Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM

INVESTIGATION	Kingston Wastewater Consent Further Information Review	**PROJECT**	ORC Consent Reviews
CLIENT	**Otago Regional Council**	**PROJECT NO**	C03263537
CLIENT CONTACT	Sarah Davidson	**PREPARED BY**	Oliver Hunt & Hilary Lough
CLIENT WORK ORDER NO/ PURCHASE ORDER	PO022738	**SIGNATURE**	&
		DATE	9 December 2021

Introduction

Pattle Delamore Partners Limited (PDP) has been engaged by Otago Regional Council (ORC) to review a consent application by Queenstown Lakes District Council (QLDC) to discharge treated wastewater into land from a proposed community reticulated wastewater scheme for Kingston. PDP has previously reviewed information on the proposed scheme submitted to ORC for pre-application review in 2018, provided an initial review of the full consent application in 2020 and a review of the first section 92 response in 2021. These reviews were documented by PDP in memorandums dated 1 June 2018, 24 July 2020 and 14 April 2021, respectively. The consent application has been prepared by Lowe Environmental Impact Limited (LEI).

This discharge will be from the existing township, with allowance for growth, and a new subdivision adjacent to the existing township. At total completion, the proposed wastewater treatment plant (WWTP) and land treatment area(s) (LTAs) are expected to receive an average of 900 m^3/d from 1200 dwellings including 225 existing dwellings within Kingston and 975 new dwellings in the proposed subdivision. The proposed LTAs are located in Kingston Station to the south of the township and the proposed subdivision. Sub-surface drip irrigation is proposed as the method of discharge from the WWTP.

In PDP's April 2021 review, it was recommended that further information on the following aspects be provided:

- Any additional data from ORC for the Kingston monitoring bores since the 2006 data reported on.
- More information on LTA and subdivision leaching for the post-development scenarios.
- Consideration of the allowable leaching rate being contingent on connection of existing on-site disposal systems in Kingston.

PDP also recommended:

- Ongoing collection of groundwater quality monitoring data to provide a longer-term record of the existing groundwater conditions (ideally prior to granting of consent but alternatively prior to the discharge commencing), consisting of at least 12 samples taken at monthly intervals.
- Ongoing collection of groundwater level information to provide a longer-term record of the existing groundwater conditions and provide further information on flow directions.
- A consent condition relating to a nutrient balance, including information on the cut and carry regime.
- Further consideration by the applicant of improved treatment prior to discharge and discharge over a larger LTA area to reduce the potential for nutrient leaching and resulting surface water quality impacts on Lake Wakatipu.

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ORC requested further clarification from the applicant on nutrient loading rates and potential leaching in an email dated 15 April 2021[1]. The applicant provided a response to this information in a memorandum dated 11 June 2021. The response included additional calculations of nitrogen leaching.

This memorandum has been prepared by PDP to review the additional information provided. This memorandum also provides comment on the proposed nitrogen concentrations for Stage 1 and 2 of 50 and 30 mg/L, respectively, that were proposed by the applicant on 23 June 2021[2].

Review of Additional Pre and Post Development Leaching Scenarios and Proposed Limits

The 11 June 2021 s92 response provides additional scenarios as recommended in PDP's 14 April 2021 review. These have been calculated in line with our suggestions.

The applicant has also accepted our suggestion of increasing the leaching allowance from the LTAs based on the number of existing septic tanks in the township that are connected to the reticulated system. This has been based on our suggested allowance of 5.2 kg N/year for each septic tank/on-site system.

In our 14 April 2021 review, we suggested that at the commencement of the consent the total consented leaching from the 70 ha of combined subdivision and LTA area be limited to 1050 kg N/y (average 15 kg N/ha/y), in line with the calculations presented by LEI for the applicant. This has generally been adopted in the volunteered conditions from the applicant, although it appears from the proposed conditions that this would just apply to the LTA area rather than the subdivision area and the LTAs. This could result in an increase in nitrogen leaching if part of the LTA and the subdivision areas are not yet developed and maintained as farmland. We would recommend that the nitrogen mass balance should ideally include those areas, although we do acknowledge there may be challenges with this if leaching calculations change as a result of the method of calculation (for example different Overseer versions or replacement tools). Given the additional restrictions around the mass loading rates (up to 450 kg/ha/year of nitrogen) and concentration limits on the effluent, it is considered reasonable for this to apply just to the LTAs. However, one option to further reduce the potential for increased leaching would be to also specify a maximum leaching rate per area of the LTAs (for example 142 kg/ha/year of nitrogen and 0.6 kg/ha/year of phosphorus as calculated in the application).

