

To: Rebecca Jackson

From: Claire Conwell

Company: Otago Regional Council

SLR Holdings NZ

cc: Samantha Isles

Date: 9 November 2023

Project No. 13556

RE: RM23.185 – Green Island Landfill Surface Water Quality Technical Review

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1.0 Introduction

SLR Consulting NZ (SLR) has been engaged by Otago Regional Council (ORC) to conduct a technical review of the resource consent application (including multiple attachments and request for information (RFI) responses submitted by Dunedin City Council (the applicant) for the operation, expansion, and closure of the Green Island Landfill.

Dunedin City Council is proposing to continue to extend the life of the Green Island Landfill to allow acceptance of waste until between December 2029 and March 2031, following which closure operations and landfill aftercare will commence.

2.0 Scope of Review

This review covers Surface Water Quality aspects of the application, aspects of the application considered as part of this review this review include:

- Review of the surface water quality data and assessment of effects to the receiving environment arising from the management of the leachate collection and stormwater management systems
- Review of groundwater / surface water interaction as these relate to surface water quality.
- Assessment of the proposed monitoring schedule, including locations, frequency and parameters.

The key documents reviewed were:

- AEE Appendix 6: Waste Futures - Green Island Landfill Closure Surface Water Report
- AEE Appendix 5: Waste Futures - Green Island Landfill Closure Groundwater Technical Assessment (as these relate to surface water interactions)

3.0 Response

ORC posed the following questions (in bold) which are responded to in turn below.

3.1 General response

- 1. Is the technical information provided in support of the application robust, including being clear about uncertainties and any assumptions? Yes, or no. If not, what are the flaws?**

The issue of hydraulic connectivity has been discussed Tim Baker in the groundwater review memo to gauge an understanding of the assumptions and reasoning around whether groundwater has the potential to act as a vector for the discharge of leachate contaminant to the surface water receiving environment. I refer to Tim Baker's memo for further discussion about the hydrogeological model.

For surface water, the key assumption applied to the surface water quality AEE is that all of the leachate generated on site is collected via the collection trench, thus prevents offsite migration. The groundwater technical review finds that this may not be the case – given the collection trench does not extend to the depths of the Abbotsford Mudstone (marine deposit basement), thus there remain the potential for groundwater flow beneath the trench, and above the low permeability mudstone.

The degree to which this contributes to potential for the migration of leachate contaminants to surface water quality in the receiving environment has not been acknowledged. Rather, the surface water report is based on the assumption that there is no leachate migration via groundwater, on the basis that there is no evidence of leachate contaminants exceeding guideline thresholds in surface water sampling programme. It is not correct to assume that if there are no guideline exceedances, this equates to no discharge of leachate.

The migration of leachate offsite is partially discussed in the ecotoxicological assessment report, undertaken by Cawthron¹. This found the presence of leachate organics in groundwater samples, and suggested that there may also be dissolved metals in groundwater contributing to the observed ecotoxicological effects in test species. This is pending further assessment, but warrants more comprehensive assessment into the overall weight of evidence' approach to the assessment of effects.

- 2. Are there any other matters that appear relevant to you that have not been included? Or is additional information needed? Please specify what additional info you require and why [please explain]**

Addressed above.

- 3. If granted, are there any specific conditions that you recommend should be included in the consent?**

With regards to overall receiving environment monitoring, and particularly surface water, I recommend that an Adaptive Monitoring Plan to be developed. This should set out the objectives of the Surface Water Quality Monitoring Programme and identify contingencies to be implemented. These contingencies, for example, should link to the proposed

¹ Champeau, O. Northcott, G. and Tremblay, L. 2023. Preliminary assessment of the impacts of the Green Island landfill leachate on the receiving environment using passive samplers and toxicity testing. Prepared for Boffa Miskell Limited. Cawthron Report No. 3895, 13p plus appendices. In Appendix 12 Green Island Ecological Impacts Assessment Technical Report. March 2023.



Groundwater Monitoring and Contingency Plan, and Ecological Monitoring Plan. The plan should include:

- Details of all monitoring site locations and justifications;
- A sampling and analysis plan, including the sampling methodology to be followed;
- An approach to how the data is interpreted and assessed in conjunction with the groundwater quality monitoring (refer to Groundwater Quality memo for further details);
- A detailed Stormwater Management Plan (this may be done as a separate plan, but should integrate proposed change to stormwater management over the next 6 years of waste acceptance, establishment of the Resource Recovery Park Precinct (RRPP), and details of long term closure stormwater management, with appropriate review periods incorporated).

