Under	the Resource Management Act 1991 (**RMA**)
In the matter of	an application by **Dunedin City Council** for resource consents for the operation, closure and aftercare of the Green Island Landfill, Dunedin.

Statement of evidence of Robbie Adrian Arnold Roberts

4 March 2025

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Qualifications and experience

1 My name is Robbie Adrian Arnold Roberts. I am known as Adrian Roberts.

2 I am a Technical Director and Associate at GHD specialising in waste containment infrastructure.

3 I am an environmental engineer with 20 years' experience at GHD. Over the course of my career, I have worked on a wide range of waste containment projects including the planning, design, construction, audit and operation of waste containment facilities. This has included landfills ranging from small regional facilities to large metropolitan sites throughout Australia, New Zealand and elsewhere for municipal, industrial, mining and hazardous wastes.

4 My academic qualification is a Bachelor of Engineering (Hons), University of New South Wales.

5 My professional memberships are:

(a) Member of Engineers Australia (EA)

(b) Member of the Waste Management & Resource Recovery Association (WMMR)

6 I have been involved in the review of the Australian Standards for geosynthetics with the Australian Standards Committee – CE20 Geosynthetics.

7 My assessment is based upon the description of the Application as contained in Section 2 of the AEE.

8 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023. This evidence has been prepared in accordance with it, and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

9 I have been asked to prepare evidence in relation to civil design aspects of the Green Island Landfill proposal. As per the directions set out in the Commissioner's minute[1], this evidence is focused on potential areas of contention in relation to the proposed landfill cap and leachate

[1] RM23.185 Directions of the Commissioner, Minute 1. 21 January 2025.

management as it relates to the landfill civil design included in the ORC technical review undertaken by Mr James Colin Elliott (21 Feb 2025).

10 This includes:

(a) A brief overview of the site history and development of the landfill cap.

(b) Assessment of the landfill cap risk profile at a reduced grade.

(c) Leachate management and extraction.

Executive summary

11 I have provided a brief overview of the site and landfilling history and development of the landfill cap

12 I have reviewed, and proposed revision, of the recommended Consent Conditions as they relate to the landfill cap and leachate extraction.

13 I have provided responses to matters raised by the landfill design and management technical review completed on behalf of by Mr James Colin Elliott (21 Feb 2025).

14 The construction of the final landform cap consistent with earlier consents and designs with a 2% or greater surface gradient is not expected to result in significant additional risk of surface water ponding or increase in leachate generation over time due to the lower potential for differential settlement.

15 Further, any localised differential settlement that may occur can be sufficiently managed within the existing monitoring and management practices of the site.

16 Future waste volumes are uncertain, and the final landform is therefore also uncertain. Therefore, the Consent Conditions should reflect this uncertainty and the final landform should be revised as part of the Landfill Closure Plan.

17 To demonstrate how this would be facilitated I reviewed the current design and developed a possible final landform that targeted a final cap gradient of 4% or greater. This revision resulted in a final landform of 4% or greater for most of the landform. Therefore, I am comfortable that the cap gradients can be improved but note that the final cap grades cannot be finalised until final waste volumes are known. I note the draft conditions contemplate this process (General Conditions 2b and 2c)

18 It is proposed that the order of the final cap profile in General Condition 36 is adjusted to reflect the current site operations. This is consistent with the

soil layer profiles suggested by ORC in their draft conditions of consent. The only change has been to re-arrange the order (from top to bottom) and swap the bottom two layer thicknesses to reflect current site operations:

(a) 350 mm topsoil.

(b) 600 mm low permeability clay.

(c) 200 mm compacted cover soil.

(d) 300 mm compacted intermediate cover soils.

19 Leachate head within the landfill is expected to decrease over the coming years as the landfill is progressively capped and closed. Other mitigation measures are also proposed including the continued installation of horizontal leachate drains within the waste and pumping of leachate from installed landfill gas wells.

20 The existing and proposed measures for leachate extraction and the progressive installation of the final cap are expected to reduce the leachate head within the landfill. Unless the monitoring required by the Landfill Development Management Plan and the Landfill Closure Management Plan demonstrate that the leachate head is rising to above a level that would compromise stability of the landfill and/or is having an adverse environmental impact I do not see the benefit of undertaken a leachate pumping trial as outlined in proposed ORC Condition 6 (Section B).

