CADIA

HOLDINGS

PTY LIMITED

TRADING AS
CADIA VALLEY OPERATIONS

ABN 95 062 648 006

14 August 2018

Mr David Kitto
Executive Director, Resource Assessments and Business Systems
Department of Planning & Environment
GPO BOX 39
SYDNEY NSW 2001

Cadia Valley Operations
Cadia Hill Tailings Continuation Modification - Statement of Environmental Effects

Dear David,

The Cadia Valley Operations are located approximately 25 kilometres (km) south-west of Orange, in the Central Tablelands of New South Wales (NSW) (Figure 1 – Enclosure 1).

Cadia Holdings Pty Limited (CHPL) is the owner and operator of the Cadia Valley Operations, and is a wholly owned subsidiary of Newcrest Mining Limited.

Project Approval (PA 06_0295) for the Cadia East Project was granted by the NSW Minister for Planning under Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) on 6 January 2010.

A MEMBER OF THE NEWCREST
GROUP OF COMPANIES

PA 06_0295 includes all components of the Cadia Valley Operations including the Cadia East underground mine, the Cadia Hill open pit mine, the Ridgeway underground mine, the concentrate dewatering facilities in Blayney, and a wide range of ancillary and supporting infrastructure. These integrated operations are herein referred to as the Cadia Valley Operations.

PA 06_0295 has been modified on a number of occasions, with the Determination of Modification 11 most recently occurring in 20 April 2018.

Background

As you are aware, on Friday 9 March 2018, CHPL identified a limited breakthrough of tailings material at the embankment of the Northern Tailings Storage Facility (NTSF).

The slumping of the embankment was fully contained within the Southern Tailings Storage Facility (STSF) that is located immediately downstream. No external environmental impacts arose from the incident (i.e. all tailings and waste rock material in the slumping area were wholly contained within the STSF).

Subsequently, CHPL was granted approval on 20 April 2018 (through Cadia Valley Operations Modification 11 – Cadia Hill Tailings) to deposit Cadia Valley Operations (CVO) tailings in the completed Cadia Hill open pit (i.e. in-pit deposition) up to a final elevation of 420 metres (m) Australian Height Datum (AHD), once consolidated (i.e. approximately 30 million tonnes [Mt] tailings).

Cadia Valley Operations Modification 11 allowed recommencement of full mining and ore processing activities at the Cadia Valley Operations and re-instatement of the full operational workforce. Tailings deposition into Cadia Hill open pit commenced in May 2018.

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Cadia Hill Tailings Continuation Modification

CHPL is currently investigating the factors that led to the limited breakthrough of tailings material at the embankment of the NTSF, including exploring engineering solutions to repair the embankment. In parallel, CHPL has identified the opportunity to deposit additional tailings within the completed Cadia Hill open pit (Figure 2 – Enclosure 1).

The proposed Cadia Hill Tailings Continuation Modification (the Modification) would not involve any change to the approved Cadia Valley Operations except with respect to the final tailings deposition level within the Cadia Hill open pit.

The Modification would include deposition of CVO tailings in the completed Cadia Hill open pit (i.e. in-pit deposition) up to a final elevation of 560 mAHD, once consolidated (i.e. approximately an additional 70 Mt tailings);

All Modification components would be located wholly within the extent of the approved Cadia Valley Operations (i.e. no additional land disturbance is required).

Table 1 provides a comparative summary of the proposed modified operations against the currently approved Cadia Valley Operations.

Key elements of the Modification are shown on Figures 2 and 3 (Enclosure 1).

Environmental Review

There are no proposed changes to the physical extent of the approved Cadia Valley Operations or operational workforce.

Consequently, there would be no material alteration to the approved impacts of the Cadia Valley Operations on the following aspects:

- ecology;
- heritage (Aboriginal/Historical);
- visual amenity;
- noise;
- air quality;
- road network; and
- population, employment and community infrastructure demand.

To evaluate the potential environmental implications of the proposed changes to tailings and water management on-site the following specialist environmental reviews have been completed (Enclosures 2 to 4, respectively):

- Groundwater Assessment – Australasian Groundwater and Environmental Consultants (AGE).
- Final Void Water Balance and Water Management – Hydro-Engineering Consultants (HEC).
- Expert Opinion – Dr Noel Merrick (HydroAlgorithmics).

Table 1
Snapshot of Proposed Changes to Currently Approved
Cadia East Project

Project Development Component	Currently Approved [1]	Cadia Hill Tailings Continuation Modification
Mining Methods	Cadia Hill - conventional open pit mining methods. Ridgeway - underground sublevel and block caving with development of associated surface subsidence zone. Cadia East - underground panel caving with development of associated surface subsidence zone.	No change.
Life of Mine Cadia East Ore Production	Approximately 456 Mt.	No change.
Life of Mine Cadia Valley Operations Ore Production	Approximately 562 Mt.	No change.
Waste Rock Management	Deposition in the North and South Waste Rock Dumps and mined-out void of the Cadia Extended open pit. Cadia East waste rock to be deposited in the South Waste Rock Dump.	No change.
Life of Mine	Mining up until approximately 2030. Project Approval to 2031.	No change.
Tailings Management	Use of the Northern Tailings Storage Facility (NTSF) and Southern Tailings Storage Facility (STSF) and raising of these storages via upstream embankment lifts. 30 Mt of tailings disposal in Cadia Hill open pit.	70 Mt of additional tailings disposal in Cadia Hill open pit. Total life of mine tailings disposal volume unchanged.
Ore Processing	On-site processing of up to 32 million tonnes per annum (Mtpa) of gold and copper ore.	No change.
Concentrate Transport and Dewatering	Gold/copper concentrate is transported from the ore processing facilities via a concentrate pipeline to the Blayney Dewatering Facility. Construction of Cadia Valley Operations Dewatering Facility to the east of Blayney and eventual decommissioning of the existing Blayney Dewatering Facility. Installation of a new concentrate pipeline from the Cadia Valley Operations to the Cadia Valley Operations Dewatering Facility. Transport of dewatered mineral concentrate by rail to the eastern seaboard.	No change.
Water Supply and Management	Water supply sourced from the Cadiangullong Dam, Flyers Creek Weir, Cadia Creek Weir, Orange Sewage Treatment Plant treated effluent, Blayney Sewage Treatment Plant treated effluent, on-site groundwater bores, Belubula River and site runoff. Development of additional pipeline/pumping systems and raising of the Rodds Creek Water Holding Dam. Contingent transfer of supernatant tailings water from STSF and NTSF to Cadia Hill open pit for water management. Internal tailings return water pipeline and pumping systems from Cadia Hill open pit.	No change.
Operational Employment	An average of 880 employees up to a maximum of approximately 1,300 employees.	No change.
Final Landforms	Includes South Waste Rock Dump, North Waste Rock Dump, NTSF, STSF, Cadia East Subsidence Zone, Ridgeway Subsidence Zone, Cadia Hill open pit, Cadia Extended open pit, Cadiangullong Dam, Rodds Creek Holding Dam and other water management infrastructure.	No material change to approved final landform. Tailings deposition up to approximately 110 m below surface of final waterbody equilibrium level.

[1] PA 06_0295 for the Cadia East Project, as modified by section 75W modifications numbered 1-10 and section 4.55(1A) modification number 11.

Groundwater Review

In the Cadia East Environmental Assessment (EA) (CHPL, 2009)[2], it was identified that the Cadia East underground mine subsidence zone would eventually intersect the Cadia Hill open pit, and the open cut and underground voids would then combine to form an integrated post-mining landform, with a single final void waterbody.

Mining in the Cadia Hill open pit ceased in 2012. The Cadia Hill open pit is hosted in competent Ordovician volcanic rocks and has been subject to long term monitoring of groundwater impact propagation, and also geotechnical evaluation with respect to pore pressures in the pit walls (i.e. for pit safety/stability purposes).

AGE (July 2018)[3] (Enclosure 2) concluded the following with respect to the very low inherent permeability of the Cadia Hill open pit host rock into which the tailings would be deposited under the Modification:

> *The most recent update to the groundwater model adopted a hydraulic conductivity for the Ordovician rock mass of between 5 x 10^{-12} to 6 x 10^{-11} m/sec to achieve calibration with estimated and observed groundwater inflows to the mining areas.*

The groundwater review conducted by AGE (July 2018) (Enclosure 2) considered the potential groundwater implications of the proposed deposition of approximately an additional 70 Mt of tailings in the Cadia Hill open pit and concluded the following:

> *The available information on the groundwater regime indicates that there is no potential for connectivity between the tailings emplacement proposed within Cadia Hill Open Pit and the surrounding groundwater regime because:*
>
> - *Tailings will be some 148 m lower than the invert of Cadiangullong Creek at 708 mAHD …*
> - *After closure, the recovered water level within the Cadia Hill Open Pit and Cadia East subsidence zone combined final void will reach an equilibrium of 670 m AHD, which is lower than the groundwater level measured within piezometers in the surrounding rock mass, and means the inward hydraulic gradient towards the pit shell that has developed following commencement of mining, will remain during deposition of the tailings and continue post mining.*
> - *Tertiary basalt and Silurian limestones that can form aquifers within the region have not been intersected by the Cadia Hill pit shell and the hydraulic gradients will not promote flow in the direction of these aquifers.*
>
> *Given the lack of connectivity, the risk to the groundwater regime from the tailings emplacement is considered negligible.*

With respect to potential impacts on groundwater quality, AGE (July 2018) (Enclosure 2) also concluded:

> *Previous studies also identified that the water quality of the combined Cadia Hill and Cadia East final void will be affected by the long term evapo-concentration of salts and also acidic drainage of potentially acid forming Ordovician host rock affecting pH and dissolved metal concentrations. The continued addition of the tailings solids to the Cadia Hill Open Pit would not affect the long term water quality of the recovered groundwater table or combined final void, as the void water quality would continue to be an outcome of evapo-concentration of salts and the geochemistry of the Cadia East host rock, both of which would be unchanged by the Modification.*

Based on the above it can be concluded from a groundwater perspective that there would be minimal environmental impact arising from continued tailings deposition in the Cadia Hill open pit, as there would be no mechanism for an increase in potential impacts.

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[2] Cadia Holdings Pty Limited (2009) *Cadia East Project Environmental Assessment.*

[3] Australasian Groundwater and Environmental Consultants (2018) *Cadia Hill Tailings Continuation Groundwater Assessment.*

This is particularly the case as the quality of water in the approved Cadia Hill open pit and Cadia East combined final landform waterbody would be dominated by the evaporative concentration of salts in the long term, and the final consolidated tailings would be some 110 m below the equilibrium surface level of this waterbody.

The above groundwater review conclusions from AGE are supported by the expert opinion of Dr Noel Merrick (Hydro Algorithmics, July 2018)[4], who concluded (Enclosure 4):

> *Based on the documents cited, the reviewer holds the following opinions:*
>
> - *The evidence for ongoing behaviour of the Cadia Hill pit as a groundwater sink is compelling.*
> - *A predicted ultimate freeboard in excess of 50 m indicates negligible risk of spilling outside the Cadia Hill – Cadia East continuum.*
> - *The usual requirement of $10E^{-9}$ m/sec as the permeability of a liner/container, for prevention of leakage/seepage, is irrelevant when the fluid feature is a gaining system (a sink).*
> - *The model-calibrated hydraulic conductivity of $5E^{-12}$ to $6E^{-11}$ m/s is credible, based on recent core measurements that give a median of $1.7E^{-12}$ m/s; however, the magnitude is inconsequential as only the rate of filling would be affected in a gaining system.*
> - *The barrier/conduit status of intersected faults is irrelevant while the pit remains a groundwater sink (with hydraulic gradients towards the pit).*
> - *The proposed additional tailings deposition would not alter the findings of my previous expert opinion...*
>
> *In particular, the reviewer concurs with AGE that "the risk to the groundwater regime from the tailings emplacement is considered negligible."*

Groundwater monitoring at the Cadia Valley Operations during the in-pit deposition of tailings at the Cadia Hill open pit would continue to be undertaken in accordance with CHPL's existing Water Management Plan.

The current groundwater monitoring programme is extensive (Figure 4 – Enclosure 1). In accordance with commitments for Modification 11, CHPL has revised the number of groundwater bores proximal to the Cadia Hill open pit, to verify the ongoing hydraulic gradient towards the areas of historical and current mining. CHPL is progressively constructing and commissioning additional groundwater monitoring bores (MB91-95) (Figure 4 – Enclosure 1). These monitoring improvements are documented in a draft revision to the Water Management Plan (CHPL, 2018)[5].

Final Void Water Balance and Water Management

The final void water balance review conducted by HEC (July 2018)[6] (Enclosure 3) considered the potential final void water balance implications of the proposed deposition of an additional 70 Mt of tailings in the Cadia Hill open pit and concluded the following:

> *… the water in both the Cadia Hill open pit and the Cadia East subsidence zone void is predicted to reach an oscillating equilibrium level around the level of the saddle (670 mAHD), which is approximately 51 m below the lowest point on the perimeter of the Cadia Hill open pit. This level is unchanged from previous Cadia East modelled long term equilibrium.*
>
> *Minor fluctuations in the water level around the level of the saddle are expected thereafter in response to climatic conditions. The results indicate that void surface waters would continue to be isolated from Cadiangullong Creek even under extremely wet climatic conditions. The results also indicate that the tailings proposed to be deposited to 560 mAHD would remain submerged by up to approximately 110 m of final void water.*

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[4] Hydro Algorithmics (2018) *Cadia Hill Tailings Continuation – Expert Opinion.*

[5] Cadia Holdings Pty Limited (2018) *Draft Water Management Plan.*

[6] Hydro Engineering & Consultants Pty Ltd (2018) *Final Void Water Balance and Water Management.*

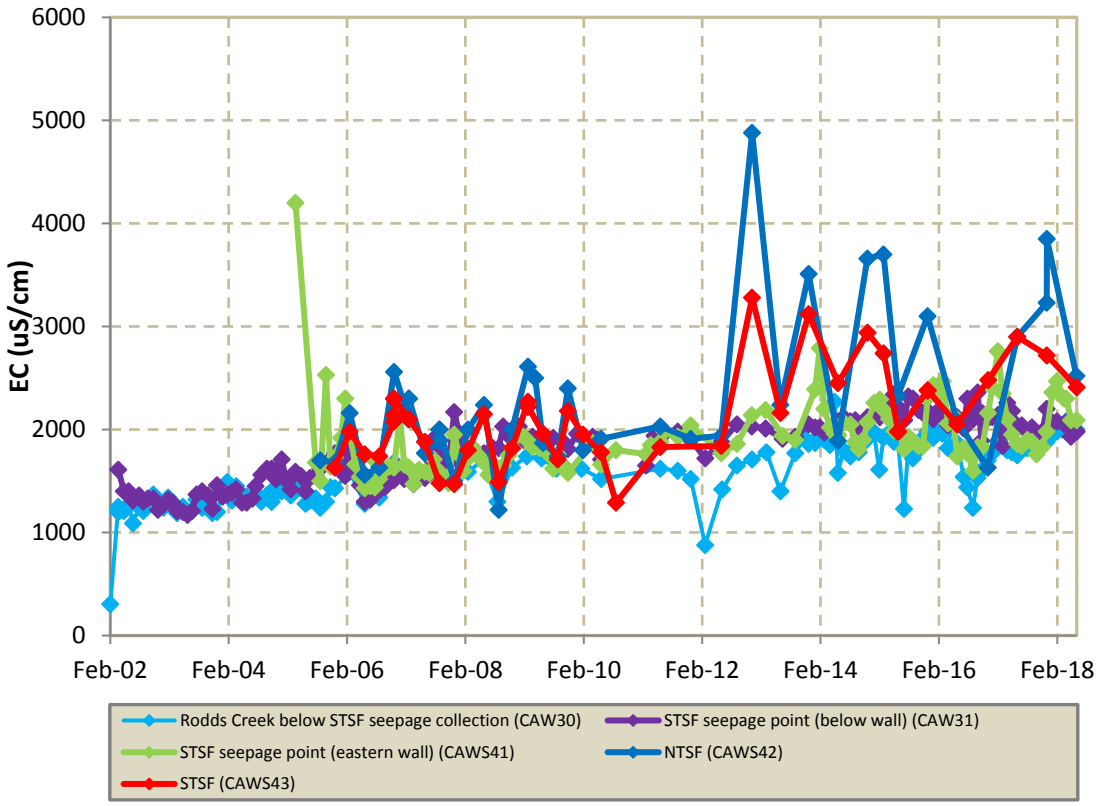
With respect to potential impacts on final void water quality, HEC concluded (Enclosure 3):

- *Cadia Valley Operations is already approved to deposit tailings to the Cadia Hill open pit.*
- *The approved final Cadia Hill and Cadia East subsidence zone void lake would concentrate salts over time due to evaporation from the surface of the waterbody.*
- *The combination of acidic drainage generated from the oxidation of potentially acid forming Ordovician volcanic material within the Cadia East cave zone and the long term evapo-concentration of salts would be key drivers of the final void water quality of the approved Project.*
- *Both of these key drivers of final void water quality would be unchanged by the proposed Modification.*

At the Cadia Valley Operations, tailings are produced from the grinding of mineralized gold and copper ore in the processing plant, where the target minerals are separated from the tailings via flotation before the concentrated minerals are dewatered for export. The remaining tailings that are currently deposited into the Cadia Hill open pit are typically low in sulphur and are non-acid forming as the sulphide mineralization is largely extracted in processing and therefore reports to the concentrate product.

It is also noted that tailings supernatant water that is approved to be transferred to the open pit is typically in the electrical conductivity (salinity) range of 1,000-2,500 microsiemen per centimeter (µS/cm) (Graph 1). This range is significantly less saline than long term water quality predicted for approved final void.

