

Awa Koura Mining Limited
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Takaka 7182

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Environmental Associates Ltd
Our Ref: EA00160

Attention: Darryl Sycamore

Groundwater Resources Technical Assessment of Proposed Alluvial Mining Activities for Awa Koura Mining Limited, Queensbury, Central Otago

1.0 Summary

The following letter-report provides analysis and assessment of potential effects upon the groundwater (and associated surface water), environments, for a proposed alluvial mining activity, located in the Sandy Point area, Queensbury, Central Otago. For the open alluvial pit pond mining proposal, whilst mining process water will be recirculated and form a non-consumptive use, additional water will be required for dust suppression and minor rehabilitation uses. This net use of water will be sourced from the mine pit pond.

Utilising existing local aquifer hydraulic parameters from previous aquifer testing in the area, the impact of seasonal drawdown from the net water abstraction for dust suppression and minor rehabilitation uses, does not exceed the permitted baseline (of 0.2 m maximum seasonal drawdown), upon any neighbouring well utilised for water abstraction. Additionally, the effect of stream depletion upon perennial surface water bodies (solely the Clutha River Mata-Au), is of a De Minimis nature, and within permitted activity limits. Lastly, any potential for sediment migration from the mine pit pond, will be minimal or not-measurable, due to the net abstraction of water from the pond and the resulting groundwater flow toward the pit. Notwithstanding a proportion of the time (during when the mining activity is within 100 m of the Clutha River Mata-Au), the net water take (as above) will be able to occur as a permitted activity, there is otherwise sufficient groundwater allocation available to cater for the requested abstraction.

This assessment of water use and allocation, potential drawdown interference, stream depletion and sediment migration for the requested alluvial mining proposal, represents a less than minor or non-measurable effect upon the environment in all cases.

2.0 Aquifer Hydraulic Information

Whilst there are no aquifer test results available for the proposed area of alluvial mining, there are two adjacent wells/sites that provide a very good indication of the expected hydraulic parameters that would be encountered during the mining activity. Well G40/0215 reports Transmissivity and Storage from aquifer testing of 1,400 m²/day and 0.15 respectively (Otago Regional Council On-line GIS Maps Database). Well G40/0206 was solely step tested, with the results indicating a Transmissivity and Storage of 750 m²/day and 0.15 respectively.

It is expected that the proposed area of mining (on the basis of hydrogeology and the above reported aquifer hydraulic parameters), exhibits higher hydraulic conductivity and saturated thickness compared to the aforementioned well sites. Such that Transmissivity (the product of hydraulic conductivity and saturated thickness), is highly likely to be significantly greater than the above reported values. However, for the purposes of this technical assessment, a conservative Transmissivity value of 1,500 m²/day and Storage of 0.15, have been utilised to assess the potential impact of the mining activities upon the groundwater and surface water environments.

3.0 Efficiency of Water Use

Whilst the groundwater taken from the mine pond for mining materials processing is immediately returned to the pond (is non-consumptive), the net groundwater abstraction for dust suppression and some rehabilitation use is broadly consumptive. There are no guidelines for water use for dust suppression and rehabilitation, and these uses vary with each mining project. An appropriate estimate of the water use for dust suppression and rehabilitation for Awa Koura Mining Limited's Queensbury mining proposal is on the basis of:

- 20 L/s take for daily operational dust suppression and rehabilitation use (as required).
- An equivalent 6-hours per day maximum take, or 432 m³/day (5 L/s steady state).
- Monthly volume of 20-days per month maximum use = 8,640 m³/month, and
- Annual volume equivalent to 8-months maximum = 69,120 m³/annum.

Consistent with Schedule 5 of the Regional Plan Water for Otago, the maximum seasonal take is assessed as 3.3 L/s (288 m³/day) over a 240-day period.

Given the limited (small) net take for dust suppression and some rehabilitation, and considering a proportion of the take is able to occur as a permitted activity (refer below), the effect of efficiency of water use upon the environment is considered to be less than minor.

4.0 Consideration of Drawdown Interference and Stream Depletion Effects

Given the above assessment regarding typical aquifer hydraulics at the site, consideration of the potential environmental effects of the proposed (net) groundwater abstraction activity for dust suppression and rehabilitation has been undertaken. As above the maximum seasonal net groundwater abstraction from the mine pit pond is 3.3 L/s over a 240-day period. The location or extent of the mine pit pond (for groundwater abstraction), has been conservatively taken as the outer extent of the proposed mining area, and/or as per any proposed set-back buffer distance to water features.

Well Interference Effects

The interference effects assessment contained in Table 1 below provides for the seasonal rate and duration of net groundwater take in prediction (using Theis) of unconfined aquifer drawdown from the transient mine pit pond. The distance to local wells and scale of seasonal drawdown from the proposed net groundwater take is provided in Table 1.

Table 1

Drawdown Effects Prediction (after 240-days pumping @ 3.3 L/s, Unconfined T = 1,500 m²/day and S = 0.15)

Well number and use	Distance from mining area boundary to well (m)	Predicted (Theis) seasonal drawdown (m)
G40/0206 Community drinking water supply	162	0.08
CB13/0183 Irrigation	138.2	0.09
G40/0392 Domestic water supply	160	0.08
G40/0002 Domestic and stock water supply	136	0.09

For the maximum seasonal rate and duration of take, the Theis drawdown assessment (Table 1) predicts that an unconfined drawdown of greater than 0.2 m (permitted baseline with Regional Plan Water - Schedule 5), will not occur upon any local well utilised for water supply purposes. The nearest known neighboring water well to the mining area is well G40/0002 located 136 m away. The maximum seasonal drawdown predicted for that well is only 0.09 m.

