Technical Memorandum

To:	Brittany Watson	**From:**	Tim Baker
Company:	Otago Regional Council	**SLR Consulting New Zealand**	
cc:		**Date:**	11 July 2025
		Project No.	875.V13600.00002

RE: RM24.098 – WM New Zealand, Fairfield Closed Landfill Groundwater Technical Peer Review

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 subsequent attachments and request for information (RFI) responses submitted by WM New Zealand (WM, the applicant) for discharge and take activities associated with the Fairfield Closed Landfill aftercare.

SLR completed an initial review of the application in April 2024 and identified a number of items requiring further clarification (Section 92). A response to the request for further information was provided by the applicant in June 2025.

2.0 Scope of Review

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The scope of this review includes **groundwater** aspects of the application and responses to questions asked by ORC. The key documents included in this review are:

- PDP, 2024a. Fairfield Landfill – Technical Assessment of Effects on Groundwater, Surface Water and Ecology.
- PDP, 2024b. Fairfield Landfill - 2024 Annual Monitoring Results.
- Planz Consultants, 2025. Waste Management NZ Limited – Fairfield Closed Landfill Application (RM24.098) Response to the section 92 Request for Further Information.
- Proposed Consent Conditions (Appendix 8) (Updated 13 June 2025).
- Fairfield Aftercare Management Plan (Draft).

3.0 Assessment

Q1: Do you agree with the technical information provided in the report regarding groundwater? i.e. estimated hydraulic conductivity, Hydraulic gradient, and contaminant concentration?

Yes. While there is limited aquifer property data and testing results on which to base the assessments, the assumptions that have been made with the available data appear valid and founded on accepted hydrogeological practice. The testing that has been done, is well documented and thorough. With regards to contaminant concentrations, there is a good

record of groundwater quality data so that provides a more robust basis from which to assess effects.

Q2: Do you agree that the average mass discharge of TAN (Total Ammonia Nitrogen) indicates the interception drainage system is intercepting roughly between 95.4% and 99.4% of the leachate being generated? If not, please detail why.

I have reviewed the mass discharge assessment that was used to calculate the TAN mass flux in offsite groundwater. This assessment concludes that the vast majority (95-99%) of the leachate is being captured by the leachate interception drainage system, with the balance flow beyond the landfill boundary into the wetland and estuary area.

The assessment is based on four main assumptions:

1. The TAN concentrations in the deep wells outside the landfill are representative of the entire thickness of strata below the wetland/estuary. *I agree with the Applicant that this is likely conservative as shallower wells do indicate lower concentrations.*
2. The underlying mudstone is impermeable. *This results in a conservative estimate of flux because all on the TAN load is confined to the upper estuarine deposits*
3. Assumed a uniform thickness of estuarine deposits of 10 m. *This seems reasonable, although lack of bore logs means this is uncertain. If the unit were thicker, the total mass could be larger, and percentage captured by the trench lower.*
4. TAN detected in deeper wells is entirely from the Fairfield Landfill and not other catchment sources. *I think this is a fair assumption, and unlikely conservative. It is unlikely other catchment sources (such as Green Island) would impact the groundwater on this side of the estuary.*

I consider the method that PDP has taken to estimate contaminant flux in groundwater to be appropriate. However, one aspect of this estimate not discussed in detail is the accuracy of leachate volumes (discharged to the DCC reticulated sewer) used in the calculation. As noted in the 2024 Annual Monitoring Report, there have been multiple occasions (including all of February 2024) when the pumpstation (EPS 42) has not been operating. If the pump station is not operating, no leachate is pumped from the landfill. It is hard to have confidence in the comparison of offsite groundwater discharges to pumped leachate volumes if the pump station is regularly not working as the leachate volume data would be inaccurate. This is discussed further below in Q6).

Q3: Do you agree with the Applicant's assessment that the furthest downstream upwelling point is at the point of the Abbotsford Mudstone outcropping (~1.2 km downgradient)? (See section 9.1)

Yes, the conceptual model presented in the report supports this. The difference in hydraulic properties between the silts and sands (Estuarine deposits) and the Abbotsford Mudstone means that groundwater would be forced to the surface where the mudstone outcrops. This means the focus area for downgradient groundwater impacts is within this 1.2 km reach of the river/wetland.