Graph 1
Recent Monitored* Electrical Conductivity of Tailings Water/Seepage



*Monitoring locations shown on Figure 4 (Enclosure 1).

Based on the above, it can be concluded from a surface water perspective that there would be minimal surface water impacts from the proposed continued tailings deposition into the Cadia Hill open pit. The post-mining final void water quality and final waterbody equilibrium level would be unchanged.

Tailings deposition into the Cadia Hill open pit commenced in May 2018. Once all relevant infrastructure is fully installed, CHPL will manage water that accumulates in the Cadia Hill open pit (from tailings supernatant water and rainfall runoff) by recovering (pumping) this water to the water management system for re-use in ore processing, consistent with the approach for the STSF and NTSF. CHPL will progressively construct tailings delivery and return water pipelines that traverse down to a lower elevation within the Cadia Hill open pit. This will increase the control of the beach profile and subsequently provide greater water extraction potential.

Pumping rates would approximately match the tailings deposition rate and anticipated rainfall runoff. Reclaim from the Cadia Hill open pit would be given the same use priority as the other operational tailings storages.

Consistent with the recommendations of HEC (Enclosure 3), CHPL would also extend the current surface water monitoring network to include the following additional monitoring during Cadia Hill open pit tailings deposition:

- weekly monitoring of pond water level;
- daily volumes of water reclaim; and
- daily volumes and tonnages of tailings discharged.

Final Landform

The Modification would not alter the final Cadia Hill and Cadia East subsidence zone void lake equilibrium level and the tailings would lie some 110 m below this surface as described above (Figures 3 and 5 – Enclosure 1). It has also been concluded that the Modification would have no adverse impact on regional groundwater quality or final void waterbody quality in the long term.

It can therefore be concluded that the Modification would result in no material change to the approved final landform for the Cadia Valley Operations, and hence is of minimal environmental impact. Safety management measures at the combined Cadia Hill and Cadia East subsidence zone void would be unchanged by the Modification (i.e. exclusion by safety bunding/fencing).

In addition, as the tailings in the Cadia Hill open pit would be submerged by water, there would be no need to install a soil cover on the tailings, as will be the case with the approved NTSF and STSF at closure.

Hazard and Risk

The Cadia Hill open pit is a 500 m deep mine void, located in hard rock and upstream of the existing approved ore processing facilities, STSF and NTSF.

The existing tailings and water return pipelines and associated pumps and electrical reticulation would continue to be utilized in support of the Modification.

Deposition of tailings in the Cadia Hill open pit therefore would not result in any adverse change to the likelihood or consequences of a hazardous event at the Cadia Valley Operations.

Biodiversity

Biodiversity values require consideration in accordance with Section 7.17(2)(c) of the *Biodiversity Conservation Act, 2016*, which states:

> *(c) however a further biodiversity development assessment report is not required to be submitted if the authority or person determining the application for modification (or determining the environmental assessment requirements for the application) is satisfied that the modification will not increase the impact on biodiversity values,*

Clause 1.4 of the *Biodiversity Conservation Regulation, 2017* provides a description of the biodiversity values requiring consideration. These biodiversity values and a description of how these values have been considered for the Modification is provided in Table 2.

Table 2
Biodiversity Values Consideration – Cadia Hill Tailings Continuation

Biodiversity Value	Modification Consideration
(a) threatened species abundance—being the occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site,	Development and vegetation clearing of the Cadia Hill open pit commenced in 1995 and operations commenced in 1998. During these operations, a very large open pit was excavated, with dimensions of approximately 1,450 m by 1,350 m and a depth in the order of 500 m. Mining in the Cadia Hill open pit ceased in 2012. The void consists of a series of access ramps and steep walls and contains instruments such as piezometers. No vegetation exists within the void. Within the void that remained post-mining, two adits were constructed within the final void shell. One of these adits temporarily provided habitat for bats, however these bats were removed in April 2018 in accordance with the Threatened Species Management Protocol contained within the Land and Biodiversity Management Plan (CHPL, 2017)[7], and the adit was subsequently permanently closed. Given this and that tailings deposition is currently occurring in accordance with PA 06_0295, no further fauna habitat potential associated with this adit remains. The second adit is located much higher in the void (at 600 m AHD) and used operationally for ventilation of the underground mine workings. Given that tailings deposition would occur to a maximum level of 560 mAHD, the adit would not be affected by the Modification.
(b) vegetation abundance—being the occurrence and abundance of vegetation at a particular site,	There is no vegetation associated with the Modification, therefore there is no impact on vegetation abundance anticipated.
(c) habitat connectivity—being the degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range,	As no fauna habitat exists, there is no impact on habitat connectivity anticipated.
(d) threatened species movement—being the degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle,	As no fauna habitat or vegetation exists, there is no impact on threatened species anticipated.
(e) flight path integrity—being the degree to which the flight paths of protected animals over a particular site are free from interference,	Given the absence of suitable habitat and that the void has been excavated below ground level, there is no impact on flight path integrity anticipated.
(f) water sustainability—being the degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities at a particular site.	The outcomes of the water resources studies conducted for this Modification demonstrate that the Modification would result in negligible risk to groundwater resources and would not change the final void hydrology in the long-term.

No impacts on biodiversity values have been identified as:

- no surface disturbance or vegetation clearance would be associated with the Modification; and
- no suitable native fauna habitat (including bats) exists within the relevant portion of the Cadia Hill open pit.

Accordingly, with reference to Section 7.17(2)(c) of the *Biodiversity Conservation Act, 2016* and the *Threatened Species Test Significance Guidelines* (State of NSW and Office of Environment and Heritage, 2018)[8], no Biodiversity Development Assessment Report is required for the Modification as the Modification would not increase impacts on biodiversity values.

[7] Cadia Holdings Pty Limited (2017) *Land and Biodiversity Management Plan.*
[8] State of NSW and Office of Environment and Heritage (2018) *Threatened Species Test Significance Guidelines.*

Other Environmental Considerations

Consideration of other potential environmental impacts arising from the Modification is provided below:

- **Land Resources and Downstream Water Quality** - no implications as continued tailings deposition is wholly within an approved open pit and no credible solute seepage pathway to the exterior environment exists.
- **Workforce Demand and Accommodation** - no change to the Cadia Valley Operations workforce would be required.

Cadia East Underground Mine Safety

CHPL has developed and refined a site specific calibrated subsidence model for the Cadia East underground mine. The calibrated model indicates there would be no extension to the subsidence zone that was previously predicted and approved for the Cadia East Project.

Based on the proposed Modification consolidated tailings deposition level of 560 mAHD, calibrated subsidence modelling and the very low permeability host rock, CHPL does not have any underground mine safety concerns with the storage of additional tailings and tailings supernatant water in the Cadia Hill open pit. No safety issues have been identified from the deposition of tailings to date.

Notwithstanding, CHPL would continue to implement its operational safety management systems, including ongoing monitoring and risk assessments.

Consultation

CHPL held a Cadia District Residents Meeting on 19 July 2018 where attendees were briefed on the Modification. The meeting included a briefing from AGE Hydrogeologist, Mr James Tomlin. Questions from the residents in attendance included queries regarding the overall groundwater regime and groundwater system and the context of the Cadia Hill open pit. At the meeting, Mr Tomlin explained the Cadia Hill open pit is within very hard rock of low permeability and that the steep hydraulic gradients towards the open pit would prevent solute transport beyond the open pit (consistent with AGE [July 2018]). Following the briefing, no further concerns were raised from the residents in attendance.

Additionally, CHPL separately briefed Blayney Shire Council, Cabonne Council and Orange City Council on the proposed Modification. Letters provided by the three local Councils in response to CHPL consultation on the Modification are provided in Enclosure 5.

CHPL also briefed a meeting of the Environmentally Concerned Citizens of Orange on 25 July 2018. No objections or concerns were raised with the proposed Modification.

It is anticipated that the consultation undertaken to date would be ongoing with all key stakeholders during the continued deposition of tailings into the Cadia Hill open pit.

Assessment Pathway

Environmental Planning and Assessment Act, 1979

Cadia Valley Operations was gazetted as a State Significant Development for the purposes of future modifications on 13 April 2018. Following review of the potential environmental impacts of the Modification, approval for the Modification is therefore formally sought to PA 06_0295 under section 4.55(1A) of the EP&A Act.

Section 4.55(1A) of the EP&A Act relevantly provides:

> *(1A)* ***Modifications involving minimal environmental impact, and***
>
> *A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*
>
> *(a) it is satisfied that the proposed modification is of minimal environmental impact, and*
>
> *(b) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified (if at all), and*
>
> *(c) it has notified the application in accordance with:*
>
> *(i) the regulations, if the regulations so require, or*
>
> *(ii) a development control plan, if the consent authority is a council that has made a development control plan that requires the notification or advertising of applications for modification of a development consent, and*
>
> *(d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be.*
>
> *…*

The consent authority is required to satisfy itself that any proposed modification under section 4.55(1A) of the EP&A Act would result in the Cadia East Project remaining substantially the same development as originally approved in 2010, inclusive of consideration of the changes arising from the previously approved modifications.

A comparative analysis is provided in Enclosure 6 that outlines the key elements of the approved modifications 1-11, including the key environmental assessment outcomes. Consideration of the key comparatives detailed in the draft guideline *Modifying an Approved Project* (NSW Government, 2017)[9] when considering whether the Modification could be considered to be "substantially the same" is provided in Table 3.

Table 3
Summary Evaluation for 'Substantially the Same' Test

Key Comparatives	**Cadia Hill Tailings Modification Plus Modifications 1-11*** **Change to Originally Approved**
Development size, scale and footprint	No material increase.
Intensity including rates of production	Approx. 19% increase in ore processing rate and concentrate production (Mod 6).
Primary, secondary and ancillary use	Secondary use of completed open pit for supernatant tailings water storage (Mod 6) and tailings solids storage (Mod 11). Continued use of open pit for tailings storage (this modification - Mod 12).
Project life and hours of operation	Nil.
Extent, duration and severity of impacts	No material change.

* Refer Enclosure 6.

Enclosure 6 demonstrates that all previous modifications have not materially altered the essence of the Cadia Valley Operations, nor have the approved environmental impacts of the operations been materially altered.

The Cadia Valley Operations has demonstrably remained a very large gold/copper mining complex that incorporates the following key elements approved under PA 06_0295 in 2010 (Figures 1 and 2 [Enclosure 1] and Tables 1 and 2):

[9] NSW Government (2017) *Modifying an Approved Project Impact Assessment Guidance Series June 2017.*

- three individual gold/copper mines;
- major ore handling and processing facilities;
- mineral concentrate transfer, dewatering, storage and transportation facilities;
- extensive water supply and water management systems;
- major waste rock dumps and tailings storages that comprise very extensive mine landforms in the Cadia Valley; and
- a wide range of supporting infrastructure and facilities.

This would also clearly continue to be the case if the Modification was approved (Table 2) and therefore the consent authority can be satisfied that the Cadia Valley Operations incorporating the Modification would remain "substantially the same".

Environment Protection and Biodiversity Conservation Act, 1999 (Cth)

Given the location and nature of the proposed modification (i.e. no additional land disturbance, continued beneficial use of a completed open pit for tailings deposition) CHPL is satisfied that the Modification would not have a significant impact on any relevant Matter of National Environmental Significance under the *Environment Protection and Biodiversity Conservation Act, 1999*.

Summary

The Modification does not propose any increase to the approved rates of mining, ore processing or tailings emplacement at the Cadia Valley Operations. Nor would it alter the project operational workforce.

The Cadia East Project would remain substantially the same as originally approved under the Cadia East Project Approval (PA 06_0295), inclusive of the proposed Modification and the previously approved modifications.

In order to assess the potential environmental impacts of the proposed Modification a number of environmental reviews were completed. These reviews and the other assessments detailed above have concluded that the Modification would have minimal environmental impact.

CHPL consulted with local stakeholders during development of the Modification application, including a residents meeting which provided attendees with an opportunity to engage in discussion regarding potential groundwater impacts associated with the Modification and any other concerns that the residents may have regarding the modification. Additionally, CHPL separately briefed the Environmentally Concerned Citizens of Orange, Blayney Shire Council, Cabonne Council and Orange City Council on the Modification. Letters of support provided by the three local councils in response to CHPL consultation on the Modification are provided in Enclosure 5.

The Cadia Valley Operations environmental management and monitoring measures currently being applied by CHPL would continue to be applied to minimise the potential impacts on existing environmental values.

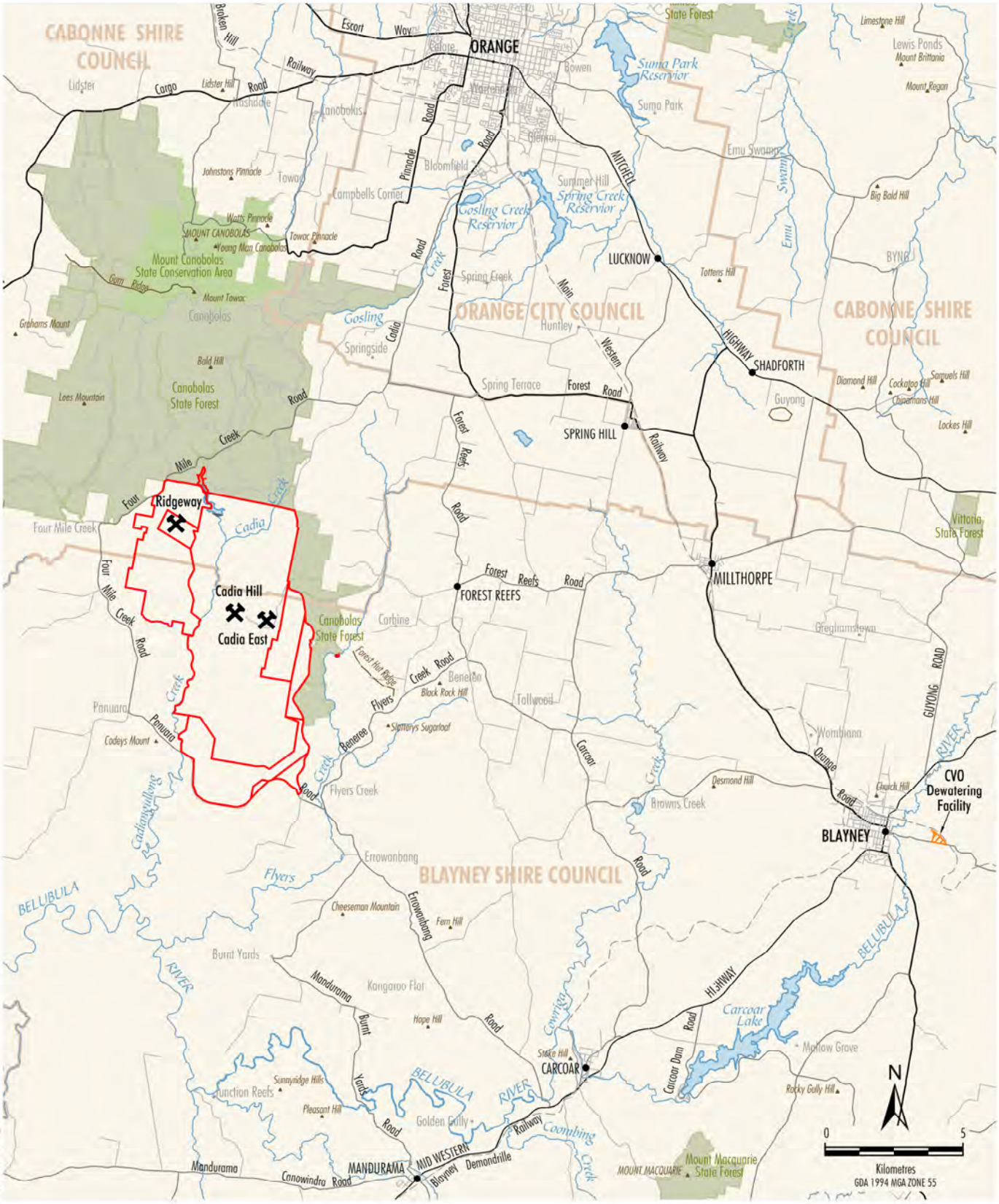
Please do not hesitate to contact me on (02) 6366 6326 if you would like to discuss.

