Otago Regional Council

MEMORANDUM

To:	**Andrew Maclennan**, [redacted]
From:	**Amanda Homersham** [redacted]
	Amir Levy [redacted]
Date:	**13/05/2026**
Re:	**Hydrology Review, Parkburn FTAA Substantive Application -** Assessment of water take and use and lake cover nutrient accumulation

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Purpose

This memo reviews the technical assessment of water take and use and the Lake cove nutrient accumulation undertaken by Environmental Associates Ltd. for Fulton Hogan Land Development Limited (dated 23 April 2026).

Surface Water Take

One of the three viable options proposed is a surface water take from Lake Dunstan within a proposed amenity cove. The assessment concludes that this option is acceptable as it falls within the permitted activity limits of the Regional Plan: Water for Otago (Rule 12.1.2.2). However, a permitted activity status does not demonstrate that environmental effects are negligible.

The assessment includes a screening level consideration of nearby abstraction, noting that there are no consented surface water takes within approximately 2km of the proposed point of take, and that the proposed abstraction is small relative to the wider allocation within Lake Dunstan. This provides context and indicates that wider scale allocation pressures are unlikely to be significant. However, the assessment considers consented takes only, with no discussion of other permitted abstractions that may cumulatively contribute to demand. Identifying permitted takes can be challenging, as these activities are not captured within the Consents Otago mapping system. However, permitted abstractions may collectively represent a high level of use, particularly in areas experiencing ongoing development. The assessment also does not consider any foreseeable future development along the lakeshore that may also rely on permitted activity pathways.

Groundwater

In addition to the potential surface water take from Lake Dunstan, the applicant proposes two groundwater-sourced options for water supply. The first is a 'riparian' well next to the lake. It is assumed that such take can operate as Permitted Activity (PA), as the rate and volume are below the thresholds that require resource consents to take groundwater. However, the drilling of the

bore itself will require a Land Use consent. If this option is selected, it is strongly recommended that the applicant confirms with ORC whether the assumptions regarding taking groundwater under a PA are correct. The second option is to amend an existing consent that is currently used for abstracting groundwater for quarrying and gravel processing. The applicant states that this existing take, which will cease to be used as the quarry is replaced with a subdivision, can comfortably accommodate the application's required volumes and rates. Although this is likely correct, if this route is taken and approved, the consent volumes and rate will need to be amended and reduced to reflect the lower requirements.

Similar to the surface water assessment, the groundwater evaluation also lacks data and information. This includes lack of explanation of the assumptions regarding groundwater flow, and it only uses data from one well to assess groundwater quality in the area. It also generally refers to data from other bores (page 5) but does not provide any further information. Furthermore, the assessment of groundwater quality comments that some results are 'low' (Table 2), but does not compare them to any standards.

Water quality

The assessment assumes a daily lake level fluctuation of approximately 0.3 m in Lake Dunstan to estimate flushing and mixing within the proposed coves. This assumed value was used to calculate lake inflow volumes, cove flushing rates, and nutrient concentrations. However, this assumption introduces uncertainty because lake level fluctuations are not constant throughout the year and are typically reduced during summer periods, when inflows are generally lower, power generation patterns may be more stable, and lake level operating ranges often narrow. The assumption favours conditions where the coves behave as a well flushed embayment, where in reality, smaller fluctuations may result in the coves having a weaker hydraulic connection to the lake. It is estimated that approximately 10% of the cove volume is flushed daily, however if actual fluctuations are smaller, cove flushing will be reduced which may result in longer residence times or reduced dilution of nutrients/concentrations elevated above those predicted. The period when fluctuations in lake level are the smallest (generally during summer) coincides with peak temperatures and the greatest risk of nuisance algal growth. Hence, by adopting a constant 0.3 m daily fluctuation, the assessment likely overestimates cove flushing and underestimates nutrient accumulation, particularly during the summer. This introduces a bias where the current estimates may not adequately represent worst case water quality outcomes within the proposed coves.

The flow estimates presented in Tables 4 and 5 are based on a simplified steady state water balance approach, however, the derivation of these values is not explicitly documented within the assessment. While the general methodology can be inferred, the absence of calculations introduces uncertainty to the results.

- The primary inflow (59 L/s for Cove A and 38.4 L/s for Cove B) is derived from an assumed daily exchange of approximately 10% of the cove volume, which itself is directly linked to the assumed 0.3 m lake level fluctuation. As a result, the flushing rate has not been independently calculated but is predetermined by this assumption. Any overestimation of lake level variability will therefore overestimate flushing and dilution.

- Groundwater inflows (7 L/s and 4.9 L/s) and outflows (1 L/s and 0.5 L/s) are presented without supporting inputs or calculations.

- The flow balance assumes constant inflows and complete mixing under steady state conditions. However, both the lake driven changes and groundwater inputs are likely to vary over time, particularly in response to seasonal lake operation and recharge variability. This means that the model may not capture periods of reduced flushing or potentially longer residence times, which are likely to adversely impact water quality.