Q4: The Applicant has not concluded what the effects will be on groundwater quality. In your opinion, is there any further investigations/ testing that could be completed to be able to conclude the actual and potential effects on groundwater quality? Please be specific with your answer.

While there is not a specific conclusion about the effects on Groundwater Quality, both Section 9 of the Groundwater assessment (PDP, 2024a) and the 2024 Annual Monitoring Results Report (PDP, 2024b) both details the effects on groundwater quality and provide a reasonably thorough assessment (given the available data) of the current state of the groundwater quality.

The main conclusions I have taken form the report are:

- Groundwater quality within the eastern landfill appears stable
- Groundwater quality within the western landfill is stabilising, but still variable at a couple of locations
- Offsite groundwater quality is stable but elevated, concentrations of TAN indicate that there is still off-site contamination of groundwater that is entering the estuary/wetland area.

I also recommend a one-off repeat of the estuary/wetland investigation carried out in 2012. This comprised the installation of 10 temporary wellpoints in the wetland area, and collection of groundwater quality samples during low estuary water levels.it assisted with the understanding of contaminant transport into the wetland area and a repeat would allow a comparison of the two sets of results.

Q5: Have the cumulative effects on groundwater quality been adequately addressed?

The report does not specifically address cumulative effects on groundwater quality, and this is a gap in the information.

However, the landfill will be having a significantly greater effect on groundwater quality downgradient of the landfill than any of the other surrounding land uses. So, in this regard, the cumulative effects of the landfill are not critical to know, because the degree of effect form the landfill would be the main contributor.

To confirm this, we can check the upgradient vs downgradient quality. There is only one real upgradient monitoring well to compare results to, that is LS22. This well has the lowest or lowest equal concentrations of the major landfill leachate indicators (TAN, nitrate, sulphate, zinc, EC, and Cl), considerably lower than the downgradient wells. This demonstrates the degree of impact that the landfill has on groundwater, relative to upgradient land uses.

Q6: Is the proposed management of the interception system appropriate? Noting the Applicant has had recent issued with pump failures.

No, it is not. The only detail regarding the management of the interception system appears to be in the Aftercare Management Plan Table 5.1 which outlines the frequency of monitoring in limited detail.

The operation of the leachate system is critical in maintaining a depression in the phreatic groundwater level to prevent the outward flow of groundwater from the landfill towards the wetland-estuary system. This is a requirement of the current consent (Condition 4, 7 & 8). This is achieved by pumping the leachate from the large sump at pump station EPS42. This

is the only pump in place to pump leachate form the site, so its continued operation is critical.

Based on the reporting in the 2024 Annual Monitoring Report, there are ongoing operational and maintenance issues with the leachate pumping system. In this report it was noted that:

- The pump was not operating when PDP staff visited in January and October 2024.
- It was reported to PDP that the pump did not operate for an entire month (February) until it was noticed in the following months inspection.
- The alarm systems were not working.
- Inspection frequency was monthly but increased to weekly following the discovery of these issues.

Clearly, the operation and maintenance of the leachate pumping system needs a detailed review, and this review and subsequent AMP should form a requirement of any future consent. Currently, the collection of data is too manual, the systems lacks redundancy, and the gaps between checks too long.

Some recommendations include:

- A requirement to build redundancy into the pumping system.
- An upgraded telemetry and alarm system that also has redundancy. Data recorded should include water levels within the pumping sumps, pump operation, flow. This data should be continuous.
- An investigation into changes to the system that would allow the pumping of leachate to continue when levels in the estuary are high. At present, the leachate pump system is set to automatically shut down ('high-high' alarm) when flooding/inundation of the pump station sump occurs, to avoid pumping estuary water. Flooding/inundation occurs due to the occasional closure of the estuary mouth creating a backwater effect within the estuary-wetland increasing water levels.

Q7: Are the proposed measures to reduce leachate management overtime appropriate? In your opinion, are there any other measures that could be adopted to reduce leachate generation?

When the leachate pumping system is operational the measured levels within the interception drainage system show a depression of the phreatic surface (saturation zone) along the length of the leachate interception drain. On this basis the leachate system is effective, however it is let down by poor maintenance and insufficient monitoring.