Yours sincerely

Jane Chung
Approvals Superintendent (Acting)
Cadia Valley Operations

Enclosure 1 Figures
Enclosure 2 Groundwater Assessment
Enclosure 3 Final Void Water Balance and Water Management
Enclosure 4 Expert Opinion
Enclosure 5 Correspondence from Local Councils
Enclosure 6 Summary of Previous Cadia East Modifications 1-11

ENCLOSURE 1
FIGURES



LEGEND

- Mining Lease/Mining Lease Application Boundary
- Local Government Area
- Road
- Railway
- NSW State Forest
- NPWS Reserve

Source: Department of Lands NSW (2006); Department of Industry (2017)

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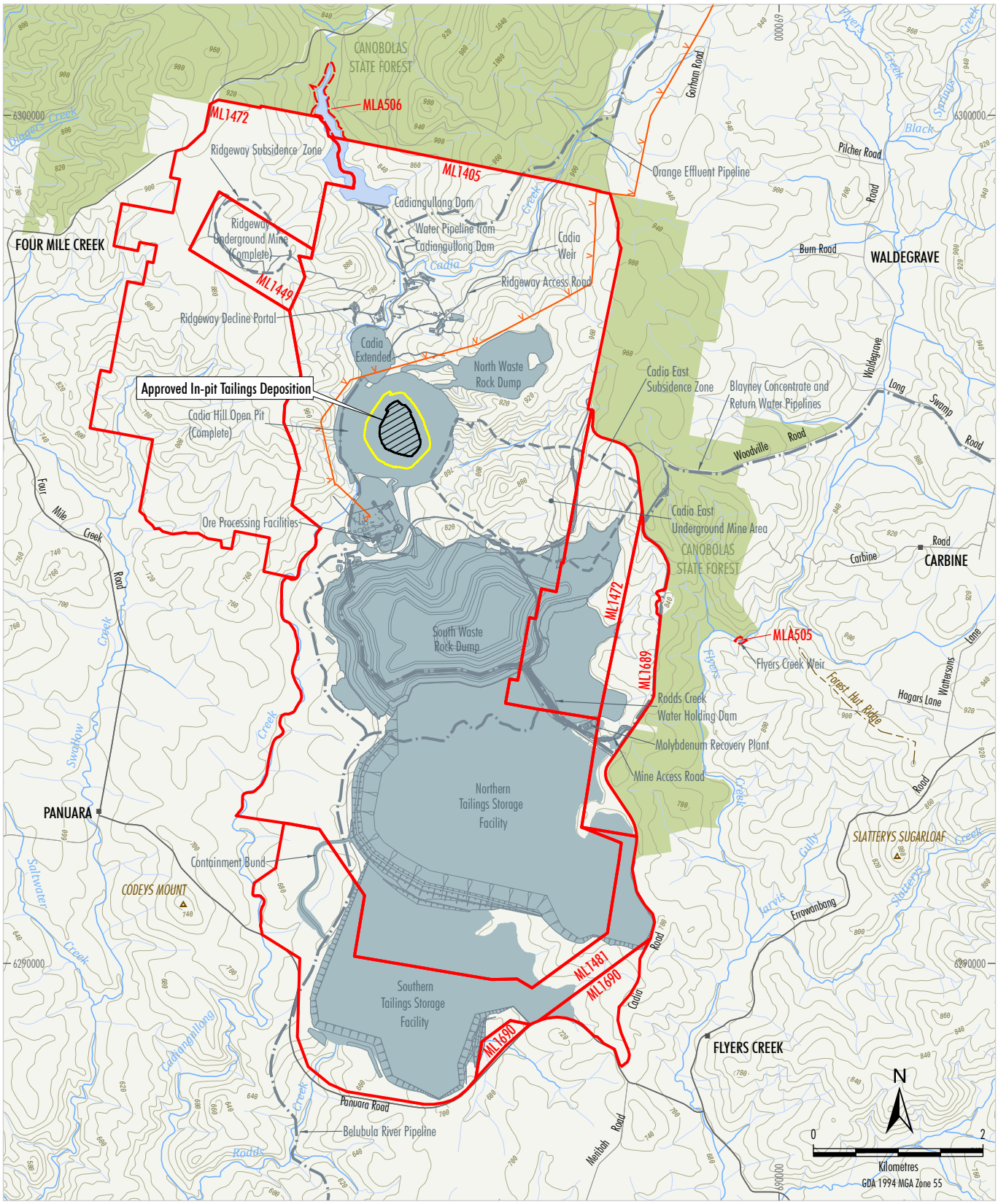
CADIA VALLEY OPERATIONS

Regional Location

Figure 1



NEC-18-88 MOD12_201C

LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- State Forest
- Powerline
- Existing/Approved Mine Infrastructure and Landforms
- Proposed Modification In-pit Tailings Deposition

Source: Land and Property Information (2017); NSW Planning & Environment Resource & Energy (2017); CHPL (2018)

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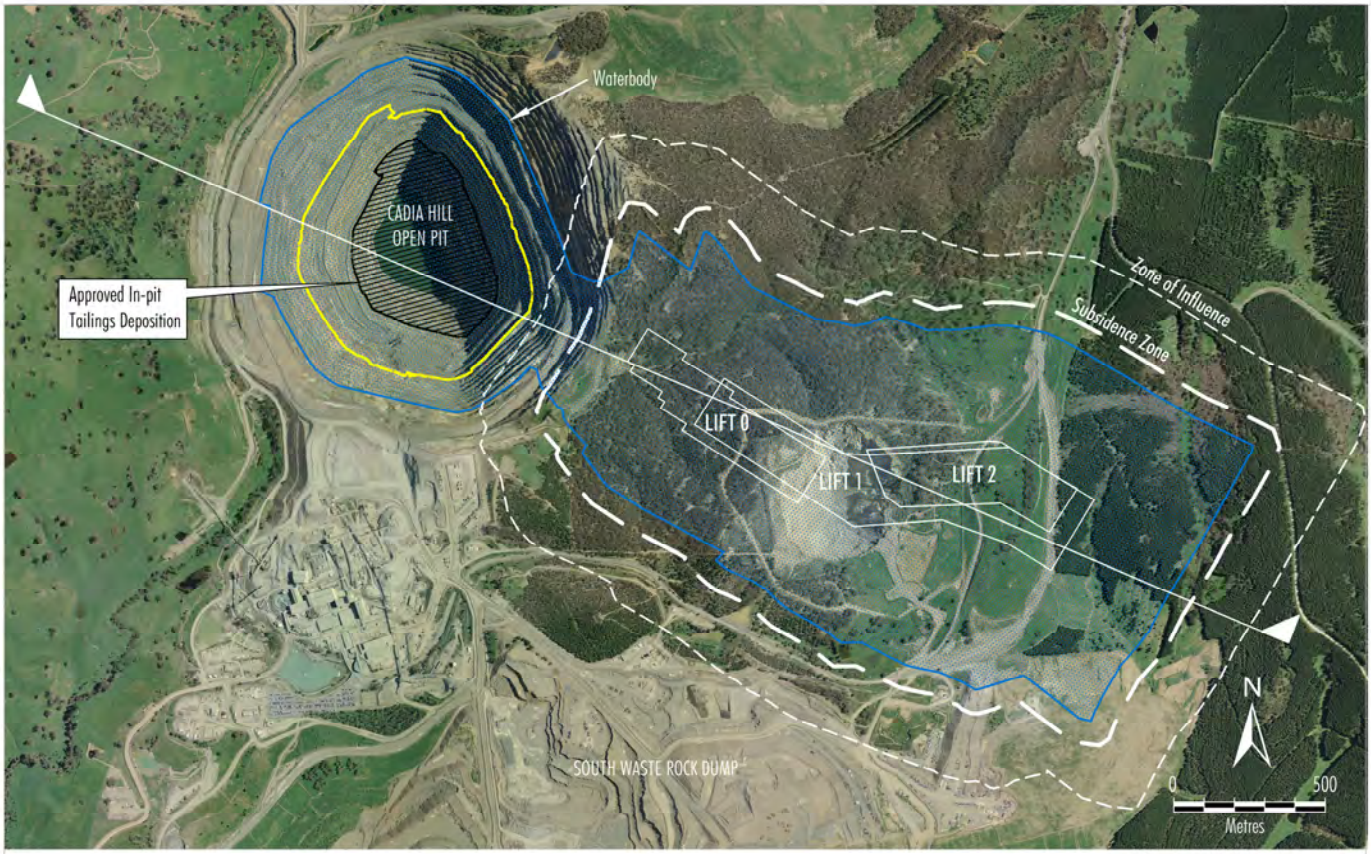
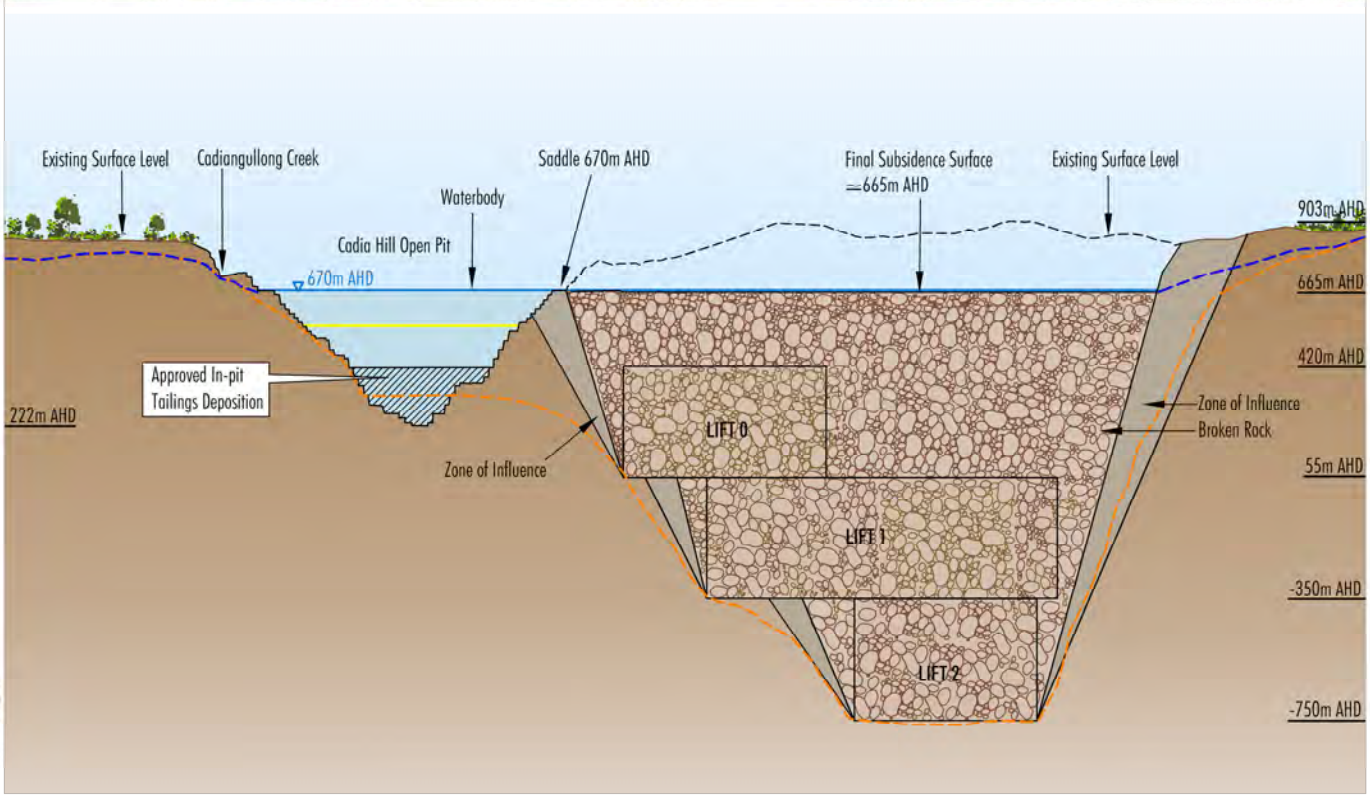
CADIA VALLEY OPERATIONS

Modification Location

Figure 2





NEC-16-88 AKD12_102A

LEGEND

- Approved Underground Mine Footprint
- Post Mining Indicative Phreatic Surface
- Approved Operations Indicative Phreatic Surface
- Proposed Modification In-pit Tailings Deposition

Source: CHPL (2008) ; After AGE (2018)

NEWCREST MINING LIMITED

CADIA VALLEY OPERATIONS

Conceptual Long Section of the Cadia Hill Open Pit and the Cadia East Subsidence Zone

Figure 3

LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- State Forest
- Powerline
- Tailings Water Quality Location
- Groundwater Bore
- Proposed Groundwater Bore
- Existing Site Recommissioned for Cadia Hill Tailings Deposition

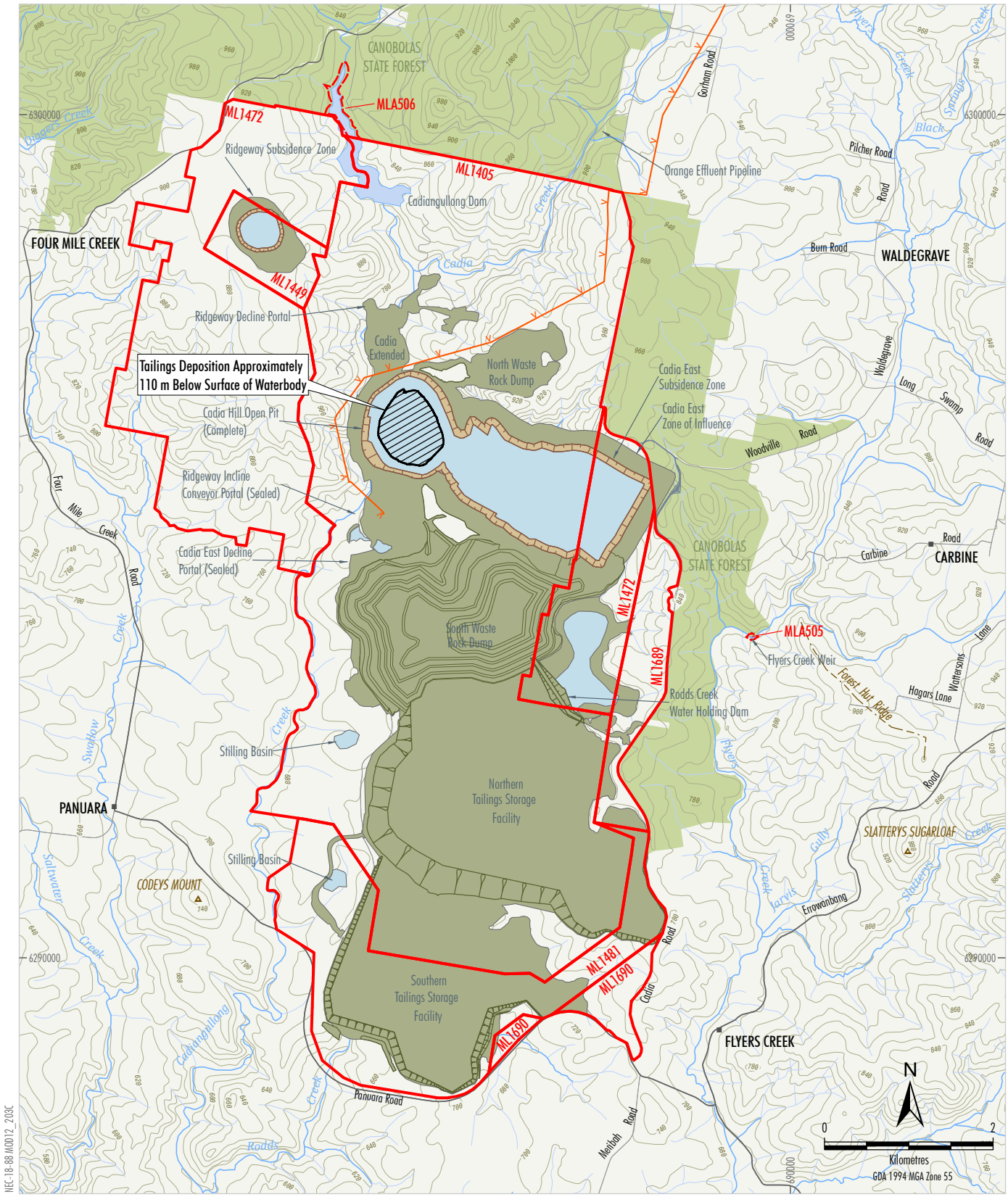
Source: Land and Property Information (2017); NSW Planning & Environment Resource & Energy (2017); CHPL (2018)

NEWCREST MINING LIMITED

CADIA VALLEY OPERATIONS

Cadia Valley Operations
Groundwater Bore and
Tailings Water Quality Locations

Figure 4



NEC-18-88 MOD12_203C

LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- State Forest
- Powerline
- Revegetated/Rehabilitated Area
- Waterbody

Source: Land and Property Information (2017); NSW Planning & Environment Resource & Energy (2017); CHPL (2018)

NEWCREST MINING LIMITED

CADIA VALLEY OPERATIONS

Post Mining Landforms

Figure 5

ENCLOSURE 2
GROUNDWATER ASSESSMENT

Australasian Groundwater
and Environmental Consultants Pty Ltd
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AMD/JST/DWI:tb
G1383P.CadiaMOD12
1 August 2018

Attention: Ms Jane Chung

Cadia Valley Operations – Newcrest Mining Limited
via email

Dear Jane,

RE: Cadia MOD12 - Cadia Hill Tailings Continuation – Groundwater Assessment

1 Introduction and scope of work

The Cadia Valley Operations (CVO) are located approximately 25 (km) kilometres south-west of Orange, in the Central Tablelands of New South Wales (NSW), and comprises one open cut mine (Cadia Hill), and two underground mines (Ridgeway and Cadia East). Cadia Holdings Pty Limited (CHPL) owns and operates the CVO and is a wholly owned subsidiary of Newcrest Mining Limited.

Prior to March 2011, CHPL deposited tailings from the ore processing facilities in the Northern Tailings Storage Facility (NTSF) and the Southern Tailings Storage Facility (STSF). Following a limited breakthrough of tailings material from the NTSF embankment into the STSF on 9 March 2018, CHPL re-evaluated the long term tailings storage options.

Subsequently, CHPL gained approval on 20 April 2018 through "Cadia Modification 11 – Cadia Hill Tailings" (CHPL, 2018) to deposit tailings within the completed Cadia Hill open pit. This approval is for a tailings level up to 420 metres Australian Height Datum (mAHD).

It is understood that CHPL plans to seek a new approval to increase the in-pit deposition of tailings up to a final elevation of 560 m (AHD). This modification is being undertaken via a Statement of Environmental Effects (SEE), and this letter report forms supporting documentation for the SEE.