Section 4.0 states that the dimensions of the proposed amenity coves are shown in Figure 3, however, no dimensions are presented on that figure and instead are only described within the text. The basis for the cove dimensions used in the water balance and nutrient modelling is therefore unclear. In addition, the report states that the coves will be "relatively open" to Lake Dunstan, however, this assumption is not clearly supported by the available information. The presence of the cycle trail crossing the outlet of one of proposed coves suggests that connectivity to the main lake may be partially constrained, depending on the design. Therefore, it is unclear what form of hydraulic connection will be provided beneath the cycle trail (e.g. culverts, bridge opening, or open channel) and whether these structures may restrict flow and limit flushing under certain lake level conditions.

The assessment focuses on nitrogen, predicting cove concentrations of 0.116–0.119 mg/L, however, Phosphorus is not assessed. This creates uncertainty as Phosphorus often contributes to nuisance algal growth. Cove construction effects are also not assessed here, -but are deferred to a earthworks report. This ignores the strong links to cove water quality, particularly regarding the impacts from potential sediment disruption and deposition or the infilling of the coves. The groundwater quality assessment is based primarily on a single monitoring well (G41/0103). Groundwater nutrient inputs to the coves may be underestimated, particularly under future development scenarios such as nutrients sourced from fertilisers, wastewater, and storm water disposal, which are not addressed. Therefore, although the information provides a partial understanding of the current state of the environment, it lacks details on the potential impacts of the proposed development. This lack of information impose substantial challenges for assessing the impacts of this application.

Additional Information Required

In order to reduce the uncertainty identified in the current assessment and to support a more robust evaluation of potential localised effects, the following additional information and further assessment are recommended:

Cumulative Effects of Water Abstraction

- Consideration of permitted takes in addition to consented abstractions, to better understand cumulative demand and of potential future abstraction pressure associated with anticipated lakeside development.

Cove Flushing and Connectivity

- Provision of empirical lake level data (e.g. seasonal and operational records) to justify the assumed 0.3 m daily fluctuation or identify a more suitable value.
- Sensitivity analysis of cove flushing rates under a range of lake level fluctuation scenarios, including low-variability summer conditions.
- Estimation of residence times within the coves under reduced flushing scenarios.
- Provision of detailed plans and dimensions for the proposed coves to confirm the basis of the modelling.

- Detailed design information for the connection between the coves and Lake Dunstan, including any structures (e.g. culverts or bridges). Any relevant hydraulic assessment associated with how the structure may influence flow connectivity.
- Confirmation of whether partial restriction of flow may occur and the implications for flushing and water quality.

Water Balance and Flow Inputs

- Transparent documentation of the water balance calculations presented in Tables 4 and 5. Justification and derivation of groundwater inflow and outflow estimates including assumptions and values/measurements used to compute groundwater-lake interaction
- Consideration of temporal variability in inflows (lake-driven and groundwater), rather than reliance on steady-state assumptions.

Water Quality Assessment

- Inclusion of phosphorus in the water quality assessment, given its importance in driving algal growth.
- Consideration of internal nutrient cycling processes (e.g. sediment release under low oxygen conditions).
- Integration of the earthworks and sediment assessment with the cove water quality assessment. Evaluation of potential sediment mobilisation, deposition, and infilling effects during and after construction
- Nutrient budget associated with the proposed activities (e.g. irrigation, wastewater disposal, stormwater discharge)

Groundwater Contributions and Quality

- Additional groundwater monitoring data to better characterise spatial variability in nutrient concentrations.
- Assessment of how groundwater quality and loading may change under future land use and development scenarios.
- Evaluation of uncertainty associated with reliance on a single monitoring well.

Conclusions

Overall, the assessment provides a high-level evaluation of water supply options and potential cove water quality effects. The scale of the proposed abstraction relative to Lake Dunstan is small, and it is reasonable to conclude that effects at the wider lake or catchment scale are likely to be negligible.

However, the assessment relies on assumptions and a steady state modelling approach that introduces uncertainty into the likely effects at a local scale. Key aspects of the assessment, including lake driven flushing, groundwater inflows, cove geometry, and nutrient dynamics, are not tested through sensitivity or scenario analysis. In particular, the reliance on a constant lake level fluctuation assumed hydraulic connectivity, and likely increase in nutrient inputs, is likely to overestimate flushing and underestimate the potential for nutrient accumulation within the coves, especially during critical summer conditions.

While the assessment of effects may be acceptable in terms of wider catchment scale effects, the current assessment does not provide sufficient certainty to robustly characterise any local

scale environmental effects within the proposed coves. Given the semi-enclosed nature of these environments, there remains potential for localised water quality degradation, particularly under conditions of reduced flushing, elevated biological activity, and substantial increase in nutrient input from waste and storm water disposal and fertiliser application. Further refinement of the assessment would improve confidence that these localised effects are appropriately understood and managed.