

Otago Regional Council
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Attention: Hilary Lenox

Dear Hilary

Technical Review to Inform Notification Decision: Smooth Hill Landfill - Appendix 3 - Landfill Concept Design

Introduction

- 1 Dunedin City Council (DCC) proposes to establish a new Class 1 landfill, to be located at Smooth Hill to the south of Dunedin Airport. DCC has applied to Otago Regional Council (ORC) for a range of resource consents required for the establishment and operation of the proposed landfill.
- 2 Tonkin & Taylor Ltd (T+T) has been engaged by ORC to undertake a technical review of the landfill concept design aspects of the application lodged by DCC in support of its resource consent applications.
- 3 The purpose of this report is to set out the findings of our technical review of DCC's landfill concept design to inform a decision to be made by ORC regarding notification of the resource consent applications.
- 4 The following documents have been considered as part of this technical review:
 - **Dunedin City Council - Proposed Smooth Hill Landfill: Section 92 Review - Requests for Further Information:** *Report prepared for ORC by T+T, September 2020.* (Herein referred to as the 's92 Request').
 - **Revised Appendix 3 - Landfill Concept Design Report:** *GHD August 2020 Updated May 2021. Waste Futures Phase 2 – Workstream 3 Smooth Hill Landfill, Landfill Concept Design Report. Report prepared by GHD Limited for Dunedin City Council.* (Herein referred to as the 'Landfill Design Report').
 - **Revised Appendix 4 - Concept Design Plans.**
 - **Revised Appendix 9 - Surface Water Assessment Report:** *GHD August 2020 Updated May 2021. Waste Futures Phase – Smooth Hill Landfill, Surface Water Assessment. Report prepared by GHD Limited for Dunedin City Council.* (Herein referred to as the 'Surface Water Assessment Report').
 - **Smooth Hill Landfill Further Information:** *Provided by ORC as part of its s92 response of 4 August 2021.* (Herein referred to as the 'Further s92 Response').
 - **Smooth Hill Landfill Draft Conditions:** *Provided by ORC as part of its Further s92 Response of 4 August 2021.* (Herein referred to as the 'Draft Conditions').

- 5 This technical review has been undertaken by Anthony Bryce, Environmental Engineer at T+T. It has been prepared in accordance with T+T's letter of engagement with the ORC dated 12 November 2019.

Description of the proposal

- 6 The proposed Smooth Hill municipal landfill is intended to replace the existing Green Island landfill located in Dunedin. The Smooth Hill Landfill is now reduced in scale from the original application as follows:

- A footprint of 18.6 ha instead of the original 44.5 ha.
- A gross capacity reduced from 7.9 million m³ to 3.3 million m³.
- Net waste capacity of 6.2 million m³ to 2.9 million m³.
- The predicted landfill life reduced from 55 years to approximately 40 years.

The landfill will be designed to accept municipal solid waste in accordance with proposed acceptance criteria applicable to a Class 1 Landfill.

- 7 The overall landfill project is to include:
- Earthworks to construct the required shape.
 - Construction of a low permeability lining system with the intent of preventing leachate escape into the surrounding environment.
 - Construction of a leachate collection system above the low permeability lining system, with storage and tankering of leachate from the site.
 - Stormwater control around the constructed landfill and other areas of the site, with treatment and attenuation of stormwater as it leaves the site.
 - A landfill gas (LFG) collection system with treatment by flaring.
 - Provision of access, services and utilities as required for the construction and operation of the landfill.

Landfill design assessment

- 8 The revised Landfill Design Report and associated drawings describe concepts for a landfill design based on sound design principles and details generally as described in the Disposal to Land Guidelines¹ (the Guidelines) and typically adopted throughout New Zealand. It is critical that these concepts be developed into a detailed design that continues to follow the principals of the Guidelines and good practice to achieve the required environmental protection. This must then be followed by a high quality of construction, verified by Construction Quality Assurance (CQA), to provide the level of environmental protection proposed in the concept design. It is critical that an appropriate level of review of the detailed designs and CQA documentation for each stage of landfill development is provided by or on behalf of the Regional Council.
- 9 Our assessment of the key elements of the design of the proposed landfill that pose the greatest risk for environmental effects is described below.

Landfill lining system

- 10 The applicant proposes to use either a Type 1 or Type 2 lining system as described in the Guidelines. A type 1 system comprises a geomembrane overlying a low permeability clay (coefficient of permeability (k) less than or equal to 1×10^{-9} m/s) and Type 2 comprises geomembrane over a geosynthetic clay liner (GCL) and clay (k less than or equal to 1×10^{-8}

¹ Technical Guidelines for Disposal to Land, WasteMINZ, 2018.

m/s). The applicant has provided information that suggests suitable soils are available on site for the construction of these lining systems.