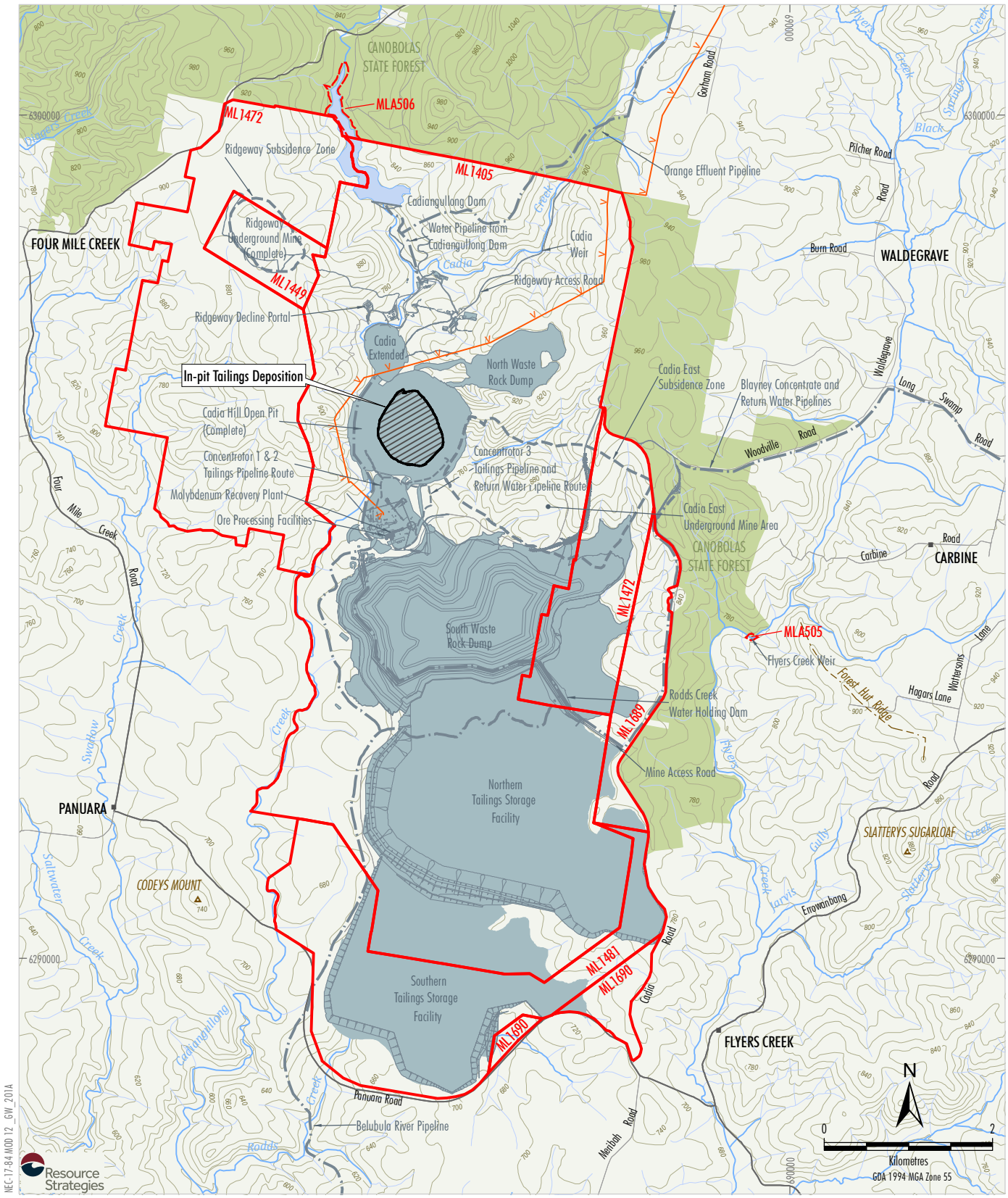
The approved closure strategy for Cadia Hill is to maintain a final pit void lake that is a sink to the surrounding recovered groundwater regime.

The proposed Cadia Hill Tailings Continuation Modification (the Modification) would not involve any change to the approved Cadia Valley Operations, except with respect to the Cadia Hill tailings deposition level.

The proposed Modification includes deposition of CVO tailings in the completed Cadia Hill open pit (i.e. in-pit deposition) from an approved elevation of 420 mAHD to 560 mAHD, once consolidated (i.e. approximately 70 million tonnes [Mt] of additional tailings or approximately two years duration at permitted annual ore processing rates).

Figure 1 shows the locations of Cadia Hill open pit and the footprint of the proposed tailings emplacement. Figure 2 includes a long section through Cadia Hill open pit and Cadia East. It shows the proposed in-pit tailings emplacement, the potential conceptual phreatic groundwater surface at the end of Cadia East mining, and the long term modelled recovered water levels within the Cadia Hill open pit and Cadia East subsidence zone and the combined final void waterbody (and associated final conceptual phreatic surface). It also illustrates the relationship of the tailings emplacement with the Cadia East underground mine and the surrounding environmental features including Cadiangullong Creek.

CHPL engaged Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to assess the impacts of the additional tailings emplacement within Cadia Hill open pit on the groundwater regime. This letter reviews the groundwater systems in the area of the Cadia Hill open pit and discusses the potential groundwater related impacts of the proposed tailings emplacement. The impacts are also compared with the Minimal Impact Considerations of the *NSW Aquifer Interference Policy* (AIP) (NSW Office of Water [NOW], 2012) for completeness.



LEGEND

- Mining Lease Boundary
- Mining Lease Application Boundary
- State Forest
- Powerline
- Existing/Approved Mine Infrastructure and Landforms

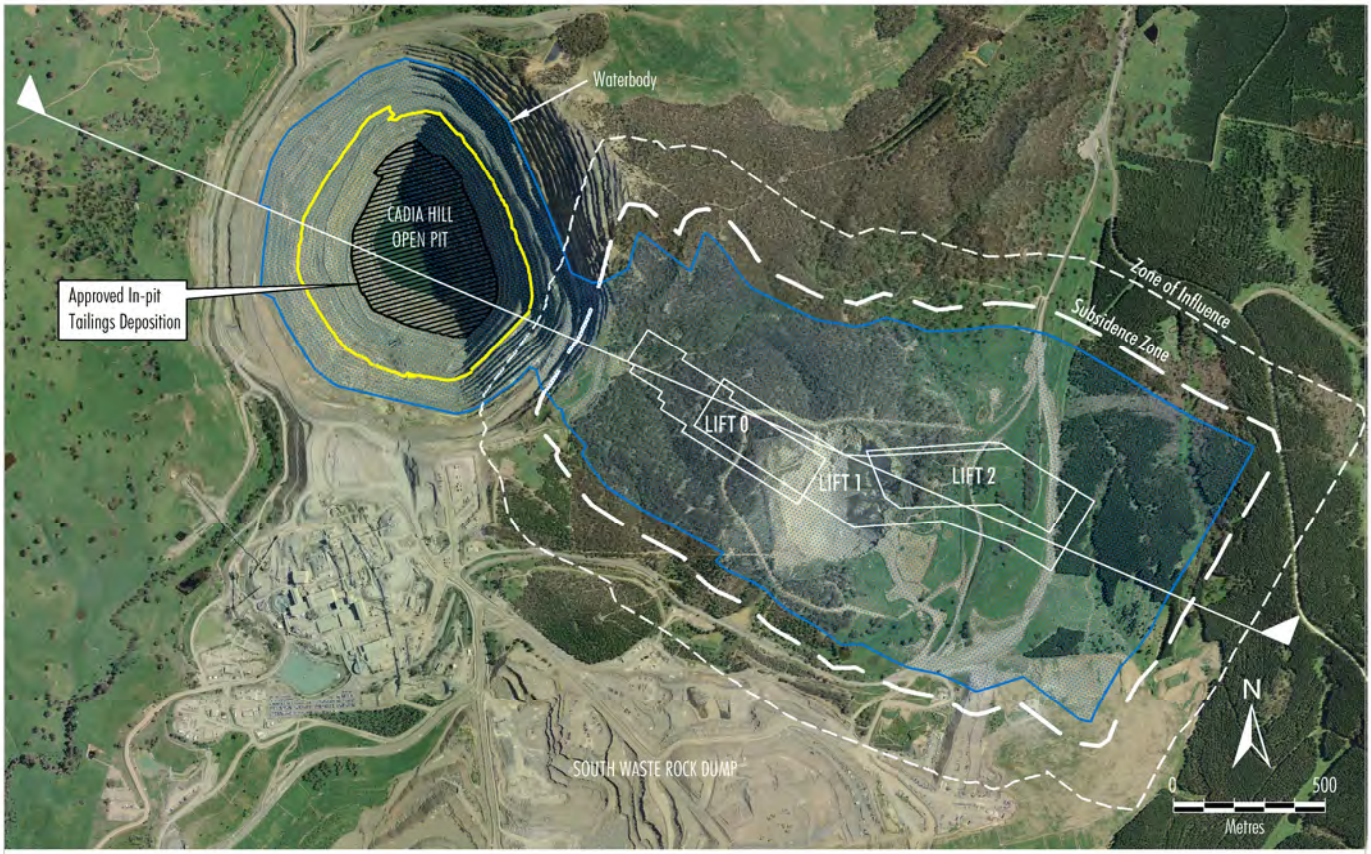
Source: Land and Property Information (2017);
NSW Planning & Environment Resource & Energy (2017)
CHPL (2018)

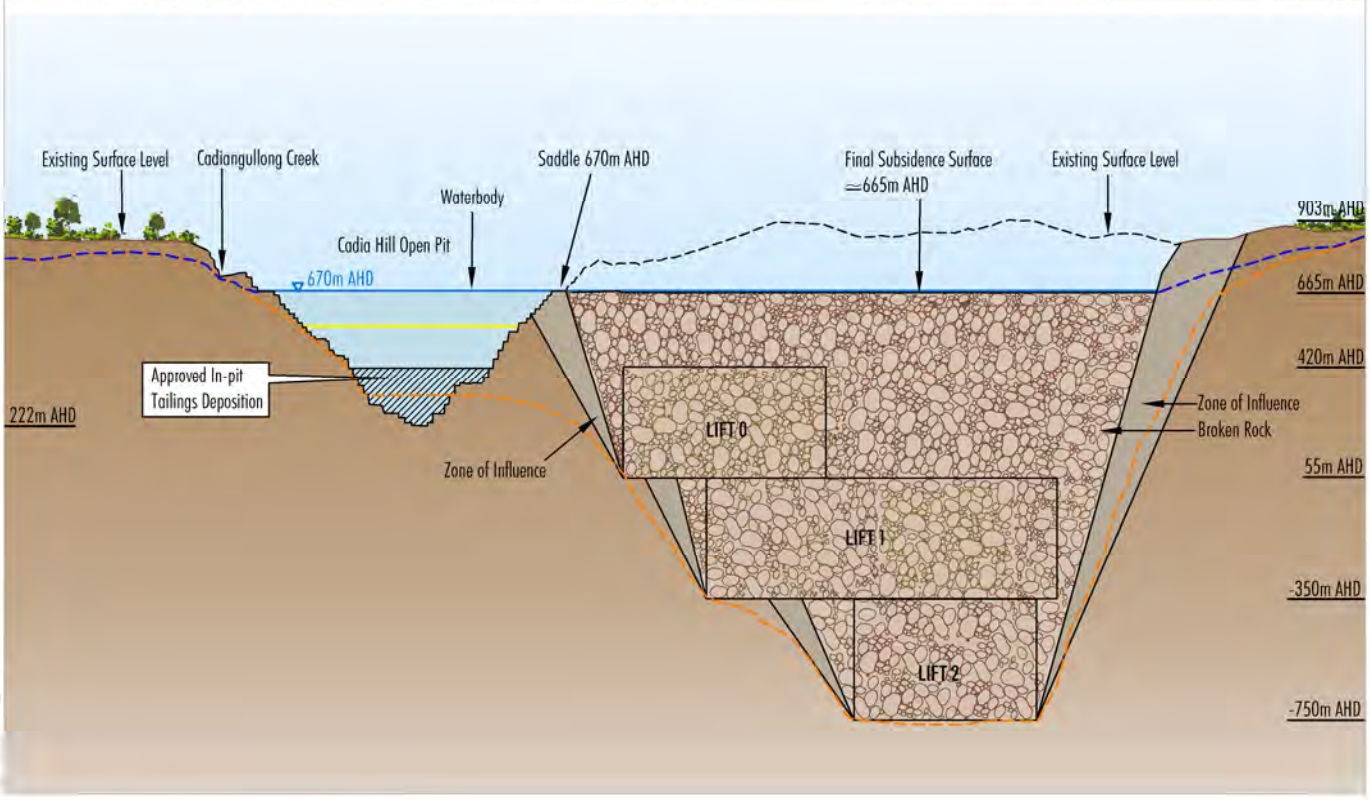
NEWCREST MINING LIMITED

CADIA VALLEY OPERATIONS MODIFICATION 12

Modification Location

Figure 1





LEGEND
Approved Underground Mine Footprint
Post Mining Indicative Phreatic Surface
Approved Operations Indicative Phreatic Surface
Proposed Modification In-pit Tailings Deposition

Source: CHPL (2008) ; After AGE (2018)

NEWCREST MINING LIMITED

CADIA VALLEY OPERATIONS

Conceptual Long Section of the Cadia Hill Open Pit and the Cadia East Subsidence Zone

Figure 2

2 Groundwater regime of Cadia Hill

There are three major hydrostratigraphic units that occur at CVO and within the surrounding region:

- Tertiary basalt, which forms a productive aquifer utilised by surrounding properties with varying yields from low to high and consistently fresh water suitable for potable use;
- the underlying Silurian sediments sequence which is more variable in permeability but form a low yield aquifer from fractured sandstone and siltstones, with locally high yields where fractured limestones are present towards the base of the sequence; and
- the Ordovician volcaniclastic basement rocks which have a widely spaced and poorly interconnected fracture network and therefore form an aquitard with very low yields and slightly brackish water quality.

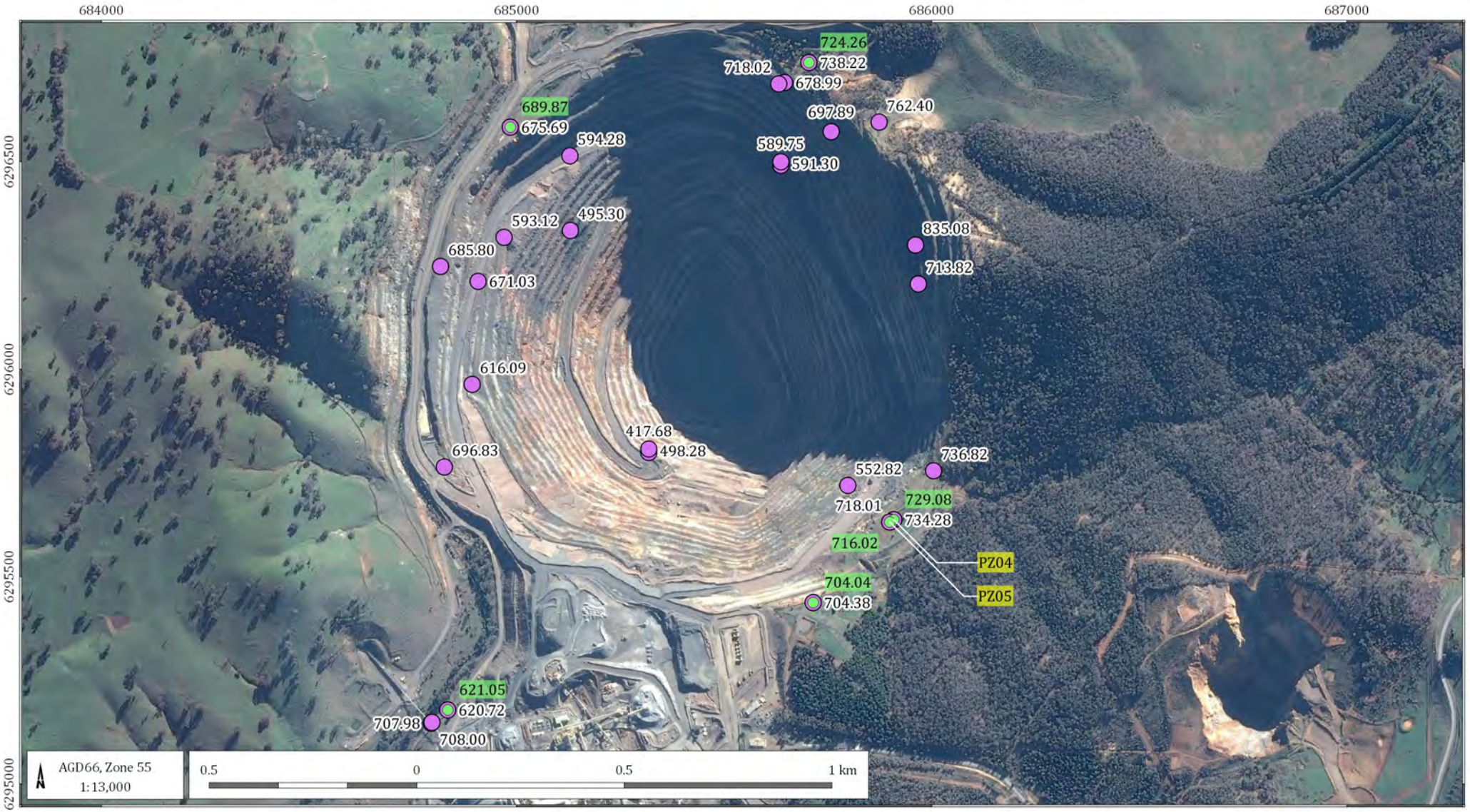
Cadia Hill open pit operated between 2002 and 2012 extracting mineralised gold-copper porphyry deposits from the Ordovician bedrock down to a level of approximately 220 mAHD, which is approximately 500 m below the pit crest at 721 mAHD. A small area of Silurian sediments was exposed in the north-east wall of Cadia Hill open pit and comprises alternating units of sandstone and siltstone. The limestone unit that can form an aquifer at the base of the Silurian sequence was not encountered at Cadia Hill. Likewise Tertiary basalt flows that form an aquifer system further to the north and east of CVO were also not encountered within the pit shell.