There is the potential that additional leaching to groundwater and the lake could still occur if new septic tanks are installed within the township as a result of infill, however, the above approach is considered generally in line with the applicant's goal of avoiding an increase in nutrient leaching to the lake as a result of this activity.

The applicant has proposed a method of calculating the nutrient balance. We recommend that evidence is provided to support the proposed rates for ammonia volatilisation (5%) and denitrification (10%). Specific information should be provided on denitrification expected in this setting given the concentration of ammonia in the discharge, the expected rate of ammonia volatilisation based on soil conditions, irrigation method and the pH of the wastewater/soil for both Stages 1 and 2. We also consider the proposed annual and simplistic method of calculating leaching could result in an underestimate of leaching, and an appropriate approved tool (Overseer or equivalent) should be used as part of a nutrient management plan to calculate the nutrient balance.

Comments on Proposed Nitrogen Limits

Our comments above relate to maintaining the current overall nitrogen load. However, we maintain the view that, in order to prevent degradation of Lake Wakatipu's water quality, particularly given the potential for further residential development and agricultural intensification around the lake, that best practice methods should be applied to wastewater treatment to minimise nutrient leaching to the lake. As outlined in our

[1] Email from Sarah Davidson (ORC) to Brian Ellwood (LEI) 15 April 2021

[2] Email from Brian Ellwood (LEI) to Sarah Davidson (ORC) 23 June 2021

previous reviews, the nutrient loading rate for nitrogen on the LTAs (450 kg/ha/year) is high compared to the plant uptake expected in this environment, particularly in the cooler months, and this is shown in the significant calculated leaching to groundwater by LEI (142 kg/ha/year). The phosphorus loading rate (222 kg/ha/year) is also very high compared to plant uptake although we acknowledge there is potential in the underlying strata to provide for some storage of phosphorus and monitoring is proposed including for Olsen P (although no trigger levels are provided). It is possible that phosphorus may reach saturation levels much more quickly (less than 15 years) than assessed in AEE, given shallow soil depths compared to the assessment depth of 1.5 m. The applicant should pay close attention to the Olsen P results and adjust treatment as required to avoid phosphorus leaching occurring at significant levels. We recommend that Olsen-P should have a trigger level of a maximum of 40 mg/L, beyond which no irrigation should occur (an alternate LTA area would be required).

To reduce the loading rates, we recommend both providing for improved effluent treatment to minimise leaching, at least during the cooler months when the LTAs will provide no or limited plant uptake, and maximising the area of the LTAs for each stage to better match the nutrient loading rates to plant uptake, in the periods when plant uptake does occur.

For Stage 1, if the nitrogen limit is as high as 50 mg/L as a 12 month rolling mean, one option would appear to be to increase the area to increase potential plant uptake. However, as shown in Table 3 of the 11 June 2021 LEI response, the hydraulic loading rate is already low at 2.5 mm/day and reducing this further may not be advantageous for plant growth. We would recommend a more appropriate environmental limit should be applied for Stage 1, ideally 30 mg/L or less as a 12 month rolling mean.

For Stage 2, we would recommend a more appropriate (and achievable) environmental limit based on the system proposed would be 20 mg/L or less (ideally 10 mg/L or less to minimise winter nutrient leaching). A nitrogen concentration of 20 mg/L was modelled by LEI in the AEE.

In the 11 June 2021 memorandum, the applicant has noted the system could be upgraded in future and acknowledges that improved environmental outcomes would be achieved if a lower nitrogen concentration wastewater was applied at the same hydraulic loading rate as currently modelled.

Overall, we acknowledge the application as it stands seeks to maintain rather than improve water quality and we accept that a lower standard of wastewater treatment will potentially achieve that goal, although we consider this is not helpful in terms of preventing a deterioration in lake quality, given the results of the initial surface water quality sampling and the potential for further nutrient inputs from other current and future developments around the lake as well as other sources of nutrients. We consider that a better standard of treatment from the WWTP and the LTAs is practical and feasible to achieve, as outlined in our 14 April 2021 memorandum.

Summary

The applicant has provided useful information on the expected nitrogen leaching for different development scenarios and has proposed a limit in line with our suggestion based on the number of septic tank connections (albeit only for the LTAs rather than the subdivision area).

The applicant has also proposed a nitrogen concentration limit for the treated effluent of 50 mg/L and 30 mg/L for Stages 1 and 2, respectively, as 12 month rolling means. While we acknowledge that these limits may achieve the applicant's goal of not increasing leaching to the lake, we consider a better standard of treatment would be appropriate, together with nutrient loading rates on the LTAs that better match expected plant uptake. Phosphorus levels in the soil should be closely monitored and have an appropriate trigger level.

We have provided comments on the draft conditions in a separate document provided to us by ORC.

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