Additionally, mitigation of seasonal drawdown has not been taken into account within the analysis in Table 1. There are three mitigating factors for the mining operation that will offset seasonal drawdown of which make the above assessment more conservative:

- The mine pit pond is transient and is unlikely to be in any specific location for up to 240-days.
- No effect of the Clutha River Mata-Au recharging boundary has been considered that will serve to offset any regional drawdown, and
- The full seasonal allocation has been used as opposed to the balance of groundwater allocation taking into account when the take is within permitted activity requirements.

The drawdown analysis concludes that the proposed net groundwater take from the mine pit pond for dust suppression and rehabilitation, will have a less than a minor effect of drawdown (within permitted baseline) upon any neighbouring wells. The effect in all cases is within that allowable under Schedule 5B of the Regional Plan: Water for Otago.

Stream Depletion Effects

There is only one perennial water body that occurs in vicinity of the proposed mining area, which is the Clutha River Mata-Au. All other water bodies (small streams) that debouch onto the aquifer, only flow during heavy rainfall periods and are otherwise ephemeral. There is a proposed set-back buffer distance from the proposed mining area to the Clutha River Mata-Au of 40 m.

An analysis of potential stream depletion effect upon the Clutha River Mata-Au is provided in **Appendix A**. The stream depletion analyses predict the maximum potential stream depletion effect upon the Clutha River Mata-Au in respect of both a 40 m distal net groundwater take, and the requested take being in excess of 100 m from the river (for maximum 7-day and seasonal rates of take). These two scenarios are prescriptive of the groundwater take being a permitted activity and requiring resource consent respectively.

For the take located at 40 m from the Clutha River Mata-Au, the maximum effect of stream depletion assessed by the Jenkins model, is up to 4.6 L/s (91% of the maximum 7-day take), and 3.3 L/s (99% of the seasonal take). For the groundwater take being located just in excess of 100 m from the river, the maximum effect of stream depletion is up to 4 L/s (79% of the maximum 7-day take), and 3.2 L/s (96% of the seasonal take).

In the first instance, the take within 100 m of the Clutha River Mata-Au is a permitted activity and whilst the stream depletion effect upon the river is below 5 L/s, the effect is within permitted baseline. For the requested net groundwater take being in excess of 100 m from the Clutha River Mata-Au (and not covered by permitted activity), the maximum stream depletion effect is less than 5 L/s and therefore there is no requirement for any surface water allocation and environmental flow restriction. However, the Clutha River Mata-Au contains a very large potential allocation and has a sustained large flow year-round. A stream depletion effect upon the Clutha River Mata-Au of less than 5 L/s is considered to be De Minimis, and additionally, the actual depletion rate is much less than the permitted activity for adjacent groundwater takes.

The proposed net groundwater take will have a less than minor and non-measurable effect upon stream depletion of any local perennial water body.

5.0 Effects on Water Allocation

The proposed mining activities are located within the Luggate Groundwater Management Zone, and currently there is an available groundwater allocation of 2,651,599 m³/annum (ORC GIS On-line Maps database). This is from a working MAL of 5,800,000 m³/annum. Notwithstanding that a proportion of the required groundwater take for dust suppression and rehabilitation uses is able to be taken under permitted activity, the requested annual volume of take for those uses is only 2.6% of the available groundwater allocation. Additionally, the Clutha River Mata-Au contains a large amount of available water allocation, although the groundwater take proposal is either within the limits of the permitted activity (within 100 m of the river), or does not deplete the surface water body by any more than 5 L/s.

On the above basis, the effect of the proposed groundwater take for dust suppression and rehabilitation uses, will be of a less than minor nature upon water allocation.

6.0 Sediment Migration Effects

The potential for sediment migration (of sediment laden groundwater), away from the proposed mine pit pond during mining activities, and into the aquifer, will be relatively low on the basis of the following:

- A net groundwater flow toward the mine pit pond will be maintained by the proposed groundwater take for dust suppression and rehabilitation. The seasonal rate of take is 3.3 L/s abstracted from the mine pond, and otherwise
- Any migration of sediment laden groundwater from the mine pit pond will be in the direction and with the velocity of natural groundwater flow. In all cases the direction of natural groundwater flow is toward the Clutha River Mata-Au, and the average velocity of flow is estimated (with a typical natural gradient of 1:200 or 0.005, and hydraulic conductivity of 100 m/day), to be 0.5 m/day.

For any sediment migration away from the mine pit pond, and considering that at least a 40 m buffer exclusion zone will be maintained between the mine pit pond and the Clutha River Mata-Au, there is a lag time of groundwater movement to the river of at least about 80-days. This is a significant retention time for any sediment laden groundwater to incur sufficient filtration through the gravels and silts, prior to entering the Clutha River Mata-Au. It is expected that sufficient alluvial filtration of any sediment laden groundwater would actually occur within the first 5 m of horizontal aquifer occurrence.

The effect of potential sediment migration away from the proposed mine pit pond is assessed as being of a less than minor nature upon the environment.

7.0 Summary of Effects of the Proposal

In consideration of the existing environment and the scope and scale of the requested mining (water resources) activities, it is considered that in the above cases **the proposal will have a less than a minor or not-measurable effect upon the environment.**

I would be pleased to be of assistance if you have any further queries on any of the above matters.

Yours faithfully
Tom Heller
Director: Water & Environment

A handwritten signature in blue ink, appearing to read 'T. Heller', is positioned above the company name.

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Appendix A – Stream Depletion Analyses