Geotechnical investigations conducted during mining (Newcrest 2006) noted Cadia Hill open pit occurs within a low permeability rock mass, and groundwater ingress was generally only evident in localised areas through structures. A number of faults intersect Cadia Hill open pit with visual examinations summarised by AGE (2009) indicating the faults are between 0.5 m and 20 m wide and characterised by milled rock and clay gouge infill with fractured wall rocks. During mining, the faults did not produce problematic volumes of groundwater with the clay gouge material expected to retard water movement through the fault plane.

During mining, CVO monitored pore pressure within the pit walls using a series of geotechnical piezometers. The data from the piezometers indicate a very steep hydraulic gradient and therefore a limited cone of groundwater depression formed within the rock mass surrounding the pit shell. Groundwater levels measured from monitoring bores in 2012 (when mining ceased) are presented in Figure 3. This figure also displays additional groundwater level data measured at the beginning of 2018, which indicates that water levels have only varied a matter of metres over the last 5 to 6 years. Some have increased whilst others have decreased despite the significant gradients adjacent to and around the pit effectively driving groundwater towards the pit and reducing water levels within the surrounding strata.

To better demonstrate the groundwater level relationship to the pit shell, a cross section of the pit and the measured groundwater levels at the end of mining (2012) is presented in Figure 4. The steep gradients are readily visible in the cross section with generally high groundwater levels still evident surrounding the pit. Due to the limited drainage of groundwater, horizontal drain holes were the most effective method for reducing pore pressure and the risk of slope failures during mining.

During operations groundwater inflow into Cadia Hill open pit could not be directly measured as it occurred as slow seepages across the pit walls that mixed with runoff, or was readily evaporated, or bound by capillary action to the excavated ore and waste rock. Figure 5 below illustrates the rock mass exposed within the Cadia Hill open pit and the localised seepage zones evident as zones of iron staining on the walls.



LEGEND

- Water level observation (mAHD, 2018)
- Water level observation (mAHD, 2012)

Cadia MOD12 Cadia Hill tailings continuation (G1383P)

Groundwater monitoring at Cadia Hill Pit

DATE
06/07/2018

FIGURE No:
3

Source: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.;
G:/Projects/G1383P.Cadia MOD12 Cadia Hill tailings continuation/3_GIS/Workspaces/001_Deliverable1/3.00_G1383P.Groundwater monitoring at Cadia Hill Pit.qgs

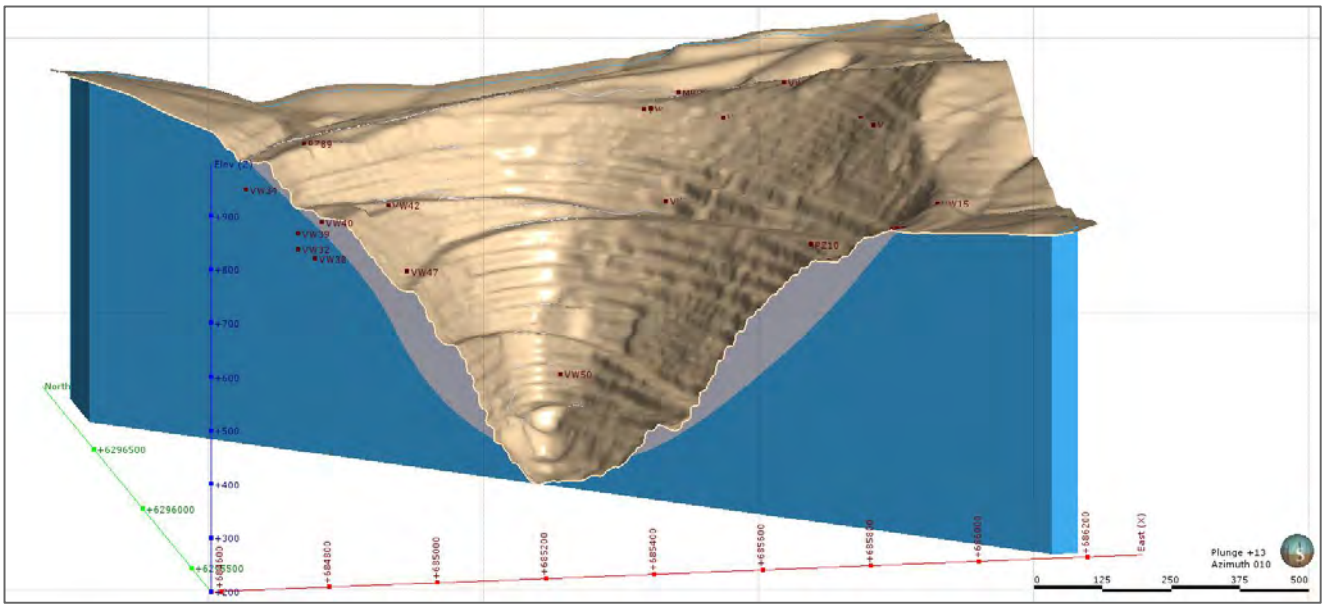


Figure 4 Cross-section through Cadia Hill Pit showing measured water levels

Figure 5 Photo within Cadia Hill Pit showing limited and isolated seep zones

CVO used a water balance method to back calculate the volume of groundwater entering the pit from the total volume of water pumped from the pit. The water balance method estimated a groundwater ingress to the Cadia Hill open pit of <0.7 mega litres (ML)/day.

The general lack of significant aquifer systems and limited groundwater ingress to Cadia Hill open pit means that CVO have located groundwater monitoring bores where the more sensitive and productive Tertiary basalt and Silurian aquifer systems occur beyond the limit of the pit shell to the north and east of Cadia Hill. Cadia Hill is situated within the Cadiangullong Creek catchment which is drained by Cadiangullong Creek which flows southward to the Belubula River. The creek has been diverted around the western edge of the Cadia Hill open pit for a distance of approximately 2 km. The predominance of the low permeability bedrock in the Cadiangullong Creek catchment in the vicinity of the mine means there is limited discharge of groundwater to the creek as baseflow, particularly during dry periods.

3 Previous modelling

The impact of the Cadia Hill open pit, Cadia East underground mine and Ridgeway underground mine on the groundwater regime has been assessed using numerical groundwater flow models. AGE (2009) describes the numerical model developed for the Cadia East Environmental Assessment which was approved in 2009. The groundwater model has been updated on two occasions since this time in accordance with Schedule 3, Condition 34(d) of PA 06_0295 (AGE 2013, 2016).

As noted previously, due to the very low inherent host rock permeability (Newcrest 2006, 2015), Cadia Hill open pit experienced very low groundwater inflows over its life. AGE (2009) constructed a 3D numerical groundwater flow of CVO that included Cadia Hill open pit. The model was constructed using the MODFLOW-SURFACT software and represented the three key regional hydrostratigraphic units, being the Tertiary basalts, Silurian sediments and Ordovician volcaniclastics.

The model was calibrated to average water level measurements. Calibration was achieved by adopting a horizontal hydraulic conductivity for the Ordovician rock mass of 1×10^{-8} m/sec. Subsequent updates to the numerical model (AGE 2013, 2016) adopted lower hydraulic conductivity values for the Ordovician rock mass to improve the ability of the model to replicate the groundwater ingress estimated for Cadia East and Cadia Hill open pit. The most recent update to the groundwater model adopted a hydraulic conductivity for the Ordovician rock mass of between 5×10^{-12} to 6×10^{-11} m/sec to achieve calibration with estimated and observed groundwater inflows to the mining areas.

The groundwater modelling has consistently predicted a relatively steep cone of depression and limited zone of drawdown within the rock mass around the Cadia Hill pit shell (and the Cadia East underground mine). This has been confirmed by monitoring within geotechnical piezometers installed within the Cadia Hill pit walls that have retained high pore pressures.

The AGE (2009) numerical model provided an estimate of groundwater inflow rate to the Cadia Hill open pit of 1.5 ML/day reducing to 1.3 ML/day when Cadia East mine was developed. As noted, subsequent updates to the groundwater model have reduced the bedrock hydraulic conductivity to achieve a better match to the estimate of groundwater inflow to Cadia Hill from the pit water balance of <0.7 ML/day (AGE 2016).

Gilbert & Associates (2009) assessed the long term behavior of the waterbody that will form in Cadia Hill using a water balance model. Groundwater inflows predicted by AGE (2009) were represented in the model along with surface runoff from the adjacent catchment, incident rainfall and evaporation from the surface of the Cadia Hill open pit and Cadia East subsidence zone combined final void waterbody. The modelling indicated Cadia East would slowly fill over a period of 150 to 160 years before spilling into the Cadia Hill open pit and eventually reaching a combined equilibrium water level of 670 mAHD at around 330 years. The model was subsequently updated using a Cadia Hill open pit groundwater influx of 0.7 ML/day and Cadia East underground influx of 1.5 ML/day to better represent the estimates of the pit water balance and observed underground inflows. The updates had no effect on the equilibrium level, but extended the period to equilibrium to approximately 900 years (Hydro Engineering Consultants [HEC], 2018).

At equilibrium, the 2009 modelling indicated the evaporation rate from the final void would average 12.5 ML/day, which is significantly in-excess of the groundwater ingress. AGE (2009) concluded the evaporative pumping effect of the final void waterbody will result in the water level remaining below pre-mining levels forming a 'groundwater sink' which will continue to draw groundwater into the void over time. While the 2018 revised modelling conducted by HEC indicates that the final void evaporation rates would be closer to 10 ML/day, it remains much more than groundwater inflows and the predicted long term equilibrium water level would be unchanged (HEC, 2018).

The effect of this will be to concentrate salt within the void waterbody, preventing movement of void water into the rock mass surrounding the pit shell. Further, it is noted that the quality of the final void waterbody is also predicted to be affected by the geochemistry of the host rock mass, with acidic drainage generated from the oxidation of potentially acid forming Ordovician volcanic material within the cave zone likely to reduce the pH and increase dissolved metal concentrations in the water (Gilbert & Associates, 2009).

4 Water quality

Groundwater quality data collected from the Cadia Hill open pit and from two monitoring bores (PZ4 and PZ5 is summarised in Table 1. The locations of monitoring bores PZ4 and PZ5 is indicated in Figure 3.

Table 1 Water quality data

Analyte	Units	Pit Lake	Pit Lake (CAWS65)	PZ4	PZ4	PZ5
Date sampled		20/03/2018	1/05/2018	25/05/2018	21/06/2018	20/06/2018
pH Value	pH Unit	8.16	8.24	4.2	5.01	7.18
EC	µS/cm	1,820	1,790	128	114	230
TDS	mg/L	1,380	1,380	67	78	165
Chloride	mg/L	21	20	5	8	19
Sulphate	mg/L	756	859	15	25	24
Hydroxide Alkalinity	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity	mg/L	150	156	<1	<1	49

Analyte	Units	Pit Lake	Pit Lake (CAWS65)	PZ4	PZ4	PZ5
Total Alkalinity	mg/L	150	156	<1	<1	49
Calcium	mg/L	178	192	6	8	24
Magnesium	mg/L	86	90	1	2	5
Sodium	mg/L	101	103	1	6	10
Potassium	mg/L	4	5	2	3	3
Aluminium	mg/L	0.01	0.1	0.35	0.02	<0.01
Antimony	mg/L	<0.001	<0.001	0.002	0.002	<0.001
Arsenic	mg/L	<0.001	<0.001	0.001	<0.001	<0.001
Cadmium	mg/L	<0.0001	<0.0001	0.0004	0.0003	0.0002
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Cobalt	mg/L	<0.001	<0.001	0.007	0.006	0.002
Copper	mg/L	0.005	0.009	0.4	0.151	0.05
Lead	mg/L	<0.001	<0.001	0.038	<0.001	<0.001
Manganese	mg/L	0.006	0.006	0.101	0.117	0.159
Molybdenum	mg/L	0.034	0.04	<0.001	<0.001	0.002
Nickel	mg/L	<0.001	0.001	0.017	0.014	0.004
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	mg/L	<0.001	<0.001	0.21		
Zinc	mg/L	0.056	0.129	0.21	0.307	0.25
Iron	mg/L	<0.05	<0.05	0.55	<0.05	<0.05
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nitrite	mg/L	<0.01	<0.01	<0.01	0.05	0.03
Nitrate	mg/L	0.45	0.4	3.52	3.11	4.91
Nitrite + Nitrate	mg/L	0.45	0.4	3.52	3.16	4.94
Total Kjeldahl Nitrogen	mg/L	<0.1	<0.1	1.7	1.4	0.6
Total Nitrogen	mg/L	0.4	0.4	5.2	4.6	5.5
Total Phosphorus	mg/L	<0.01	0.03	0.18	0.16	0.68

The water quality data indicates the groundwater quality in the Pit Lake is slightly alkaline and brackish. The water quality data for PZ4 (which is approximately 40 m deep) indicates this groundwater is acidic and fresh, whilst the groundwater quality for PZ5 (which is approximately 100 m deep) is neutral and fresh.

The relative proportions of the major ions in the five water samples are presented graphically in the Piper diagram in Figure 6.

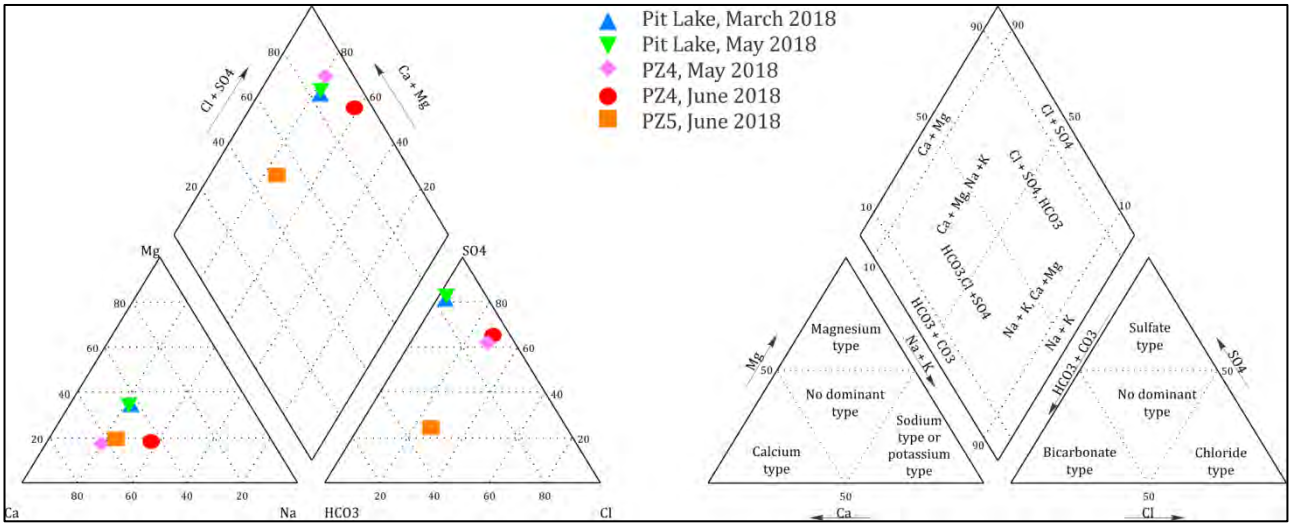


Figure 6 Piper diagram – Pit Lake and surrounding groundwater quality

The Piper diagram identifies three different water types as follows:

- pit water shows a calcium-sulphate dominate water type;
- bore PZ4 groundwater shows a calcium-sulphate dominate water type; and
- bore PZ5 groundwater shows a calcium-bicarbonate dominate water type.

Additional observations regarding the dissolved metals concentrations include detectable levels of:

- aluminium, copper, manganese, molybdenum nickel and zinc within the Pit Lake waters;
- aluminium, antimony, arsenic, cadmium, cobalt, copper, lead, manganese, nickel, and zinc in PZ4; and
- cadmium, chromium, cobalt, copper, manganese, molybdenum, nickel, and zinc in PZ5.

The data indicates an overall increase in dissolved metals concentrations in the more acidic groundwater (PZ4) compared to that for the more alkaline water in the Pit Lake.

5 Impact assessment

The impact of depositing tailings within Cadia Hill open pit on the groundwater regime depends on the potential for tailings water to leak from the pit shell into the surrounding rock mass and then to move to receptors such as aquifers or streams. The movement of tailings water into or out of the pit shell is controlled by the difference in the water level within the pit shell, and the groundwater level in the rock mass immediately outside the pit shell. The proposed modification comprises deposition of approximately 70 Mt of additional tailings from the approved consolidated level of tailings deposition of 420 mAHD up to a consolidated tailings level of 560 mAHD. Should emplacement cease at a consolidated tailings level of 560 mAHD, post mining the void will flood with water submerging the tailings and recover to an estimated final void equilibrium level of 670 mAHD (HEC, 2018).

The available information on the groundwater regime indicates there is no potential for material transport of tailings solutes between the tailings deposited in Cadia Hill open pit and the surrounding groundwater regime. This is a function of the lower level of tailings and water within the Cadia Hill pit shell compared to the water levels within the surrounding rock mass. The tailings emplacement is some 148 m lower than the invert of Cadiangullong Creek at 708 mAHD (Figure 2). Whilst the tailings are being emplaced into Cadia Hill open pit, this will mean there is no potential for flow of tailings water into the creek. After closure, rainfall and groundwater seepage over an extended period will fill the void to an estimated level of 670 mAHD, which is some 40 m lower than the base of Cadiangullong Creek, and again will prevent any mechanism for flow of tailings solutes into the creek.

