Town Planning Group (NZ) Limited
PO Box 35
Christchurch

T 0800 22 44 70
W www.townplanning.co.nz

Offices in Tāhuna & Ōtautahi

7 May 2025 **Our Ref** 2562-21

Environment Southland
Alexandra Smith

VIA EMAIL: Alexandra.Smith@es.govt.nz

Dear Alex

RESPONSE TO HYDROLOGY REVIEWER
APP-20242608 – WAIKAKA GOLD MINES LIMITED

1 INTRODUCTION

This letter is in response to an email dated 23 April 2025 in which the hydrology technical reviewer raised matters relating to the further information response. We have provided a screenshot of the reviewer feedback to each matter followed by a response to the queries raised. The responses below have been drafted by Tom Heller (Environmental Associates Limited) and Anita Collie (Planner).

2 RESPONSE

Information Requested with Response

	Question	Response assessment
1.	**Given that the groundwater abstracted will be primarily returned to the Waikaka Stream, with significant delay and a significant distance from the take, and that at least 10% of water will be lost in processing, can you please demonstrate why the take should be considered non-consumptive?**	Definition of non-consumptive will be required from a planning perspective. Given that most of the water will be abstracted from deeper levels, it is unlikely that it would have discharged directly to Waikaka Stream in this location and the ultimate receptor is unknown. It therefore cannot be considered non-consumptive.

It seems to be agreed that surface water take / use / diversion is non-consumptive through the diversion channels.

It also seems to be agreed that there is a degree of non-consumptive use of groundwater, however the degree of such appears to be unresolved. However, the AEE assesses the impact on allocation and other groundwater users as if the take were fully consumptive, and so it appears to be a moot point.

2. **The naming of observation wells, pump test sites and pumping test data is difficult to follow and doesn't appear to be consistent (or exclusive) and there are no clear maps of the pumping test setups, or clear tables that summarise each pumping test. There are no summaries of the bores present, their screen depths, and the lithology they are targeting. Can you please provide a clear summary of all of the available data, and their corresponding appendices? The two bore logs provided for those called 'Main bores' have a maximum depth of 22 m.b.g, and none of the monitoring piezometer logs seem to be any deeper than this. Given that the maximum depth of excavation is to be 50 m, this data is not adequate to conceptualise the site. The data provided in the Aquafirma report is also poorly documented.**	The maps provided were not considered adequate descriptions of the pumping tests, hence the request for clearer summaries and maps. Without clearer maps the reviewer will have to spend an unreasonable amount of time at the applicant's cost to understand the parameters and limitations of the tests. The response did not provide clearer maps. There are no screen depths provided for the piezometers or construction details for the pumping bores for any of the Aquafirma tests in the Excel spreadsheets provided or WK logs provided, however the Aquafirma report (Section 2.3.1) states that the screened intervals were no more than 2 m, which is inconsistent with the additional information regarding screened intervals provided in Point 3 of the s92 response. This would influence the pumping test interpretation. WK141 is the only 'log' that contains lithological logging information and shows many layers of interbedded gravel and clay. None of the logs contain bore construction information. Each of the tests have been of short duration (24 hours) and have only tested the response of the lower layer of basal wash, not the entire stratigraphy. Given that there will be an open pit, this seems to be an oversight. The connectivity of the lower layer with the upper layers will be created by the open pit, regardless of the overlying stratigraphy. Only one test was completed at depth (37 m.b.g) at the northern end of the site. No testing has been completed on the true left bank of the Waikaka River.

The existing map of aquifer test sites shows the location of each of the Aquafirma and Waikaka Gold test locations. The details of each aquifer test are contained within each test spreadsheet (provided by the RFI response), which include site/piezometer location details relative to pumping wells, and all monitoring data associated with each test. The content and quantity of aquifer test information provided in support of the groundwater take application exceeds the minimum test information and quality requirements stipulated by the consent authority.

Noting that the Aquafirma tests were conducted some years ago and reporting standards have altered in the intervening years, we cannot obtain information that they did not record at the time. Piezometers and pump well screen depths and lithology for the Aquafirma pump tests are on Page 5 of the Environmental Associates RFI response report dated 27 January. Tom Heller confirms that where we were not able to get screen depth info directly for the Aquafirma tests, he has compared test holes to nearby lithology holes and provided the depth range of the lithology. The 2 m screened depth is within the lithology range noted.