- 11 The quality of construction is key to providing an effective landfill lining system for environmental protection, and the provision of good CQA is required to ensure a high quality of construction of both the clay and geosynthetic components of the lining system. In this regard, as noted in literature, the presence of wrinkles in the completed geomembrane is a major potential source of additional leakage through the lining system and requires careful construction control.
- 12 The proposed construction of the landfill has a 10 m toe bund across the mouth of the valley, with side slopes cut to 1V:4 H (25%) with 10 m wide benches at 10 m height interval (first bench) and up to 20 m between the first bench and the landfill perimeter. Floor grades are shown to be formed generally at approximately a 4% grade. These slopes are suitable for landfill liner construction and are appropriate for leachate drainage. Overall stability of the landfill at all stages of development will need to be demonstrated during detailed design, with emphasis on a potential translational failure plane at the liner interface level. However, in general terms, we consider that the landfill as proposed can be designed to be stable.
- 13 The design proposes that a network of subsoil drains is installed beneath the liner to control potential groundwater pressures beneath the lining system. Without such relief, such groundwater pressures have the potential to cause damage to the lining system before sufficient weight has been placed above the liner as a result of waste filling. The actual layout and extent of the subsoil drains will need to be determined during detailed design based on detailed site investigations and modified as necessary during construction to intercept any observed seeps. The point of discharge from the groundwater drainage system to the downstream environment will be monitored to indicate the presence of potential leakage from the landfill to this system so that appropriate action can be taken.
- 14 Overall, we consider that the lining system proposed is robust and contains appropriate redundancy, being a multi-barrier composite liner approach. Should the geomembrane develop defects the underlying GCL and/or clay will in first instance limit leakage to the permeability of those components, and secondly provide an additional barrier and capacity to adsorb contaminants. Therefore, the risk of escape of significant quantities of leachate through the lining system is very low if it is constructed with an adequate level of CQA.

Leachate system

- 15 An equally important component of the overall landfill containment system is the leachate collection system, which must be effective in removing leachate from the landfill such that a head of leachate does not build up over the liner. By limiting the head of leachate on the liner the potential leakage through any defects in the HDPE liner are limited. For the proposed landfill the leachate collection and removal system comprises:
 - 300 mm thickness of drainage media with underlying cushion geotextile overlying the landfill liner.
 - Perforated pipework located only at the toe of the side slopes to convey leachate to a sump upstream of the toe bund of the landfill.
 - Leachate pumps and riser pipes to pump the leachate from the landfill. This avoids the need for penetrations through the lining system for leachate pipes.

The concept design report notes that the leachate collection system will be finalised during detailed design.

The drainage grades on the floor of the landfill are appropriate for effective removal of leachate. Calculations will need to be provided with the detailed design to demonstrate that a leachate head not exceeding 300 mm can be achieved for the aggregate to be used, the

drainage slope and the collector pipe spacing. We note that the maximum leachate drainage path on the floor of the landfill is in the order of 150 m. From our experience, for such a long drainage path it will be difficult to achieve a 300 mm leachate head unless additional lateral pipes are provided or a very coarse drainage aggregate is used. Under such conditions, the design may need to consider the use of a filter geotextile above the drainage aggregate to protect the drainage capacity of the stone from clogging.

The applicant has shown no leachate collection pipes on the intermediate benches. This will result in relatively large volumes of leachate from the side slope areas crossing the benches and ultimately accumulating on the floor. Again, the applicant will need to demonstrate that a 300 mm leachate head can be achieved for this scenario. Good practice would be to install leachate collection pipes on the benches to provide some redundancy and to reduce leachate flow through the drainage aggregate and ultimate accumulation of leachate at the floor level.

The applicant has provided some redundancy in the leachate collection system by showing two collection pipes at the toe of each side of the landfill. I consider that provision should be made to be able to clean these pipes, and this could be readily achieved with a pipe laid up the slope of the toe bund to clean-out ports located at the surface of the landfill.

These two matters regarding the design leachate head and the provision of adequate redundancy/cleaning provision can be covered by appropriate consent conditions.

- 16 The applicant proposes that leachate will be pumped from the landfill into storage tanks sized to contain 48 hours storage. These will be located within a banded area to provide spill containment should a tank fail. The leachate will then be tankered off site until a gravity pipeline is constructed to convey leachate to the council sewerage system connection in Brighton. The adequacy of the storage capacity will need to be reviewed as part of the detailed design and will need to be determined on the basis of the reliability of the transport system for leachate from the landfill and whether it will be operated 7 days per week. However, overall we consider that the system described provides a suitable leachate management solution.

Stormwater management

- 17 The subject of stormwater management is introduced in the concept design report and covered in more detail in the Surface Water Assessment Report. The stormwater management system described in the application provides for appropriate management of stormwater during construction and operation of the landfill. The applicant describes a system of stormwater drains to divert all stormwater from above the toe bund level to a treatment and attenuation pond located to the west of the landfill. The documents also describe temporary stormwater ponds to capture and treat runoff from construction activities that cannot drain to this pond.
- 18 During operation, the applicant proposes to maintain separation between stormwater and waste, such that any stormwater that comes into contact with waste will be treated as leachate in accordance with standard landfill operating procedures. The application, and consent conditions, propose that the inflow to the permanent stormwater pond is continuously monitored to detect the possible presence of waste or leachate contamination.
- 19 Overall, we consider that the stormwater management system is appropriate for the landfill. Further comment on water quality matters are provided under the Water Quality Assessment.