Numerical modelling and pressures measured within geotechnical piezometers have indicated groundwater levels within the rock mass surrounding Cadia Hill pit are higher than the level of the tailings (see Figure 3) and the equilibrium water level post mining. For example the current water level measured within piezometers MB30 (702 mAHD) and PZ4 (729 mAHD), exceeds with the predicted future water level within the open void (670 mAHD). Groundwater flows from areas of high pressure/level to low pressure/level meaning the inward hydraulic gradient towards the pit shell that has developed will remain during deposition of the tailings and also remain post mining.

There is also no potential for direct connectivity with the Tertiary basalt and Silurian limestones that can form aquifers within the region, as these units have not been intersected by the Cadia Hill pit shell, and the hydraulic gradients will not promote flow in the direction of the aquifers.

The Cadia East Project was assessed and approved in 2009 prior to the enactment of the AIP (NOW, 2012). CHPL holds groundwater extraction licences to account for the groundwater ingress into mining areas. The proposed tailings emplacement will not increase the volume of groundwater entering Cadia Hill open pit during operations. The reverse is expected because the tailings will be in the range of 40% to 45% water (i.e. 55% to 60% solids), which will reduce the time to fill the final void to the equilibrium level of 670 mAHD. Therefore, there would be no net increase to the predicted groundwater take or licenced allocations required as a result of the Modification.

It is noted that the continuation of tailings deposition in Cadia Hill open pit would have no material impact on the long term recovery of regional groundwater tables or long term water quality in the final void waterbody, as these would be dominated by the Cadia East underground groundwater inflow rates, incident rainfall, host rock geochemistry and evapo-concentration of salts at the surface of the waterbody.

Notwithstanding, a comparison of the CVO including the proposed modification, against the AIP (NOW, 2012) is provided in the attached tables. It should be noted that much of the information in the tables is based on the updated modelling presented by AGE (2016), and therefore, describes the impacts of the entire CVO in comparison to the proposed modification.

6 Conclusions

The available information on the groundwater regime indicates that there is no potential for connectivity between the tailings emplacement proposed within Cadia Hill open pit and the surrounding groundwater regime because:

- tailings will be some 148 m lower than the invert of Cadiangullong Creek at 708 mAHD (Figure 2);
- after closure, the recovered water level within the Cadia Hill open pit and Cadia East subsidence zone combined final void will reach an equilibrium of 670 m AHD, which is lower than the groundwater level measured within piezometers in the surrounding rock mass (see Figure 3), and means the inward hydraulic gradient towards the pit shell that has developed following commencement of mining, will remain during deposition of the tailings and continue post mining; and
- Tertiary basalt and Silurian limestones that can form aquifers within the region have not been intersected by the Cadia Hill pit shell and the hydraulic gradients will not promote flow in the direction of these aquifers.

Given the lack of connectivity, the risk to the groundwater regime from the tailings emplacement is considered negligible.

Previous studies also identified that the water quality of the combined Cadia Hill and Cadia East final void will be affected by the long term evapo-concentration of salts and also acidic drainage of potentially acid forming Ordovician host rock affecting pH and dissolved metal concentrations. The continued addition of the tailings solids to the Cadia Hill open pit would not affect the long term water quality of the recovered groundwater table or combined final void, as the void water quality would continue to be an outcome of evapo-concentration of salts and the geochemistry of the Cadia East host rock, both of which would be unchanged by the Modification.

A supplementary review of potential impacts associated with the modification against the AIP's Minimal Impact Considerations also indicates that the modification is acceptable.

Please contact the undersigned should you have any queries or require clarification.

Yours faithfully,

JAMES S. TOMLIN
Principal Hydrogeologist/Director
Australasian Groundwater and Environmental Consultants Pty Ltd

7 References

Australasian Groundwater and Environmental Consultants Pty Ltd (2009) "*Cadia East Project Groundwater Assessment*", April 2009, Project Number G1383.

Australasian Groundwater and Environmental Consultants Pty Ltd (2013) *"Cadia East Mine Update to Groundwater Model",* June 2013, Project Number G1383A.

Australasian Groundwater and Environmental Consultants Pty Ltd (2016) *"Cadia Mine Update to Groundwater Model",* August 2016, Project Number G1383C.

Cadia Holdings Pty Limited (2018) "*Cadia Hill Tailings Modification – State of Environmental Effects*".

Gilbert Associates (2009) "*Cadia East Project, Surface Water Assessment*", Prepared for: Cadia Holdings Pty Limited, May 2009.

Hydro Engineering Consultants (2018) "*Cadia Hill Tailings Continuation: Final Void Water Balance and Water Management*", Prepared for: Cadia Holdings Pty Limited, June 2018.

Newcrest (2006) "*Cadia Hill Pit Geotechnical Report".*

Newcrest (2015) "*Cadia Hill Pit Cutback 4 Geotechnical Pre-Feasibility Study".*

New South Wales Office of Water (2012) *"Aquifer Interference Policy"*.

Attachment Responses to AIP requirements

AIP requirement		Response	
		Approved operations	Proposed modification
1	Described the water source (s) the activity will take water from?	• Lachlan Fold Belt MDB Groundwater Source • Orange Basalt Groundwater Source	No change due to Modification
2	Predicted the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity?	• Lachlan Fold Belt MDB Groundwater Source – 1024.1 ML/yr[1] • Orange Basalt Groundwater Source – 314.6 ML/yr[1] average	No additional take due to Modification
3	Predicted the total amount of water that will be taken from each connected groundwater or surface water source after the closure of the activity?	Peak will occur during mining, and reduce post mining	The evaporative pumping effect from the Cadia Hill and Cadia East subsidence zone combined final void post mining will be unchanged due to the Modification
4	Made these predictions in accordance with Section 3.2.3 of the AIP? (page 27)	Numerical model used subjected to 3D transient calibration – refer AGE (2016)	Modification will not result in significant change to environmental impacts therefore no additional modelling required
5	Described how and in what proportions this take will be assigned to the affected aquifers and connected surface water sources?	• Lachlan Fold Belt MDB Groundwater Source – 1024.1 ML/yr[1] • Orange Basalt Groundwater Source – 314.6 ML/yr[1] average	No additional take due to Modification
6	Described how any licence exemptions might apply?	N/A	N/A
7	Described the characteristics of the water requirements?	Yes – refer AGE (2016)	No additional water requirements due to Modification
8	Determined if there are sufficient water entitlements and water allocations that are able to be obtained for the activity?	Yes: • WAL31072 - Units 408.1 ML[1], Lachlan Fold Belt MDB Groundwater Source • WAL36229 - Units 1024.1 ML[1], Lachlan Fold Belt MDB Groundwater Source • WAL31062 - Units 314.6 ML[1], Orange Basalt Groundwater Source	No additional take due to Modification
9	Considered the rules of the relevant water sharing plan and if it can meet these rules?	Yes	No change for Modification

[1] Note – the licensed quantities shown incorporate a multiplier for the unit share

AIP requirement		Response	
		Approved operations	Proposed modification
11	Considered the effect that activation of existing entitlement may have on future available water determinations?	N/A	N/A
12	Considered actions required both during and post-closure to minimize the risk of inflows to a mine void as a result of flooding?	Post mining the Cadia Hill and Cadia East subsidence zone combined final void will flood and lakes will form in the subsidence voids	No change due Modification
13	Developed a strategy to account for any water taken beyond the life of the operation of the project?	Surrendering of water licenses post mining if required	No change due to Modification
	Will uncertainty in the predicted inflows have a significant impact on the environment or other authorized water users? *Items 14-16 must be addressed if so.*		No - continued tailings emplacement will reduce inflow to Cadia Hill open pit
14	Considered any potential for causing or enhancing hydraulic connections, and quantified the risk?		No potential to cause or enhance hydraulic connections
15	Quantified any other uncertainties in the groundwater or surface water impact modeling conducted for the activity?	Yes - sensitivity analysis undertaken by AGE (2016)	Pit water balance updated for proposed tailings emplacement modification – refer HEC (2018)
16	Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the project, and how these requirements will be accounted for?	Yes ongoing monitoring and routine updates to groundwater model in accordance with Schedule 3, Condition 34(d) of PA 06_0295	No additional strategies beyond those outlined within the Water Management Plan considered necessary

Determining water predictions in accordance with Section 3.2.3

AIP requirement		Response	
		Approved operations	Proposed modification
1	Addressed the minimum requirements found on page 27 of the AIP for the estimation of water quantities both during and following cessation of the proposed activity?		The proposed tailings emplacement is not expected to change previously predicted water quantities

Other requirements to be reported on under Section 3.2.3

AIP requirement		Response	
		Approved operations	Proposed modification
1	Establishment of baseline groundwater conditions?	Yes previously provided	Yes known from monitoring – no change from Modification
2	A strategy for complying with any water access rules?	Yes refer Water Management Plan	Not applicable as no additional water take expected
3	Potential water level, quality or pressure drawdown impacts on nearby basic landholder rights water users?	Yes predictions provided in previous approval documents	No additional impact on nearby basic landholder rights water users predicted
4	Potential water level, quality or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources?	Yes predictions provided in previous approval documents	No additional impacts on licensed water users in connected groundwater and surface water sources predicted
5	Potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems?	Yes predictions provided in previous approval documents	No additional drawdown impacts predicted
6	Potential for increased saline or contaminated water inflows to aquifers and highly connected river systems?	Yes predictions provided in previous approval documents- previous predictions that the Cadia Hill and Cadia East subsidence zone combined final void will form an evaporative sink concentrating salts and may include acid rock drainage (ARD)	No change due to Modification
7	Potential to cause or enhance hydraulic connection between aquifers?	Yes predictions provided in previous approval documents	No potential for cause or enhance hydraulic connection between aquifers
8	Potential for river bank instability, or high wall instability or failure to occur?	N/A	N/A
9	Details of the method for disposing of extracted activities (for CSG activities)?	N/A	N/A

Addressing the minimal impact considerations

Aquifer	Fractured rock - Orange Basalt	
Category	**Highly productive**	
Level 1 minimal impact consideration	**Previous assessment**	**Proposed modification**
<u>Water table</u> Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. **OR** A maximum of a 2 m water table decline cumulatively at any water supply work.	**Acceptable** • No high priority groundwater dependent ecosystems or culturally significant sites have been identified within the predicted zone of depressurisation. • Updated model indicates no private water supply bores predicted to be impacted by drawdown in excess of 2 m.	• No additional drawdown predicted due to proposed Modification. • No change due to Modification.
<u>Water pressure</u> A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.	**Acceptable** • Updated model indicates no private water supply bores predicted to be impacted by drawdown in excess of 2 m.	• No change due to Modification.
<u>Water quality</u> Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	**Acceptable** • Groundwater flow is towards Cadia Hill and Cadia East - therefore, there will be no change in the beneficial use category of the basalt. • Post mining ,the Cadia Hill and Cadia East subsidence zone combined final void will remain a permanent sink to groundwater and therefore the flow will be into the void and there will be no change in the beneficial use category of the basalt. • Previous predictions that the Cadia Hill and Cadia East subsidence zone combined final void will form an evaporative sink concentrating salts and may include ARD. • Transfer of tailings supernatant water to the open pit is approved.	• No change due to the Modification

Aquifer	Fractured rock - Orange Basalt		
Category	Highly productive		
Level 1 minimal impact consideration		**Previous assessment**	**Proposed modification**
Aquifer	Porous rock or fractured rock – Silurian and Ordovician Bedrock - Lachlan Fold Belt MDB Groundwater Source		
Category	Less productive		
Level 1 Minimal impact consideration		**Previous assessment**	**Proposed modification**
<u>Water table</u> Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. **OR** A maximum of a 2 m water table decline cumulatively at any water supply work.		**Acceptable** • No high priority groundwater dependent ecosystems or culturally significant sites have been identified within the predicted zone of depressurisation – • Updated model indicates no private water supply bores predicted to be impacted by drawdown in excess of 2 m –	• No change due to Modification • No change due to Modification
<u>Water pressure</u> A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.		**Acceptable** • Updated model indicates no private water supply bores predicted to be impacted by drawdown in excess of 2 m –	• No change due to Modification.
<u>Water quality</u> Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.		**Acceptable** • Groundwater flow is towards Cadia Hill - therefore, there will be no change in the beneficial use category of the water source. • Post mining the Cadia Hill and Cadia East subsidence zone combined final void will remain a permanent sink to groundwater and therefore the flow will be into the void and there will be no change in the beneficial use category of the water source.	• No change due to the Modification

Aquifer	Fractured rock - Orange Basalt	
Category	Highly productive	
Level 1 minimal impact consideration	**Previous assessment**	**Proposed modification**
	• Previous predictions that the Cadia Hill and Cadia East subsidence zone combined final void will form an evaporative sink concentrating salts and may include ARD. • Transfer of tailings and supernatant water to the open pit is approved.	

ENCLOSURE 3
FINAL VOID WATER BALANCE AND WATER MANAGEMENT

hec
HYDRO ENGINEERING
& CONSULTING PTY LTD

31 July 2018

Acting Approval Superintendent
Cadia Valley Operations – Newcrest Mining Limited
1460 Cadia Road
Orange NSW 2800
via Email
Attention: Jane Chung

Jane,

Re: Cadia Valley Operations – Cadia Hill Tailings Disposal: Final Void Water Balance and Water Management

We understand that Cadia Holdings Pty Limited (CHPL) is further evaluating long term tailings storage options following approval to store tailings in the Cadia Hill open pit to a final elevation of 420 metres (m) Australian Height Datum (AHD), with the approval obtained on 20 April 2018 (Modification 11).

It is understood that CHPL plans to seek a new approval to increase the in-pit deposition of tailings up to a final elevation of 560 m AHD.

The proposed tailings deposition would not involve any change to the approved Cadia Valley Operations except with respect to tailings transport, deposition and water return.

The proposed Modification would comprise continued deposition of Cadia Valley Operations tailings in the completed Cadia Hill Open Pit (i.e. in-pit deposition), which commenced in May 2018, occurring up to a maximum elevation of 560 m AHD once consolidated (i.e. approximately 100 million tonnes (Mt) tailings or approximately three years' duration at permitted annual ore processing rates). This is an increase of approximately 70 Mt over deposition to the existing approved elevation of 420 m AHD.

Further to our recent correspondence we have undertaken a review and update of the final void water balance model for the Cadia Hill open pit and Cadia East subsidence zone.

The final void water balance model was originally developed as part of the Cadia East Project Environmental Assessment[1]. The model has been updated to assess the final void water balance inclusive of deposition of some 100 Mt of mine tailings in the Cadia Hill open pit up to a nominal consolidated tailings level of 560 m AHD. Note that the increase in tailings deposition up to 560 m AHD represents approximately 30% of the total volume of the Cadia Hill open pit.

A conceptual longitudinal section of the Cadia Hill open pit and the Cadia East subsidence zone at the end of mining is given in Figure 1. The post-mining surface subsidence area would be approximately 255 hectares (ha) and would resemble a dish shaped depression surrounded by steep slopes on the margin. A surrounding 'zone of influence' would occupy a further 150 ha. The predicted minimum final subsidence surface within the void is at 665 m AHD.

[1] Gilbert & Associates Pty Ltd (2009). "Cadia East Project Surface Water Assessment". Report prepared for Cadia Holdings Pty Limited, April, as *Appendix F – Cadia East Project Environmental Assessment.*

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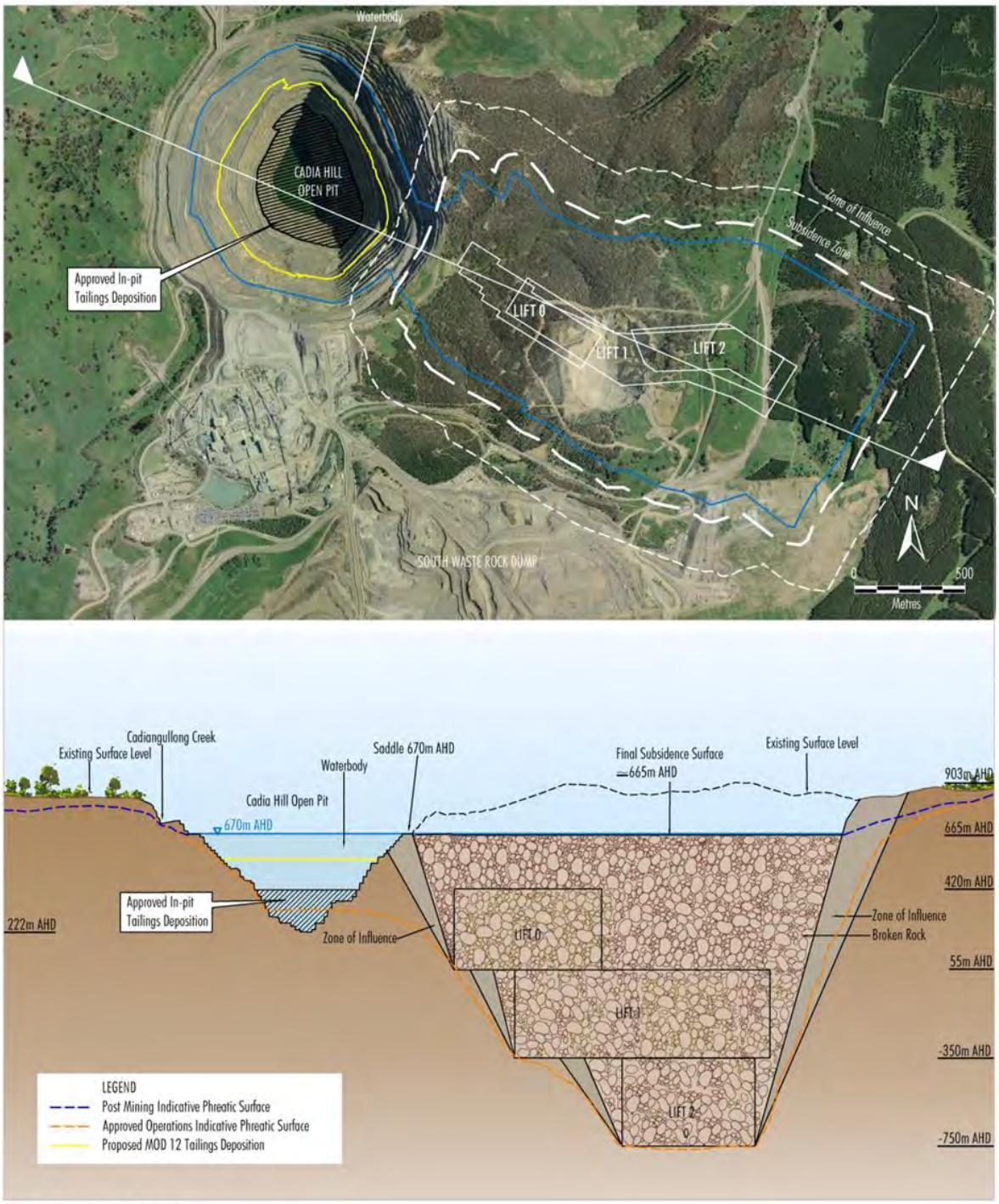

Source: CHPL (2008) ; After AGE (2018)

Figure 1 Conceptual Long Section of the Cadia Hill Open Pit and the Cadia East Subsidence Zone[2,3]

Part of the Cadia East subsidence zone would overlap the eastern edge of the Cadia Hill open pit. The predicted level of the topographic saddle between the two voids would be at a level of approximately 670 m AHD. The lowest point on the perimeter of the Cadia Hill open pit is estimated to be at 721 m AHD, near the south-western side of the open pit adjacent to Cadiangullong Creek.