3.2 Surface Water Quality

4. ***Does the application appropriately identify sensitive areas including affected water bodies (surface, ground and coastal water), wetlands, bores, drinking water supplies? Yes/no.***

The application has identified the following sensitivities:

- Surface water courses, including the existing estuarine environment, as well as contributing freshwater streams and tributaries.
- The groundwater zone appears to be appropriately identified, and please refer to the groundwater technical assessment for further details and confirmation.

Bores and drinking water supplies are not identified. Given the location of the landfill in the lower catchment, proximity to the estuary and the coastal marine area it is assumed no potable water supplies are present in the vicinity of the landfill CMA.

5. ***Is the description of the sensitive areas attributes potentially affected by the activity accurate?***

The sensitive areas attributes, with regard to surface water quality, are understood to be:

- The water quality attributes of the Kaikorai Stream; and
- The water quality attributes of the Kaikorai estuary.

Attributes (for water quality) is defined in the NPSFM as '*a measurable characteristic (numeric, narrative or both) that can be used to assess the extent to which a particular value is provided for*'.²

Whilst the specific values of the surface water quality aren't explicitly stated in the Surface Water AEE, it is inferred these to be waters that support ecosystem health, human contact, threatened species and mahinga kai. Ecosystem health is subject to the Appendix 12 Ecological Impact Assessment report, and is not reviewed here.

² <https://environment.govt.nz/assets/publications/NOF-Guidance-ME1753-Final-Oct2023.pdf>



The surface water report has referred to the current attribute state assessment available (on LAWA) for the site upgradient of the landfill, and which is assessed as being in a degraded/impacted state against the National Objectives Framework in the NPS-FM.

Assessment of parameters (attributes) for landfill monitoring include:

- Nutrients (nitrate, ammoniacal nitrogen, dissolved reactive phosphorus);
- Physicochemical parameters; and
- Toxicants (metals, organic contaminants).

The assessment of these parameters has been on the basis of whether attribute National Bottom Line, or default guideline values have been exceeded. As referred to in Question 10, there has been no apparent integrated assessment across the ecological effects for surface water quality, not has cumulative effects been addressed.

It is concluded, therefore, that the current description of the sensitive areas attributes, has not been fully provided.

6. *Has the applicant proposed appropriate methods to limit contaminants, particularly leachate, entering surface water?*

The methods to limit contaminants entering the receiving environment are identified as:

- Leachate collection trench;
- Stormwater management and sediment ponds; and
- Constructed wetlands (Eastern and Western).

Please refer to the Groundwater technical assessment for a full assessment regarding the appropriateness of the leachate collection trench system. The technical review (T. Baker) has identified that the leachate trench may not be a complete hydraulic barrier, and there is a potential pathway for flow beyond and beneath the trench into surface water. As mentioned above – this warrants a re-assessment in the application.

Regarding stormwater flows and retention, Section 4.3 describes the Existing stormwater flows, with sub-catchment rainfall intensities presented in Tables 6 and 7. The calculation assumes only a 2-3% increase in intensity due to climate change for the remaining operational time (6 years) of the landfill. I have not assessed the accuracy of this, so assume (on the basis calculations are correct), there is sufficient stormwater retention capacity on site.

Long term, it is recommended the stormwater retention is re-assessed to account for longer term rain intensities, under a range of climate change scenarios. This is required to inform long term stormwater management on site and to ensure it is still fit for purpose.

The assessment of climate change in the Surface Water AEE (Section 4.4) has also identified the elevation of the perimeter berm by 1 m will be sufficient to prevent inundation of the leachate collection trench by increases to Kaikorai Stream and any flood hazards. water levels. This has been reviewed in the Groundwater Quantity & Flood Hazard Technical Review, and is not reviewed here.



7. Has the Applicant adequately addressed the risk to human health and the environment associated with PFAS?

Not reviewed here – pending further data from the Applicant.

8. Have the adverse effects on surface water quality of the discharge of stormwater to Kaikorai Stream been adequately assessed?

The assessment adverse effects on surface water quality have been assessed via the summary of monitoring data undertaken to date in the sediment retention ponds, and across sites in the Kaikorai Stream / Abbots Creek receiving environment. This has been presented as a series of line charts, as well as summary tables in the following document:

- Appendix C Water Chemistry Monitoring, in Green Island Landfill Annual Monitoring Report 2021-2022 (20 September 2022). Report provided as Appendix B in the Appendix 06 Surface Water Report

Water quality results were benchmarked against appropriate guidelines (ANZG default guideline values for the 80th percentile level of species protection, and the NPS-FM National Bottom Line for nitrate and ammonia toxicity).