Landfill cap

- 20 The landfill cap provides a separation between future site activities and the underlying waste. It also controls the quantity of water that can percolate into the landfill to become leachate in the long term and controls potential LFG emissions from the landfill, and is this an important element of the LFG management system. The applicant proposes an “Enhanced Minimum”

final cap design as defined in the Guidelines. This comprises, from top to bottom, 150 mm topsoil, 300 mm growth media layer and at least 600 mm (and up to 1000 mm) of compacted cohesive soils (with permeability less than 1×10^{-7} m/s). This would overlay any intermediate cover already in place. We consider this appropriate for the proposed landfill.

Landfill gas (LFG) management

- 21 The application describes a combination of horizontal collection pipes as the landfill is progressively filled and vertical wells for the extraction of LFG. The collected gas will be treated in an enclosed flare with a back-up candlestick flare to be provided. The enclosed flare will need to meet the specific requirements of the National Environmental Standard – Air Quality. Electricity generation may be considered at a later date. This is a standard approach to LFG collection and treatment and is appropriate for a landfill of this nature.

Design, construction and operational review

- 22 Our review presented above focusses on the need for good review of, particularly, the design and construction of the staged development of the landfill. The Applicant has proposed some Draft Conditions in relation to the quality of design and review, however these rely on review by the ORC. In the event that the ORC does not have the technical expertise or capacity to undertake these reviews then this becomes problematic. Either an inadequate level of review will be undertaken, and/or landfill development will be delayed while the ORC seeks to outsource this review work. An alternative approach is required.
- 23 The approach adopted for a number of landfill consents in NZ is to appoint a Peer Review Panel (PRP) to review the design, construction and operation of the landfill. The PRP would comprise two or three members with specific landfill or related expertise. The PRP is appointed by the owner, and approved by the Regional Council, and they report back to the Regional Council. All costs are borne by the consent holder. It is usual for the Regional Council to then “accept” the designs, construction, commissioning etc of a cell based on the recommendation of the PRP. We have proposed consent conditions below to require the appointment of a PRP.

Proposed conditions

- 24 We consider that the Draft Conditions that relate to the landfill design reflect the proposal as described in the application and are generally appropriate. We expect that the conditions will be developed further through the consenting process.
- 25 To address the matters raised above regarding the review of design, construction and operation of the landfill, we recommend that the Draft Conditions 4 and 5 be deleted and that the following conditions be added:
4. *The Consent Holder shall establish and retain at its own cost, an independent Peer Review Panel to review the design, construction and operation of all stages of the landfill and to assess whether or not the work has been undertaken by appropriately qualified personnel in accordance with the consents and good practice. The independent Peer Review Panel shall comprise at least two persons who together shall be:*
- o Independent of the Consent Holder.*
 - o Independent of the planning design, construction, management and monitoring of the site.*
 - o Experienced in landfill design, construction and management.*
 - o Experienced in geotechnical, groundwater and surface water aspects of landfill design, construction and operation.*

- o *Recognised by their peers as having such experience, knowledge and skill.*
- o *Approved in writing by Otago Regional Council.*
- 5. *Prior to commencing the construction of a new landfill stage, the Consent Holder shall submit a design report and design drawings of the relevant stage to the Peer Review Panel for certification that it meets the requirements of the consent. The Peer Review Panel shall communicate this certification to Otago Regional Council.*
- 6. *The Peer Review Panel shall prepare an annual report to be submitted to Otago Regional Council prior to 1 March each year, on the adequacy of the following matters in relation to meeting requirements of the consents:*
 - o *Any management or monitoring plans reviewed during the year.*
 - o *Any designs reviewed during the year.*
 - o *Construction activities undertaken including:*
 - *Site preparation.*
 - *Liner construction.*
 - *Leachate collection system installation.*
 - *Landfill gas collection system installation.*
 - o *Landfill operation including:*
 - *Water control, including stormwater and leachate management.*
 - *Waste compaction.*
 - *Waste acceptance.*
 - *Daily and intermediate cover placement.*
 - *Leachate system.*
 - *Landfill gas system.*
 - o *Monitoring and records.*
 - o *Capping and rehabilitation.*

This report shall be based on:

- o *A review of the landfill annual monitoring report.*
- o *Review of designs submitted during the year.*
- o *Review of construction CQA reports.*
- o *Any further enquiries and inspections required by the Peer Review Panel to allow them to carry out their duties.*

The following should be inserted after condition 13:

- xx *The installation of the lining system shall be subject to independent construction quality assurance (CQA), to include the soil and geosynthetic components of the lining system. On completion of each stage of lining system construction a CQA report shall be prepared and shall include all of the test results, a description of the observations undertaken and certification that the lining system has been installed in accordance with the specification. This report shall be submitted to the PRP.*

Conclusion

- 26 The concepts and draft plans that have been presented by the applicant for the development of the Smooth Hill Landfill describe concepts that are in general accordance with current industry practice. On the basis of the information supplied, and with the addition of consent conditions as described above, the landfill can be expected to perform and manage environmental risks to the high standards of modern landfills.

Applicability

- 27 This Report been prepared for the exclusive use of our client Otago Regional Council , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

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