[2] Cadia Holdings Pty Limited (2000). "Cadia East Project Environmental Assessment".

[3] Australian Groundwater and Environmental Consultants Pty Ltd (2018). "Cadia Hill Tailings Continuation – Groundwater Assessment".

Given that this level is significantly higher than the projected saddle between the open pit and the subsidence zone, a single final void water body was identified as forming, spanning both the Cadia Hill open pit and the Cadia East subsidence zone[4].

The same water balance model methodology has been used as in the Cadia East Project Environmental Assessment[5] and as undertaken in support of Modification 11[6], in order to predict post-mining water level behaviour in the Cadia Hill open pit and the Cadia East subsidence zone inclusive of the proposed Cadia Hill tailings deposition.

Groundwater inflows to this void would contribute significantly to the level of the final void waterbody. Surface runoff from the adjacent catchment and incident rainfall would also contribute to total inflows. Water would be lost through evaporation from the surface of the final void waterbody (averaging some 10 megalitres/day in the long term). In the long term, the final water level in the void would reflect an average balance between residual inflows and outflows.

Groundwater inflow estimates at different final void waterbody water levels were provided by Australasian Groundwater and Environmental Consultants (AGE) as part of the Modification 11 assessment and used in the updated final void water balance modelling. Simulations have been undertaken using a long sequence of daily rainfall and evaporation data to provide an indication of the likely filling rates and ultimate equilibrium level with and without the proposed deposition of tailings in the Cadia Hill open pit.

The following summarises key features of the updated model:

1. Updated rainfall runoff model parameters – using values derived from recent calibration of the Cadia Valley Operations water balance model.
2. Updated daily rainfall data using 129 years available data from the SILO Data Drill[7] for the site location. The data was repeated several times over to generate a long sequence of rainfall for the simulation.
3. Updated daily pan evaporation data for 129 years (also from the SILO Data Drill), which was adjusted on basis of 12 years of site evaporation data and then multiplied by regional pan factors[8]. The data was repeated several times over to generate a long sequence of evaporation for the simulation.
4. Groundwater inflow rates versus water level in both the Cadia Hill open pit and the Cadia East subsidence zone provided by AGE.
5. A storage level-volume-area relationship for the Cadia Hill open pit derived from available digital terrain data.
6. A tailings deposit in the Cadia Hill open pit up to an elevation of 420 m AHD (as is currently approved) or 560 m AHD.

Other model assumptions, data and methodology are unchanged from those used in the Cadia East Project Environmental Assessment.

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[4] Gilbert & Associates Pty Ltd (2009). "Cadia East Project Surface Water Assessment". Report prepared for Cadia Holdings Pty Limited, April, as *Appendix F – Cadia East Project Environmental Assessment.*

[5] *Ibid*.

[6] Cadia Holdings Pty Limited (2018). "Cadia Hill Tailings Modification – Statement of Environmental Effects".

[7] The Data Drill is a system which provides synthetic data sets for a specified point by interpolation between surrounding point records held by the Bureau of Meteorology. Refer https://legacy.longpaddock.qld.gov.au/silo/datadrill/

[8] McMahon, TA, Peel, MC, Lowe, L, Srikanthan, R & McVicar, TR (2013). "Estimating actual, potential, reference crop and pan evaporation using standard meteorological data: a pragmatic synthesis". Hydrology and Earth System Sciences, vol. 17, pp. 1331-1363.

The results of the simulations are shown in Figure 2.

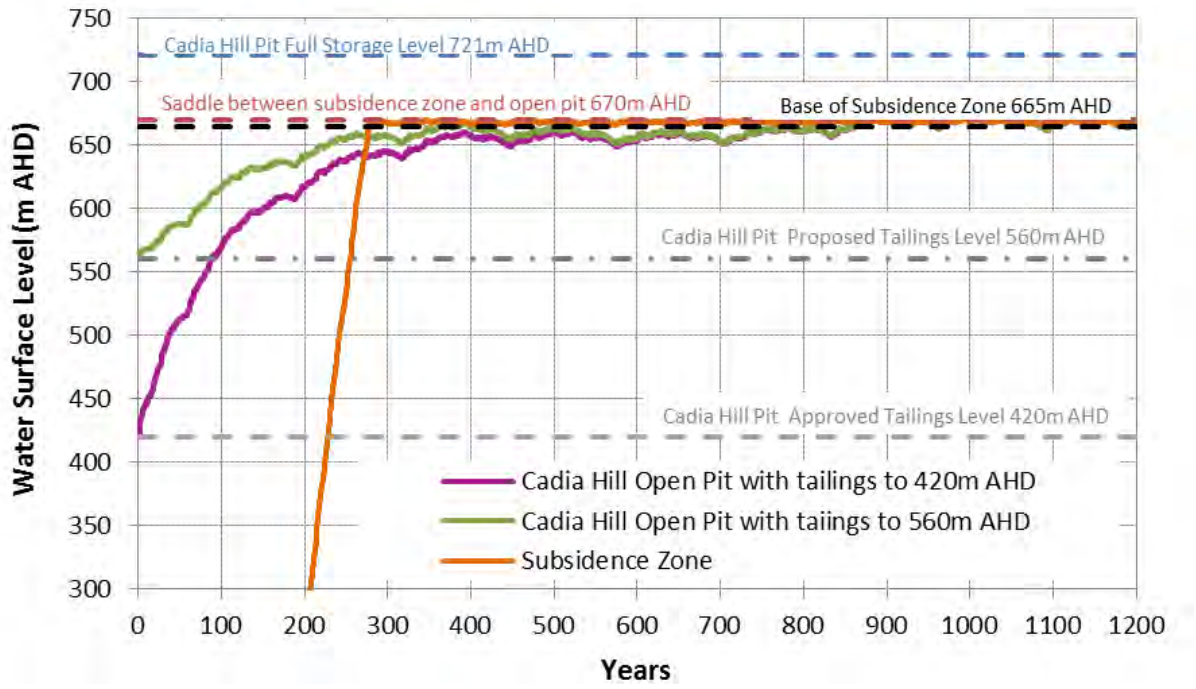

Figure 2 Simulated Final Void Filling Behaviour

The simulation indicates an estimated time required for a void water body to initially form within the Cadia East subsidence zone (i.e. to fill the void spaces of the subsidence zone) of approximately 270 to 280 years. After approximately 330 years, water from the subsidence zone is predicted to reach and overtop the 'saddle' between the Cadia Hill open pit and the Cadia East subsidence zone void. After approximately 880 years the water in both the Cadia Hill open pit and the Cadia East subsidence zone void is predicted to reach an oscillating equilibrium level around the level of the saddle (670 m AHD), which is approximately 51 m below the lowest point on the perimeter of the Cadia Hill open pit. This level is unchanged from previous Cadia East modelled long term equilibrium levels[9] [10].

Minor fluctuations in the water level around the level of the saddle are expected thereafter in response to climatic conditions. The results indicate that void surface waters would continue to be isolated from Cadiangullong Creek even under extremely wet climatic conditions. The results also indicate that the tailings proposed to be deposited to 560 m AHD would remain submerged by up to approximately 110 m of final void water.

The proposed higher initial tailings level has no material effect on the behaviour of the final void water body in the long term because of the very long period of time involved in reaching an equilibrium level and requires no change to the approved final closure concept.

It should be noted that the above predictions forecast final void filling over a very long time period. The forecast is dependent on the future rainfall and evaporation data which has been assumed to be the same as that recorded for the last 129 years, which is consistent with assumptions in the Cadia East Project Environmental Assessment.

[9] Gilbert & Associates Pty Ltd (2009). "Cadia East Project Surface Water Assessment". Report prepared for Cadia Holdings Pty Limited, April, as *Appendix F – Cadia East Project Environmental Assessment.*

[10] HEC (2018). "Cadia Valley Operations – Cadia Hill Tailings Disposal: Final Void Water Balance and Water Management".

With respect to potential impacts on final void water quality, the following is noted:

- Cadia Valley Operations is already approved to deposit tailings to the Cadia Hill open pit.
- The approved final Cadia Hill and Cadia East subsidence zone void lake would concentrate salts over time due to evaporation from the surface of the waterbody.
- The combination of acidic drainage generated from the oxidation of potentially acid forming Ordovician volcanic material within the Cadia East cave zone and the long term evapo-concentration of salts would be key drivers of the final void water quality of the approved Project.
- Both of these key drivers of final void water quality would be unchanged by the proposed Modification.

In terms of the operational water management of the Cadia Hill open pit during tailings deposition, water which may accumulate within the Cadia Hill open pit from tailings supernatant water and rainfall runoff, would continue to be managed by pumped recovery to the Cadia Valley Operations water management system and would be re-used in the process plant. The pump rate has been set to match the adopted tailings deposition rate, water liberation rate and anticipated rainfall runoff. Pumped water reclaim from the Cadia Hill open pit would continue to be given the same priority within the water management system as the other operational tailings storages.

Consistent with the Modification 11[11] recommendations, the following recommendations are made with regard to surface water monitoring of the Cadia Hill open pit during tailings deposition:

- Weekly monitoring of pond water level;
- Annual monitoring of tailings beach profile once a beach is established;
- Daily volumes of water reclaim; and
- Daily volumes and tonnages of tailings discharged.

Please contact the undersigned if you have any queries.

Yours faithfully,

Tony Marszalek
Director

[11] Cadia Holdings Pty Limited (2018). "Cadia Hill Tailings Modification – Statement of Environmental Effects".

ENCLOSURE 4
EXPERT OPINION

HydroAlgorithmics Pty Ltd ● ABN 25 163 284 991
PO Box 241, Gerringong NSW 2534. Phone: (+61 2) 4234 3802

noel.merrick@hydroalgorithmics.com

DATE: 2 August 2018

TO: Jane Chung
Acting Approval Superintendent
Cadia Valley Operations (CVO) – Newcrest Mining Limited
1460 Cadia Road
Orange. NSW 2800.

FROM: Dr Noel Merrick

RE: Cadia Hill Tailings Continuation Modification –
Expert Opinion

YOUR REF: Email 1 June 2018

OUR REF: HA2018/09

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1. Introduction

This report provides an expert opinion on the Tailings Continuation 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. Following a limited breakthrough of tailings material from the NTSF (Northern Tailings Storage Facility) embankment into the STSF (Southern Tailings Storage Facility) on 9 March 2018, Cadia Holdings Pty Limited (CHPL) re-evaluated the long-term tailings storage options.

Subsequently, CHPL gained approval on 20 April 2018 through "Cadia Modification 11 – Cadia Hill Tailings" to deposit tailings within the completed Cadia Hill Open Pit. This approval is for tailings deposition up to 420 metres (m) Australian Height Datum (AHD), once consolidated. During the approval process, the reviewer gave advice to CVO on responding to agency comments, groundwater monitoring network expansion, and core selection for laboratory measurements of permeability.

It is understood that CHPL plans to seek a new approval to increase the in-pit deposition of tailings up to a final elevation of 560 mAHD. This modification is being undertaken via a *Statement of Environmental Effects* (SEE), and this letter report forms supporting documentation for the SEE.

The substance of the Modification is:

> • *Deposition of CVO tailings in the completed Cadia Hill Open Pit (i.e. in-pit deposition) from an approved elevation of 420 mAHD to 560 mAHD, once consolidated (i.e. approximately 70 million tonnes [Mt] additional tailings or approximately two years duration at permitted annual ore processing rates).*

Dr Noel Merrick of HydroAlgorithmics Pty Ltd has been engaged to provide an expert opinion based on completed hydrogeological and hydrological assessments, and on previous experience at the site in the capacity of a peer reviewer.

2. Documentation

The expert opinion is based on the following two letter reports:

1. Australasian Groundwater and Environmental Consultants Pty Ltd (AGE), 2018, *Cadia Hill Tailings Continuation – Groundwater Assessment.* Letter JST:tb(G1383P.CadiaMOD12) to Jane Chung, Cadia Valley Operations – Newcrest Mining Limited, 6 July 2018. 14p.

2. Hydro Engineering & Consulting Pty Ltd (HEC), 2018, *Cadia Valley Operations - Cadia Hill Tailings Disposal: Final Void Water Balance and Water Management*. Letter J1310-9.l1a.docx to Jane Chung, Cadia Valley Operations – Newcrest Mining Limited, 6 July 2018. 5p.

Reference is also made to a previous expert opinion for the Cadia Hill Tailings Deposition that was undertaken in March 2018:

3. HydroAlgorithmics, 2018, *Cadia Hill Tailings Deposition - Peer Review*. Letter HA2018/06 to Andrew Wannan, Cadia Valley Operations – Newcrest Mining Limited, 13 March 2018. 4p.

An earlier peer review of the groundwater assessment by AGE for the Cadia East underground project was conducted in 2009:

4. Merrick, N.P., 2009, Review of the Cadia East Groundwater Assessment. Access:UTS Report C06/44/005 for Cadia Holdings Pty Ltd, 22 October 2009. 15p.

This earlier review was based on the following report:

5. AGE, 2009, Cadia East Project Groundwater Assessment. Report G1383/D for Cadia Holdings Pty Ltd, April 2009. 112p + 5 Attachments.

Document #1 has the following sections:

1. Introduction and scope of work
2. Groundwater regime of Cadia Hill
3. Previous modeling
4. Water Quality
5. Impact Assessment
6. Conclusions
7. References

Attachment: Response to AIP Requirements

Document #2 is a free-form report inclusive of two figures:

1. Conceptual Long Section of the Cadia Hill Open Pit and the Cadia East Subsidence Zone
2. Simulated Final Void Filling Behaviour

3. Groundwater Model Status

The main findings of the previous review in 2009 were:

1. Groundwater modelling was undertaken competently.
2. Model predictions were expected to be conservative as the modelling relied on steady-state simulation and structural controls were excluded.
3. Transient calibration should be undertaken as the model is revised progressively.
4. There is uncertainty as to the significance of geological structures.
5. There is uncertainty as to the assumed permeabilities in the Cadia East subsidence zone.

It is understood (from Document #1) that AGE has revised the groundwater model twice via transient re-calibration and transient simulation of predictions.

During that time, the horizontal hydraulic conductivity of the Ordovician rock mass was reduced from $1x10^{-8}$ m/sec to $(5\text{-}60)x10^{-12}$ m/sec to account for ongoing Cadia Hill inflow of about 0.7 ML/day and Cadia East inflow of about 1.5 ML/day.

Document #1 also reports on experience with the interception of structures (e.g. faults), being characterised by 0.5-20 m thickness, clay gouge infill, and insignificant water make.

The steep cone of depression around the Cadia Hill pit shell, predicted in Document #5, has been confirmed by geotechnical piezometers in the pit walls [Document #1]. Document #1 also provided recent groundwater level and water quality results.

4. Reported Assessments

Impact assessments for the proposed Modification are summarised in Document #1 and Document #2.

The key findings in Document #2 are:

1. The proposed volume of tailings would occupy "approximately 30% of the total volume of Cadia Hill open pit".
2. Part of the Cadia East subsidence zone would overlap the eastern edge of Cadia Hill, but only late in time, with a common saddle at elevation 670 mAHD (approximately).
3. As the lowest point on the rim of Cadia Hill is 721 mAHD, an eventual fluid surface in the Cadia Hill pit of approximately 665 mAHD would not spill, except into the Cadia East subsidence zone. Accordingly, Cadiangullong Creek is not at risk of contamination.
4. The equilibrium fluid elevation would not be reached for many centuries, and is independent of whether additional tailings are or are not deposited in the Cadia Hill pit.
5. Eventually, the Cadia Hill pit and the Cadia East subsidence zone would form a continuous volume of open fluid and/or saturated rubble.
6. The salinity of the fluid in the Cadia Hill pit would increase for many centuries due to evaporative concentration.
7. Acidic drainage from Ordovician rocks would contribute to evolving fluid chemistry.

