Groundwater Comments (Item 2) are:

Based on the presence of fault shatter zones and associated fractures within the disused Cadia Hill Pit and groundwater inflows, it is understood there is groundwater connectivity with the Cadia Hill Pit. Placing tailings into the pit therefore poses a risk of groundwater contamination. To fulfil the NSW Aquifer Interference Policy requirement “any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity” the baseline groundwater quality (metals and nonmetals) at the bottom of the pit must be established and continually monitored against the water quality (metals and non-metals) of the tailings during and after the pit in-fill.

The Model simulation reports very low hydraulic conductivity of the whole bulk Ordovician rock which is acknowledged for the purpose of accounting for the measured inflows into both the Cadia Hill Pit and Cadia East workings. However it seems inappropriate to apply the same low hydraulic value to the areas of groundwater inflow through the fault shatter zone and associated fractures. The pit is intersected by numerous faults and fractures (some 20 metres wide shatter zone) which may form preferred pathways over time for the tailing leachates to migrate into adjoining groundwater systems; given the pit will be placed with aqueous material (approx. 200 meters thick in one year, to approx. 420 m AHD) which may create adequate hydraulic head to push the leachates into the groundwater system.

The groundwater monitoring network, although adequate spatially, is inadequate in monitoring the deeper aquifer systems near the pit bottom. There are no details of any deep monitoring bores to establish the hydraulic head at or near the bottom of the pit or within the vertical zone of the proposed tailings fill in the pit. Observations from existing bores deem the pit to be a groundwater sink. It is acknowledged that this assumption applies when the pit fills up with water to the modelled equilibrium level at 670 m AHD. However, the probable existence of another groundwater level near the base of the pit indicates there may be another groundwater system at depth. Deep monitoring bores needs to be established to verify this.

CVO has acknowledged the need to carry out groundwater monitoring (hydrodynamics + water quality) during the in-pit deposition of tailings at Cadia Hill open pit.

3. Response to Dol Water Comments

In my opinion, the Dol Water *Groundwater Comments*, and subsequent itemised issues, are based on a false premise, which is that deep groundwater levels are at about the same elevation as the pit lake. There is no feasible mechanism for groundwater heads being so depressed, given the presence of tight host rock and the absence of large inflows. It is conceptually infeasible for this premise to hold. Furthermore, there is a very steep drawdown cone already demonstrated by measurement and also by calibrated modelling.

Dol Water claims that, due to the presence of fault shatter zones and established groundwater connectivity, "placing tailings into the pit therefore poses a risk of groundwater contamination". However, risk is the product of likelihood and consequence. The "consequence" is groundwater contamination, but the "likelihood" of this event is negligible due to the conceptual and demonstrated hydraulic gradient towards the pit. Therefore, the risk is negligible. "Groundwater connectivity" is not a sufficient condition for the claimed risk.

The idea of faults and fractures forming "preferred pathways over time for the tailing leachates to migrate into adjoining groundwater" can only hold if there is an hydraulic gradient away from the pit. For a gradient towards the pit, preferred pathways are irrelevant (as stated in my expert opinion in report HA2018/06). Again, the "likelihood" component of the risk is negligible.

The belief, stated by Dol Water, that an extra 200 m of tailings "may create adequate hydraulic head to push the leachates into the groundwater" is flawed and can only hold if there is an hydraulic gradient away from the pit. This is conceptually infeasible.

The "interpretation" at item 10 (of the itemised responses) of current groundwater head between 221 and 300 mAHD is without any basis whatever.

Dol Water has recommended that "adequate groundwater monitoring" be undertaken by implementing an expanded monitoring network. This is supported. However, in my view there is no need for boreholes to extend to the level of the base of the pit, as groundwater heads are likely to be much higher than the base of the pit. Similarly, there is no need for groundwater quality samples at that depth when there is no causal pathway for groundwater contamination at such depths.

4. Recommendation

It is clear that Dol Water requires further evidence of an hydraulic gradient towards the Cadia Hill pit. For this reason, my recommendation is that an initial single deep hole should be installed on the lip of the pit, or part-

way down the pit wall, before committing to spatial locations and total depths for the expanded monitoring network. The borehole should be instrumented with multiple vibrating wire piezometers. In addition, there will need to be one standpipe to great depth for a water quality sample near pit lake level to establish baseline chemistry.

The objective of the deep hole is to measure the actual vertical head gradient as well as the magnitude of the head at each sensor, to confirm there is an hydraulic gradient towards the pit no matter what sensor elevation is considered.

As the Dol Water itemised comments follow from a false premise, in my opinion, there is no point responding to each comment one by one at this time. The premise should firstly be tested by the recommended deep hole.

Yours sincerely

A handwritten signature in black ink, appearing to read 'hP Merrick'.

Dr Noel Merrick