It appeared that results for dissolved zinc concentrations in surface water receiving monitoring locations were not included in the annual report, and were not available to be reviewed. It is requested that these results are also provided.

The analysis has not undertaken any further statistical analyses beyond summary statistics (comparison of monitoring round against historical maximum, minimum, average, and number of guideline exceedances). It is recommended that in addition to the plots presented, the data is represented as box plots across sites (to enable assessment of variability across the sites), or that further summary statistics are provided (i.e. 95th percentile of data, median values). Given the timeseries available, it is also recommended to provide a Time Trends analyses, to assess if there are any seasonal effects to trends over time. This would also assist in giving weight to the statements in Section 5.1 of the AEE that discuss the findings of the monitoring programmes, and would assist to confirm these conclusions that on the basis of the monitoring data there are no significant or discernable effects due to any leachate / stormwater discharge from the site.

Time trend analyses would also serve to inform the recommendation for undertaking a cumulative effects risk assessment (see question 10).

9. Do you consider that the proposed improvements to the leachate system will be effective in improving surface water quality?

Overall, I agree that improvements to the leachate system will be effective in improving surface water quality. The caveats to this are described above, under question 6.

If the leachate system is functioning as per the design (with minimal infiltration to groundwater and ensuring the collection trench is not compromised), this should in effect, reduce contaminant discharge to the receiving environment, and not further degrade the already impacted receiving environment.

The proposed additional mitigation measures outlined in Section 5.3 also identify steps to prevent pond culvert leachate ingress (Section 5.3.3), Emergency Stormwater Management (5.3.4), and response to climate change (Section 5.3.5). These mitigation measures serve to maintain the integrity and function of the leachate collection trench (via flood prevention and overtopping) and identify areas for repairs/remedial works to be carried out.



10. Have the cumulative effects of the discharge activities been appropriately assessed? Do you concur with the assessment? Yes/No

Cumulative effects to surface water quality have not been addressed in the AEE. It is recommended that this be undertaken in conjunction with the consent application for the Resource Recovery Park Precinct (RRPP).

Cumulative effects are those effects (however individually minor the effects is):

- Those which result from the incremental effects of the activity; and
- When those are added to other past present and reasonably foreseeable future actions.

The potential for cumulative effects from the landfill associated discharges to receiving environment sensitivities in the vicinity of the footprint of the site are for:

- Water quality sensitivities and values;
- Ecological sensitivities and values; and
- Human health sensitivities and values, including mahinga kai.

It is acknowledged that cumulative effects across the receiving environment is a challenge and requires integrated assessment on a long term basis.

It is also acknowledged that the upper catchment is a highly modified environment and contributes significantly to the current state of water quality and ecosystem health in the Kaikorai Stream and Estuary. A key principle of Te Mana o Te Wai, is that the well being and health of water is prioritised. So even if there is evidence of upper catchment stress to downstream receiving environments, the state of water quality (in downstream receiving environments) should not be further degraded and should seek to be improved where possible.

For the landfill discharges, this means that discharge of chronic, low-level contaminants should be minimised where possible. Even though results of long-term water quality show that for toxicants, there are few exceedances of receiving environment criteria (i.e. ANZG default guideline values), the discharges still represent chronic long term sources of contaminant exposure to the receiving environment.

An assessment of the ecological sensitivities is set out in Appendix 12 Ecological Impact Assessment Report. This is not reviewed here, but I note the following findings:

- Sediment contaminants in the downstream sites (GI3 and GI5) are likely to be sourced from both the upper catchment well as potentially landfill stormwater discharges;
- Ecological effects are difficult to discern due to the influence of saline waters;
- Ecotoxicological effects of groundwater sources organic contaminants near GI5 show indications of ecotoxicity – noting follow up results are pending; and
- The ecological report has not integrated any findings from the surface water quality assessment into the overall ecological assessment of effects.



Given the lack of integrated assessment between the ecology AEE and surface water quality AEE that is required for the assessment of cumulative effects, it is recommended that this be addressed.