The key findings in Document #1 are:

1. With the deposition of tailings as proposed, the Cadia Hill pit would act as a groundwater sink in the short-term
2. At late time, many centuries in the future, the Cadia Hill pit would still act as a groundwater sink when equilibrium fluid levels are reached.
3. Tailings will be some 148 m lower than the invert of Cadiangullong Creek at 708 mAHD.
4. A freeboard of more than 50 m is anticipated as a protection from external spillage.
5. Due to behaviour of the pit as a groundwater sink, there is "no potential for material transport of tailings solutes" to the surrounding groundwater system, or surface watercourses.
6. As the more permeable Tertiary basalts and Silurian limestones have not been intersected by the Cadia Hill open cut, they are not at risk of contamination.
7. With the deposition of tailings as proposed, there would be a slight reduction in groundwater inflow to the Cadia Hill pit.
8. "Given the lack of connectivity, the risk to the groundwater regime from the tailings emplacement is considered negligible."

Document #1 also provided additional evidence for the strong hydraulic gradient towards the pit from all directions, based on relevant measurements in 2012 and some measurements in early 2018, reproduced partially here as **Figure 1**.

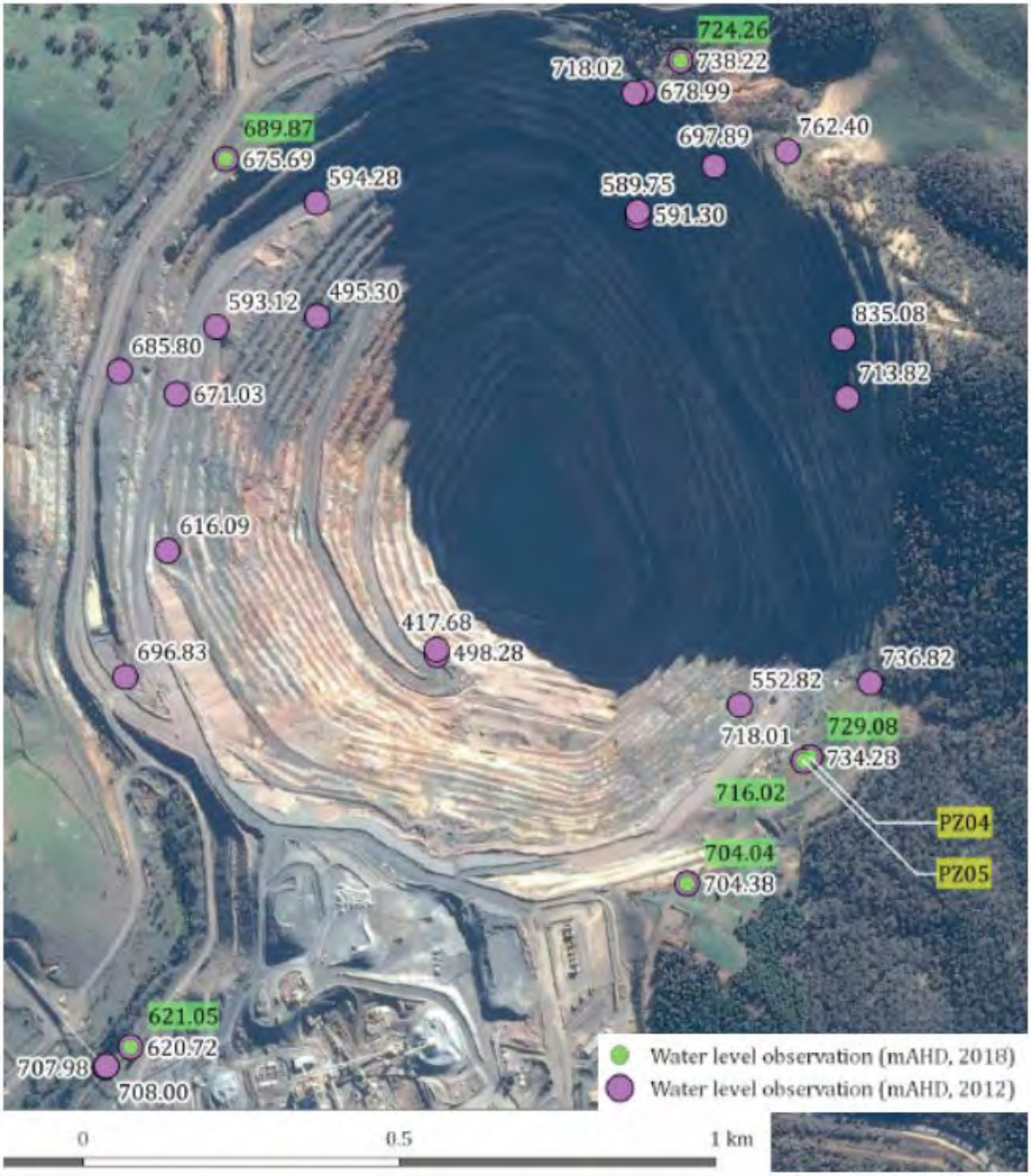

Figure 1. Measured groundwater levels in 2012 (pink) and 2018 (green)

5. Additional Observations

Without exception, this reviewer concurs with the assessments and findings proffered by AGE and HEC in Document #1 and Document #2, respectively.

The following additional observations are made here:

- The deepest bore in the existing groundwater monitoring network is at a depth of approximately 200 m. Such a depth would be more than sufficient on the rim of the Cadia Hill pit and the Cadia East operations due to the observed and simulated very steep cone of depression.

Groundwater Monitoring is carried out across a bore network at more than a hundred sites:

1. Regional Bores (7) – Historical bores, used to measure potential impacts to ground water due to mining activities

2. Ridgeway Bores (17) – Protocol bores, used to measure the impact to groundwater due to subsidence.

3. Cadia Bores (51) – MB series, used to measure potential impacts to groundwater due to mining activities.

4. Cadia East Bores (31) – Baseline data prior to Cadia East development and ongoing potential impacts to groundwater due to mining activities.

Of particular relevance are those bores in the Ordovician volcanics around the rim of Cadia Hill and Cadia East. There are 18 bores targeting this lithology, with hole depths ranging from 17 m to 136 m, with a median depth of 50 m.

The reviewer is aware of recommendations for another five monitoring bores (MB91-MB95) at sites shown in **Figure 2**, and it is understood that installation of these bores has commenced.

Figure 2. Proposed additions to the groundwater monitoring bore network

CVO has made available to the reviewer n set of laboratory permeability measurements on cores. At the time of writing, measurements of hydraulic conductivity (Kx) are available for 167 samples from 65 sites. Their statistics are summarised in **Table 1** in terms of a percentile defined as the probability of exceedance; for example, 20% of laboratory measurements have a value that exceeds 2.9E-11 m/sec.

Table 1. Laboratory Core Measurements

PERCENTILE	Kx (m/sec)
90	9.6E-13
80	1.1E-12
50	1.6E-12
20	2.9E-11
10	3.9E-10

The values are as expected for hydraulically tight rocks. As the values adopted in the current groundwater model range from 5.0E-12 to 6.0E-11 m/sec, which correspond to percentiles 37 to 17, respectively, there is good support for the model-calibrated values. There is little support for the earlier 2009-model's value of 1.0E-8 m/sec, as only 3% of measurements exceed this value.

6. Opinions

Based on the documents cited, the reviewer holds the following opinions:

- The evidence for ongoing behaviour of the Cadia Hill pit as a groundwater sink is compelling.
- A predicted ultimate freeboard in excess of 50 m indicates negligible risk of spilling outside the Cadia Hill – Cadia East continuum.
- The usual requirement of 1.0E-9 m/sec as the permeability of a liner/container, for prevention of leakage/seepage, is irrelevant when the fluid feature is a gaining system (a sink).
- The model-calibrated hydraulic conductivity of 5E-12 to 6E-11 m/sec is credible, based on recent core measurements that give a median of 1.6E-12 m/sec; however, the magnitude is inconsequential as only the rate of filling would be affected in a gaining system.
- The barrier/conduit status of intersected faults is irrelevant while the pit remains a groundwater sink (with hydraulic gradients towards the pit).
- The proposed additional tailings deposition would not alter the findings of my previous expert opinion (Document #3).

In particular, the reviewer concurs with AGE that "the risk to the groundwater regime from the tailings emplacement is considered negligible."

ENCLOSURE 5
CORRESPONDENCE FROM LOCAL COUNCILS

Blayney Shire Council
Council Office 91 Adelaide Street, Blayney **Postal Address** PO Box 62, Blayney NSW 2799
Telephone (02) 6368 2104 **Email** council@blayney.nsw.gov.au
Web www.blayney.nsw.gov.au
ABN 47 619 651 511

24 July 2018

The General Manager
Cadia Valley Operations
1460 Cadia Road
ORANGE NSW 2800

Dear Peter

RE: Application to Deposit Tailings

Further to Council's support for the modification approved by DPE in April 2018 to allow placement of tailings in the mine pit for an initial 200 metres, Newcrest Mining Cadia Valley Operations (CVO) have engaged with Council in regards to the proposal to deposit of tailings into the old mine pit for a further 140m.

This current application will enable the deposit of mine tailings for another 2 years, with transport, return of water for reuse and deposition remaining the same as per the Approval granted in April 2018. Council recognises the ongoing commitment by CVO to undertake independent environmental impact assessments with ongoing monitoring of both surface and underground water sources. Our surrounding farming lands rely on clean, uncontaminated ground and surface water for production of valuable agricultural produce.

The 2 year timeframe is necessary to ensure CVA may complete the investigation and assessment of the northern tailings dam embankment failure to then plan for the implementation of recommended remediation works.

Blayney Shire Council is supportive of CVO liaising with government agencies to facilitate a timely approvals pathway for this proposal for Cadia Hill Pit tailings.

Yours faithfully

Scott Ferguson
Mayor

CABONNE COUNCIL

Phone: (02) 6392 3247
Fax: (02) 6392 3260
Contact: Heather Nicholls

THE GENERAL MANAGER
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MOLONG 2866
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Our Ref:
Doc ID: 957918
ABN: 41992 919 200

3 August 2018

Nedra Burns
Manager Health Safety Environment & Social Responsibility
Cadia Valley Operations

Nedra.burns@newcrest.com.au

Dear Madam,

PROPOSAL TO MODIFY PROJECT APPROVAL
CADIA HILL OPEN PIT

Thank you for meeting with council staff, and your email correspondence of 27 July 2018, outlining the proposal to apply to the State government to modify the Cadia Project Approval to allow increased tailing deposition into the Cadia Hill Pit. It is understood from the information that has been provided to council that the relevant independent environmental impact assessments have been conducted, and those studies have indicated that the continuation of tailings deposition into the Cadia Hill Pit would not have an adverse environmental impact on groundwater tables or water quality.

Council has no objection to the proposal as outlined, to seek modification to the Project Approval to enable an increase of 140m of tailings deposition into the Cadia Hill Pit.

Should you have any further enquiries please contact council's Environmental Services Department on 6392 3247 between 9am and 11am Monday to Friday.

Yours faithfully,

HJ Nicholls
DIRECTOR ENVIRONMENTAL SERVICES

ORANGE CITY COUNCIL

D18/39008
F879

25 July 2018

Mr Peter Sharpe
General Manager
Cadia Valley Operations
1460 Cadia Road
ORANGE NSW 2800

Dear Mr Sharpe

DEPOSIT OF TAILINGS INTO CADIA HILL PIT STAGE 2

Orange City Council is aware of the limited slump of the Northern Tailings Storage Facility (NTSF) embankment at Cadia Valley Operations (CVO) that occurred on 9 March 2018 and of the current deposition of tailings to 200m in the Cadia Hill pit.

Council has been made aware of the proposal by CVO to deposit further tailings into the Cadia Hill pit to allow for recovery measures to be put in place at the NTSF.

Council recognises the importance of Cadia Valley Operations to the Orange economy and the valuable number of jobs it provides. Council understands the need for CVO to find alternatives to ensure the ongoing operation of the site.

It is understood that the NSW Government Department of Planning and Environment will be required to determine the impacts of this proposal including an appropriate assessment of environmental factors and other issues.

Based on the above factors, Orange City Council supports the application for the expended deposition of tailings into the Cadia Hill pit to maintain the stability of the Orange economy.

Yours faithfully

Ian Greenham
ACTING GENERAL MANAGER

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ENCLOSURE 6
SUMMARY OF PREVIOUS CADIA EAST MODIFICATIONS 1-11

Summary Comparison Table - Cadia Valley Operations (CVO) Cadia East Project and Modifications 1 – 11[1]

Approval or Modification	Mining Methods	Life of Mine Ore Production	Waste Rock Management	Life of Mine	Tailings Management	Ore Processing	Concentrate Dewatering and Transport	Water Supply and Management	Operational Employment	Other	Key Changes to Approved Cadia East Environmental Impacts
Cadia East Project (incorporating all previously approved Cadia Valley Operations [CVO])	Cadia Hill - conventional open pit mining methods. Ridgeway - underground sublevel and block caving and associated surface subsidence zone. Cadia East - underground panel caving and associated surface subsidence zone.	Cadia East - approx. 449.5 Mt. CVO - approx. 561 Mt.	Deposition in the North and South Waste Rock Dumps and mined-out void of the Cadia Extended open pit. Cadia East waste rock to be deposited in the South Waste Rock Dump.	Mining up until approx. 2030. Project Approval to 2031.	Use of the NTSF and STSF. Raising of these storages via upstream embankment lifts.	Processing of up to 27 Mtpa of gold and copper ore. Construction and operation of a Molybdenum Recovery Plant.	Transport of dewatered mineral concentrate by rail. Gold/copper concentrate transported from the ore processing facilities via a concentrate pipeline to the Blayney Dewatering Facility. Construction and operation of new CVO Dewatering Facility and concentrate pipeline.	Cadiangullong Dam, Flyers Creek Weir, Cadia Creek Weir, Rodds Creek Water Holding Dam, Orange Sewage Treatment Plant treated effluent, Blayney Sewage Treatment Plant treated effluent, on-site groundwater bores, Belubula River, site runoff and pipeline/pumping systems.	Average 880 to max approx. 1,300.	Not Applicable.	Not Applicable.
Mod 1 Cadia Hill Decline	Underground decline from Cadia Hill open pit, including bulk samples and ventilation.	0.02 Mt of additional ore.	Additional 0.8 Mt of waste rock.	No change.	No change.	No change.	No change.	No change.	No change.	Not Applicable.	No material environmental implications.
Mod 2 Blayney Dewatering Facility	No change.	No change.	No change.	No change.	No change.	No change.	Upgrade to dewatering facility capacity in Blayney and extending the life of the facility by two years.	No change.	No change.	Related to delay in establishment of CVO Dewatering Facility.	Addition of acoustic control elements which resulted in a decrease in local operational noise levels.
Mod 3 Cadia Road Pipeline Relocations	No change.	No change.	No change.	No change.	No change.	No change.	Realignment of concentrate and return water pipelines to follow existing Cadia Road rather than realigned route.	No change.	No change.	Option retained to relocate to originally approved alignment.	Minor reduction in approved land disturbance.
Mod 4 Pre-conditioning by Hydraulic Fracturing	Preconditioning of the Cadia East host rock from the surface using hydraulic fracturing.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	Not Applicable.	Negligible impacts on groundwater above those already approved. Noise impacts associated with drilling operations were temporary and limited.
Mod 5 Pre-conditioning by Blasting	Preconditioning of the Cadia East host rock from the surface using blasting techniques.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	Not Applicable.	Negligible impacts on groundwater above those already approved. Complied with existing blasting criteria. No additional noise impacts to those already assessed and approved.
Mod 6 Processing Rate Modification	No change.	Cadia East - approx. 456 Mt. CVO - approx. 562 Mt.	No change.	No change.	Minor upgrades to tailings infrastructure.	Processing of up to 32 Mtpa of gold and copper ore.	No change.	Contingent transfer of tailings water to Cadia Hill open pit for water management.	No change.	Upgrades to ore handling and processing facilities and associated increase in electricity demand. Other administrative updates.	Negligible noise emissions and no change to criteria. Negligible impacts on water supply.
Mod 7 Biodiversity Offset Modification	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	Modification of approved Biodiversity Offset Area.	No change.
Mod 8 Administrative Modification	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	Updating Project Approval schedule of lands.	No change.
Mod 9 Surface Pre-conditioning and On-Site Warehouse	Additional preconditioning of Cadia East host rock from the surface using hydraulic fracturing.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	No change.	Included on site warehouse.	Negligible impacts on groundwater above those already approved. Cumulative noise emissions compliant with noise limits.

[1] Details provided on the Department of Planning and Environment Major Projects website for the Cadia Valley Operations: http://majorprojects.planning.nsw.gov.au/

Summary Comparison Table (Continued) - Cadia Valley Operations (CVO) Cadia East Project and Modifications 1 – 11[2]

Approval or Modification	Mining Methods	Life of Mine Ore Production	Waste Rock Management	Life of Mine	Tailings Management	Ore Processing	Concentrate Dewatering and Transport	Water Supply and Management	Operational Employment	Other	Key Changes to Approved Cadia East Environmental Impacts
Mod 10 Molybdenum Plant Relocation	No change.	No change.	No change.	No change.	No change.	Relocation of the Molybdenum Recovery Plant including an upgrade in feed capacity from 460,000 tonnes per annum (tpa) to 500,000 tpa.	No change.	No change.	No change.	Increase in molybdenum product transported off-site. Relocation of the approved mine access road intersection.	No change.
Mod 11 Cadia Hill Tailings	No change.	No change.	No change.	No change.	Deposition of 30 Mt tailings into Cadia Hill open pit. Infrastructure established to support in-pit tailings deposition.	No change.	No change.	Pipeline installed to return Cadia Hill tailings water to water management system.	No change.	Minor infrastructure upgrade.	Negligible impacts on water resources above those already approved.

NTSF - Northern Tailings Storage Facility
STSF - Southern Tailings Storage Facility

[2] Details provided on the Department of Planning and Environment Major Projects website for the Cadia Valley Operations: http://majorprojects.planning.nsw.gov.au/