The landfill has been capped with clay and the final landfill profile allows for surface water to shed and not infiltrate. The Aftercare Management Plan includes the periodic monitoring and review of the landfill's structural integrity and stability (including surface cracks, erosion, seepages, inundation, and flooding) on an acceptable frequency. No response or correction actions included in the plan.

Q8: In your opinion, are there any other additional measures that could be adopted improve leachate interception?

PDP (2024a) recommended remedial works on the laterals feeding the leachate interception trench. I support this recommendation. The intent of this is to improve lateral flow to the main gravity trench, and lower leachate head within the landfill.

I also support the recommendation to raise the access track and pump chamber so that it is not affected by high water levels within the estuary.

Q9: Do you agree with the Applicant assessment and conclusions drawn from the most recent ground water monitoring results? (2024 Annual Monitoring Results).

Yes, I agree with the conclusions of the 2024 Annual Monitoring Results Summary.

The PDP assessment focuses on TAN as the key leachate indicator and uses the long-term records of TAN in wells to draw conclusions about the state of groundwater in and around the landfill. PDP (2024b) state that:

The presence of TAN within the shallow and deep wells beyond the interception drain shows that there are leachate impacts in groundwater beyond the landfill. With the exception of LS13 showing spikes, concentrations have been relatively stable and have been around this level since 2002 when sampling began (i.e. no obvious change in concentrations). This suggests the groundwater system is mostly in an equilibrium with its surrounds. This is in contrast with the samples collected from the leachate interception system which shows a

declining trend [since closing]*. It is expected that there will be a delay between seeing any changes in the groundwater quality outside of the landfill area. This will continue to be monitored.*

Having reviewed the data record, I agree with the above statement.

Other key summary points include:

This is an indication of improved water quality beneath the Western Landfill area. Other compounds such as sodium, chloride and magnesium are much lower than the other deep wells. This is an indicator of saline influences on groundwater quality in the area of well LD5 as opposed to landfill effects.

The reduction of the leachate parameters in LD5 is a good sign that leachate impacts are decreasing with depth beneath the Western Landfill area, however, we are not seeing a large change in the deep wells outside of the landfill at this stage. This may take longer before we see a change.

Q10: Is the proposed monitoring programme appropriate for establishing baseline conditions of leachate composition, efficiency of the interception system and groundwater quality? Please include reference to the appropriateness of the location, parameters and frequency. (Groundwater, Surface Water and Landfill Gas Monitoring Plan- Appendix 1).

Yes, the programme has been in place for some time and has already provided sufficient data to allow baseline conditions to be determined. I have the following recommendations for amendments to the Plan:

Locations:

- Add an additional upgradient well to the west of the eastern landfill. Currently there is only 1 upgradient well which is insufficient.
- Investigate feasibility of installing an in-landfill monitoring well to measure leachate head (replacement for well LS4).

Frequency:

- The Plan recommends water/leachate levels within EPS42 are recorded with a transducer and download quarterly. Given that the water level in EPS42 is an indication of pump and leachate trench performance, these should be telemetered and form part of the alarm system.
- The Applicant proposes to reduce the monitoring frequency form quarterly to six-monthly for groundwater (leachate interception drain wells and wells outside of the landfill). Given that there has been no discernible improvement in off-site groundwater quality, I don't think this is justified and the status-quo (quarterly) should remain in place.
- I also note that leachate quality in EPS42 is only required annually. In 2024, because the pump was not operating, the sample was not representative. I recommend that a requirement for re-sampling is incorporated into the monitoring plan.

Q11: Does the monitoring program or after-care plan have clear thresholds for when correction actions are required? If so, are these thresholds appropriate?

I have not seen any thresholds or proposed corrective actions in the Monitoring Plan. The Aftercare Plan refers to 'adverse changes' but there is no explanation as to what adverse changes in groundwater and surface water are.

The plan needs to be updated to include clearer thresholds/triggers, and response actions.

Q12: Should adverse effects be observed through the monitoring programme, is the proposed Contingency and Response Guidelines appropriate to address adverse effects?

No, there is no guidance on what adverse effects could be, and the Contingency and Response Guidelines are very brief. I would expect to see more detail on what mitigations could be implemented in response to 'adverse changes'. Currently, it just refers to checking pump performance.