In regard to the pump test duration being only 24 hours, Mr Heller advises that the flow rates were so small and limited by aquifer geology and occurrence that 24 hours was considered sufficient to assess the hydraulics. There is no oversight with the aquifer testing. The basal wash layer was the only layer of sufficient thickness and water yield to enable suitable testing to occur. Intervening layers containing any water, inclusive of the upper water table aquifer, were very thin and contained little by way of yield or water seepage. This is echoed in the Aquafirma testing that could only be achieved within the lower (deep) basal wash layer. The basal wash layer is considered to provide the majority of water to the mine pit, although other intervening layers (whilst so small in thickness and yield), that were unable to be appropriately tested, were conservatively modelled within the application AEE technical report for contribution of water to the mine pit. This reporting is clear and conservative in representation of the water balance (contributing layer water yield), to the mine pit. Other

than the lower basal wash and thin intervening strata with relatively small water yield (including the water table aquifer where it exists), the bulk of the profile thickness is clay, which contains no water or yield.

It's correct that no testing has been conducted on the true left of the Waikaka. Mr Heller does not expect the results to be substantially different from the testing area because of the apparent drill-hole lithology and the range of basal depth/strata tested by Aquafirma and Waikaka Gold respectively. The aquifer testing (inclusive of Aquafirma tests) has been deliberate in terms of the location/placement of test holes to assess the expected depth range of strata over the majority of the mine site. This also considers previous drill hole information and that depth to the basal wash layer increases (generally) in an upstream (river) direction and not laterally.

Conservative hydraulic parameters were adopted and sensitivity tested to account for potential variability in the parameters. The purpose of aquifer testing is to inform an assessment of effects, and the information provided achieves this given the context of other well users, allocation status and potential environmental effects upon surface waters.

3. **Dewatering calculations are presented for an initial mine pit of 100 m x 50 m pit. This is not consistent with the Mining Methodology report (Attachment H) that anticipates a much larger pit (170 x 100 m) at the pit base. Can you please update calculations accordingly?**	The assumption that this approach is appropriate should be confirmed in conjunction with the mining company methodology.

The response is that the pit size does not fully matter and that the pit size used is appropriate to determine short term peak dewatering rates. Mr Heller confirms that a different pit size will not impact the short-term dewatering rates. Mr Heller's view is that the pit size used is conservative (and within the maximum defined by mining methodology), and that the short term initial peak dewatering rates will be achieved before the pit reaches that size. In reality a 170 m X 100 m pit development will take a significant time period to achieve. Within that time period, short to moderate peak dewatering rates will have been encountered and particularly with abstraction of initial stored volume. It should also be noted that the longer term groundwater abstraction rates are based on a much larger pit size. Additionally, a 30% contingency has also been factored into all mine pit dewatering rates and volumes.

4. **Calculation of peak dewatering rates seems to be based on an equivalent radius of the established pit (Table 4.2). However, the entire length of the pit will need to be dewatered (500 m). Can you please explain how this calculation allows for dewatering of the entire pit, or alternatively update the calculations to ensure dewatering of the entire pit?**	The response does not adequately explain or confirm how this would provide for dewatering of the entire pit.

The response explains the method. This appears to be a disagreement over the methodology used rather than a lack of information. Mr Heller's view is that the methodology presents a conservative answer. The same methodology has also been applied to other previous mining dewatering activities in Otago and Southland where the reviewer had agreed the methodology was appropriate, and otherwise, in all cases has been shown to be appropriately conservative.

5. The mining methodology assumes that stormwater will be diverted into the mining pit from across the site. Can you please confirm whether pumping and discharge rates account for this?	The response says this will not occur which contradicts the mining methodology report. This needs to be confirmed in conjunction with the mining company's methodology.

The response is that some stormwater (from the pit and immediate environment) with the remainder of site stormwater diverted to other drainage. Section 8.2 of the Mining Method Report describes stormwater drainage and in particular that stormwater from the broader site will be prevented from entering the pit:

"The proposed network of surface drains will minimize the effects of any site flooding. The risk of high flows entering the wash extraction pit via the haul road will be controlled by designing thepit access haul roads with a drive over mound and cut off drains near the pit exit haul road to revent flood flow down the inclined haul roads. In addition, the pit will have up slope surface bunding as required to divert surface water and prevent it flowing into the operating pit." (Reference: Mining Method Report, Section 8.2, Page 49).