11. Has the Applicant proposed appropriate monitoring for the duration of the consent?

Monitoring Sites

The applicant has proposed appropriate sites for surface water quality monitoring, these are listed in Section 5.4 of Appendix 06 Surface Water quality report, and are identified as follows (noting the addition of several new sites):

- Surface water monitoring at 5 sites (GI1, GI2, GI3, GI5, GI6 (new site at the Brighton Road Bridge Kaikorai Estuary));
- Eastern Sedimentation Pond;
- Western Sedimentation Pond;
- Three New sites: South Western Pond, Eastern Constructed Wetland, South Eastern Constructed Wetland; and
- Water level monitoring (GI3, also identified as Site ST4 pressure transducer, next to GI3)

Parameters

I have cross referenced the current WasteMINZ guidance³ for monitoring parameters, referring to Table 8.2 in the guidelines. This is referred to because the landfill will be accepting municipal water for another 6 years, prior to closure.

It is noted the proposed suite includes major ions (including magnesium and calcium). It is recommended the total hardness also be reported (noting it is a different APHA reporting method, and should be requested separately. This should be included at no cost, as it's a calculation rather than an analytical method).

It is also recommended to include dissolved organic carbon in the laboratory analytical suite. This is to enable DGV for select metals to be adjusted according to local conditions (noting also that there is new guidance on the application of DGV for receiving waters, available from Envirolink⁴).

The metal contaminant copper is missing from the proposed suite – it is recommended this to be included.

Monitoring Schedule

Given the continue operation of the landfill, it is recommended that the quarterly monitoring for the following be retained as follows:

- pH;
- Electrical conductivity;

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https://www.wasteminz.org.nz/files/Disposal%20to%20Land/TG%20for%20Disposal%20to%20Land_12Oct22_FI_NAL.pdf

⁴ <https://www.envirolink.govt.nz/assets/2307-HZLC166-Implementing-bioavailability-based-toxicity-guideline-values-for-Cu-and-Zn.pdf>



- Dissolved oxygen;
- Major ions sodium, potassium, magnesium, calcium, bicarbonate, sulphate and chloride);
- Nutrients (ammoniacal-nitrogen, nitrate-nitrogen, dissolved reactive phosphorus);
- Metals (aluminium, arsenic, cadmium, chromium, iron, lead, manganese, nickel, zinc, **copper**);
- Boron;
- Chemical Oxygen Demand;
- Biological Oxygen Demand;
- Hardness (calculated from Mg+Ca); and
- Dissolved organic carbon.

The current WasteMINZ Guidelines do not include *E. coli* as a routine parameter for monitoring, and it is acknowledged that *E. coli* has not been a parameter in the historical monitoring suite.

It is anticipated that *E. coli* will form part of the monitoring suite required under the RRP consent (as it will include the composting facility), therefore consideration is required to ensure consistency in monitoring across the two consents to avoid double-ups in effort.

12. Do you agree with the Applicant's conclusions as to the level of adverse effects on surface water?

Any adverse effects are likely to be a result due to cumulative impacts, rather than acute toxicological effects from the landfill. This is supported by the available water chemistry data which notes very few exceedances of DGV/NBL attribute criteria.

The assessment is confounded to some extent by the influence of the upper catchment contributions of contaminants to the downstream receiving environment, and the limited integration of the surface quality data into the ecological impact assessment.

The assessments have been based on the assumption that there is no discharge of leachate from the site to the receiving environment (i.e. the leachate collection trench is 100% effective), but and uses the rationale that since the guideline thresholds are not exceeded, there is no evidence for leachate contamination in the receiving environment.

I disagree with this logic, as there can be low level and diffuse discharges of leachate contaminants via groundwater, to the surface water receiving environment. This will result in chronic, long term cumulative impacts, which have not been assessed. Further to this, there is some suggestion in the ecotoxicology assessment (included in the Appendix 12 Ecological Impact Assessment Report) that there may be ecotoxicological effects due to leachate entering groundwater in the vicinity of site GI5. This warrants further investigation to determine if this poses a risk to sensitive ecological receptors, beyond the routine assay test organisms in the ecotoxicology assessment.



4.0 Closure

In summary, the application with regards to surface water quality covers the broad considerations and issues. The overall assessment is considered thorough and presents a solid amount of robust data, the assumptions and conclusions set out in the technical assessment would be strengthened by additional statistical analyses. Careful consideration is recommended to be given to how cumulative effects are to be assessed, as it is acknowledged this is a challenging area. The use of adaptive monitoring plans following the closure, to ensure monitoring remains responsive to unforeseen changes in leachate management and effects to the receiving environment.

Regards,

SLR Holdings NZ



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