Q13: Has the Applicant proposed appropriate adaptive management and remedial measures to enable adverse effects identified through monitoring to be addressed?

No. I have not identified any proposed remedial measures that would be implemented to respond to adverse effects.

Q14: 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?

It is generally robust. I have included commentary on the identified flaws in the questions above.

Q15: Are there any other matters that appear relevant to you that have not been included? Please specify what additional info you require and why. Please explain.

No.

Q16: Are the proposed consent conditions appropriate (updated Appendix 8)? If not, please state why.

Water Permit – Take of Groundwater Containing Leachate and Other Groundwater:

- General: requires a reference to the proposed monitoring protocol. Suggest that this is in accordance with NEMS and undertaken but a suitably qualified person.
- General: Requires a link back to Appendix I: Monitoring Plan.
- General: requires a new condition addressing trigger levels for action, or link to it in the Monitoring Plan.
- Condition 2: I recommend addition of an advice note, or further clause that requires redundancy in the pumping system to be implemented within 6-months.
- Condition 4: Frequency of inspection of the leachate system to be <u>weekly,</u> unless a reliable telemetered monitoring and alarm system is installed, with redundancy in alarm triggering.

- Condition 10: EPS42 level monitoring should be telemetered and form part of the alarm system. The advice note here is not consistent with the requirement to maintain a groundwater level depression within the interception drain system.
- Condition 15: Increase monitoring frequency to quarterly.

Q17: If granted, are there any specific conditions that you recommend should be included in the consent beyond what the applicant has proposed?

Please see above.

Q35: Do you agree with the Applicants assessment against surface water flows? In particular, the statement that abstraction of groundwater is likely to result in a reduction of surface flows within the wetland due to a lower quantity of groundwater discharging to the wetland-estuary. (See section 10.2 of the PDP report).

Yes, it is removing groundwater that would otherwise have entered the estuary/wetland at some point (withing 1.2km of the landfill) and become surface flow. However, with the average rate of take between 0.6 and 1.4 L/s this is very small.

Q36: Do you agree with the drawdown assessment against neighbouring groundwater users? (Section 10.1 of PDP report).

Yes, I agree with the PDP report that any drawdown effects will only be local, within the landfill boundary.

Q37: Do you agree with the assessment against Saline intrusion? Why/ why not? (Section 10.3 of the PDP report).

Yes, I agree with their assessment. Saline intrusion concerns are in areas where significant groundwater pumping can reverse the saline/freshwater interface, causing salt water to intrude into freshwater aquifers. There is no deep pumping of groundwater here, so the risk is absent.

Q38: The Applicant has undertaken a potholing exercise and has subsequently provided information on the cap over the Western Landfill (s92 response, Q:10 &11). Is the cap depth appropriate to reduce leachate generation? If not, do you recommend any changes to the existing cap?

The WM potholing exercise recorded capping depth ranging between 500 and 700 mm with a final topsoil cover of between 100 mm and 200 mm. The depth recorded was generally commensurate with the minimum landfill final cap specified in Consent 95007 of 600 mm capping and 200 mm. No supporting information has been provided. Items required include the density of potholes and the material properties of capping materials (visual observations, in-situ permeability testing, and/or laboratory testing).

Q39: Have the cumulative effects on surface water and groundwater quantity been adequately assessed?

Yes, I have discussed cumulative effects above.

Q40: The Applicant has assessed the effects on groundwater and surface was quantity to be minimal in the section 6.2.2 of the PDP report. Is this statement reflective of the technical information provided in section 10 of the PDP report? Do you agree with the statement that effects will be minimal? Does this correlate to a less than minor effect? Please explain why/ why not.

Yes, I agree that the effects on groundwater and surface water quantity will be minimal. The volumes diverted by the leachate system are small in comparison to flows within the estuary and Kaikorai Stream. For comparison, the mean flow in the Kaikorai Stream is 368 L/s compared to < 2 L/s for the groundwater/surface water diversion.

Questions Q41 through Q43

These questions are repeats of Q30 to Q33 and are answered above.

Regards,

SLR Consulting New Zealand

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Responses to Questions 7 and 38 were provided by Emma Trembath.