6. Please provide continuous water level logging data for nested piezometers targeting the different aquifer levels within 50 m of the stream in conjunction with Waikaka Stream water level monitoring to assess the relationship with the stream, at both ends and central to the proposed works. Please also review the water level data that has been collected by Waikaka Gold from their existing monitoring sites and update the assessment accordingly.	

The RFI response provides a list of available information in lieu of continuous water level logging data, including well logs demonstrating clay in the stratigraphy and aquifer testing using multiple depth piezometers (in some cases nested), concluding that the requested study would not add any meaningful information. The results of the test drilling and aquifer testing are very clear that there is no connection of the basal wash layer or any intermediate layer to the Waikaka Stream. There may be some small localised connection of the upper water table aquifer (where it exists) to Waikaka Stream. However, the connection is spurious and together with small groundwater gradients, is not expected to provide any significant seepage to the mine pit. With this in mind, a conservative stream depletion analysis has been undertaken to consent authority standards to examine any plausible stream depletion effect of the mine dewatering activity. Whilst the assessed stream depletion effect is relatively small, the net effect upon surface water allocation and balance of the stream environment is considered positive overall, with discharge of the treated mine dewatering water to the stream.

Question	Response assessment
7. **Please provide measures of streambed conductance of Waikaka Stream to improve the understanding of the hydrogeological connection between Waikaka Stream and the aquifers.**	For an application of this scale, with this level of effects, it is reasonable to expect further investigations to have been completed to conceptualise the site, including continuous water level monitoring in groundwater monitoring bores around the site and in close proximity to Waikaka Stream. No investigations have been completed on the true left side of Waikaka Stream. Connectivity between groundwater and surface water has not been investigated. The assessment assumes that Waikaka Stream is a sink for groundwater, however it is more likely to be both gaining and losing throughout the affected reaches. There is currently an upward vertical hydraulic gradient. It is unclear what the effects of reversing this gradient and depressurising the confined aquifers will be. To date, the s92 RFI response only considers the need for dewatering and stream depletion calculations from the perspective of dewatering and discharge, but not the overall environmental impacts of diverting a river, destroying the streambed, homogenising the aquifer and then restoring the river. The groundwater effect considerations are far greater than that of a standard groundwater take. The AEE by Town Planning group states that the Waikaka Stream diversion will not be lined in order to replicate the natural conditions of shallow groundwater losses, however these have not been investigated at all.

Reasons are provided within the RFI response and within this document, as to why the stream bed conductance value is reasonable and appropriate. Additionally, sufficient information has been provided and discussed to quantify the limited interaction between the Waikaka Stream and the adjacent water table aquifer, insofar as any seepage that may occur to the mine pit. In that respect a conservative stream depletion assessment has been undertaken in accordance with the plan and to consent authority requirements.

Whilst there is no interaction between the lower basal wash layer and any intermediate (small) aquifer layer with the Waikaka Stream (confirmed by investigation/test data), any seepage as a result of the small upward hydraulic gradient from lower layers is fully constrained by the significant thickness of impermeable clay strata. The hydraulic effects of mine pit dewatering are clearly assessed and described in the application groundwater technical report. Ongoing water level monitoring is proposed to occur as part of the activity, as a check on lateral water level displacement over time. In terms of replication of stream bed configuration, this has been further discussed below in relation to question 11.

8. **Please provide actual pumping data from the L&M operations if available and assess the significance of this information relative to the actual mining operations that occurred.**	No additional validated information provided

The response notes that WGML do not have access to that data. However, an estimate of peak L&M dewatering rates was provided based on local knowledge (solely). The Waikaka Gold (requested) rates and volumes of take stand on their own merit and have been appropriately assessed. It should however be noted that both the Aquafirma and Waikaka Gold assessments are supportive of each other. This should provide additional comfort to the consent authority that the methodologies and outcomes are consistent and there is very useful agreement between each investigation.

9. **The geological model provided by T & T (2022) in their geotechnical assessment (Attachment J) is very different to that provided within the groundwater report. Please reconcile the data provided.**	To demonstrate the validity of this discussion, it would be helpful to provide a clear comparison of the models and sensitivity analysis with respect to the differences.

Response provides an explanation for any differences and notes that the geological model identified within the groundwater technical assessment, is still considered to be correct and consistent for the purposes of the dewatering and effects assessment reporting.

The information requested has been provided.

10. **When confined layers are depressurised, storage comes from gravity drainage, how will this alter flows into the pit?**	Response is adequate.

No additional comment.

Question	Response assessment
11. **Stream depletion calculations were completed assuming that the mine pit would be at least 50 m from the stream, however the mining methodology states that the buffer will be 30 m. The assessment states that the physical site data shows that the stream connection is poor, however this has not been justified with the data, and also is at odds with the rehabilitation strategy suggested (which states that the new channel will be in complete connection with sediments). The assessment is also based on a pumping rate of 8.1 L/s. It is unclear whether this assessment accounts for the full dimensions of the mine pit at the surface (which will be much larger than the pit base due to the required battering slopes). After stream diversions have occurred and stream lengths have been reinstated, it is expected that streambed conductance will be greatly altered, but mining will still continue. What effect will this have on stream depletion?**	The response states that "Additionally, the same materials (both for stream bed and immediate adjacent sediments), are proposed to be utilised to form a similar connection to groundwater that pre-existed." As there have not been any investigations regarding groundwater - surface water quality, it is unclear how this can be achieved.

A detailed response has been provided on the matter of the discrepancy and the calculations updated. The updated stream depletion assessment applies to all/any mine pit dewatering activities over the full period of the mining operation. The connection of the Waikaka Stream to the local water table aquifer (where it exists), and for any contribution to mine pit dewatering (as above and in the application technical report and RFI response), is considered to be low. This is confirmed by the conservative stream depletion calculations provided consistent with consent authority requirements. The effect of any small physical change to stream bed conductance from temporary stream diversions will not change any long term stream depletion or natural stream losses, as hydraulically, stream bed conductance has no bearing on long term seepage rates, only short term water transfer. The small adjacent (natural) water table aquifer gradient indicates that overall water transfer will be limited, with the stream overall being a groundwater sink. Whilst it is difficult to exactly replace the stream bed configuration that occurs naturally, conditions relating to the restoration of stream bed materials are able to be incorporated into the condition set to mitigate any discrepancies and closely replicate natural conditions. On this basis any effect upon long term stream-groundwater interaction is considered to be no more than minor.

12. Please provide adequate assessment of groundwater quality in terms of water quality sampling of each of the aquifers including documentation of sampling protocols, locations, depths, times and measurement of field parameters. Please assess groundwater quality for the full range of contaminants that may be expected in this environment (MWM have identified Al, As, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, and Zn as contaminants of concern).	No further information provided. The information previously provided was not considered adequate to provide an assessment of groundwater quality across the site, hence the request. Without adequate documentation, sampling cannot be assumed to have followed standard methodologies. MWM had recommended that further work be undertaken to understand effects to water quality "based on the conceptual site model and flow rates from various materials and mine domains. The data indicates the identified contaminants (from the column leaching tests) should be analysed as part of any monitoring programme including baseline studies and future potential project effects."

The laboratory test results provided with the AEE were consistent with MWM conclusions that localised contaminants including metals and semi-metal concentrations are low. Note that lab test data was provided which contained a larger range of metals than discussed specifically in the groundwater hydrology technical report. The reason for not discussing the additional metals in the technical report was that the concentrations were all either very low or below detection limits.

There is no specific sampling documentation available for the L&M (Aquafirma) and Waikaka Gold groundwater and surface water sampling, as the samples were taken discretely over time by L&M and Waikaka Gold staff respectively. However, the laboratory sheets (results) are available for the Waikaka Gold samples, and on the basis of all sampling results (including that of MWM), being relatively consistent, it is expected that in all cases, sampling protocol and sample handling was appropriately achieved.

Ongoing indicator water quality monitoring to confirm predictions and performance is proposed in the RFI response as part of the condition suite.

3 CONCLUSION

We trust this additional information will afford you further clarity with respect to the proposal. If you have any queries or concerns with the above, please do not hesitate to contact the undersigned at anita@townplanning.co.nz or 021 568 335.

Yours sincerely,
Town Planning Group

Anita Collie
Director