21 I recommend the leachate pumping trial is included as part of the Landfill Development Management Plan and undertaken, if required, to inform a potential adaptive management approach to any issues that may emerge associated with leachate at the site or management of leachate levels for geotechnical reasons as discussed in the evidence of Ms Fellows.

Sections as set out in scope of evidence above

Introduction

22 My evidence is based upon the information reviewed to inform the landfill cap and civil design which I prepared. I have focussed my evidence on matters raised by the landfill design and management technical review completed by Mr James Colin Elliott. However, I have also included background information where I think it is useful to provide context.

Site description and landfilling history

23 A brief overview of the site and landfilling history is provided below:

(a) Waste disposal first occurred at the Green Island site in 1954 with the disposal of industrial waste and the site has been used for waste disposal since that time.

(b) Landfilling commenced at the south-east corner of the landfill site and has continued north and west over the decades

(c) A soil bund was constructed around the edges of the landfill in the early 1990's to constrain waste placement.

(d) Leachate is managed via a leachate trench that was commissioned in 1995.

(e) Final capping in the northern area was completed in December 2022.

Landfill cap

24 General Condition 34 requires the Consent Holder to nominate a timeframe for the completion of capping within stage 1-3 following final receipt of waste in those areas and requires that final capping must be fully completed no later than two years following the final acceptance of waste at the landfill. To ensure consistency, and to allow for suitable construction windows, I recommend this condition requires the Consent Holder to complete the capping of stages 1-3 as soon as is practicable but no later than 2 years after final receipt of waste in those areas.

25 The ORC technical review (prepared by Mr James Elliott) states that:

(a) 'Clause 34: As detailed in the 2023 and 2024 LDM Memorandums, the landfill closure concept design is generally considered appropriate, notwithstanding the following.'

(b) 'Clause 35: The final landfill cap grade includes areas with a grade of 2%, which is well below the minimum grade called for in WasteMINZ of 5%.

26 GHD had previously provided commentary that earlier iterations of the landfill design and previously granted resource consents have maintained a viewing plane across the top of the Green Island landfill from the Clariton Ave area to Saddle Hill to the west. To achieve this viewing platform, previous consented designs had a final cap grade that was no flatter than 2%. This approach was retained for this current consent application to maintain the viewing plane and ensure the landform is sympathetic to the surrounding landscape as further described in the Landscape, Natural Character, and Visual Effects Report (Appendix 13 to the application).

27 To clarify the extent of the affected areas, a grade analysis of the proposed design was undertaken, and the results have been tabulated below. The results indicate that approximately 36% of the area to be consented is graded at less than the WasteMINZ Guideline requirement of 5%.

Slope range	slope area (m2)	% of total
<3%	12,838	13%
3 – 4	17,454	18%
4 – 5	5,047	5%
5 - 20	24,790	25%
20 - 100	38,968	39%

28 I agree with Mr Elliott that 'The intent of a minimum cap grade is to promote surface water runoff, and to provide some redundancy against flat spots where water can pool in the event of localised settlement due to waste breakdown (Clause 37)

29 The WasteMINZ requirement of 5% or greater is a blanket guideline requirement to be applied to a landfill cap regardless of the waste type and depth of the landfill. That is, a landfill with a much greater depth of waste and greater proportion of putrescible waste, which would likely undergo much larger differential settlements than would be expected at Green Island Landfill, would still be required to have a minimum 5% grade.

30 The 5% minimum grade requirement is typically adhered to in lieu of a site-specific assessment of the settlement risk. The Green Island Landfill is not expected to exhibit significant differential settlement post closure as:

(a) waste currently located in the footprint is expected to have already exhausted a large portion of its primary (consolidation) and secondary (creep) settlement potential due to the age of the landfill.

(b) waste placed at Green Island Landfill in the future will be predominately domestic/industrial waste and soils with a relatively low organics content as the organics have been diverted to a organics processing facility since July 2024. As such it is expected that the waste will experience less tertiary (degradation) settlement compared to waste with a high proportion of degradable material.

31 Given the lower site-specific risk of differential settlement due to the age of the existing waste and type of proposed waste, it is my opinion that the construction of the final landform cap with a shallower grade than 5% grade is not expected to result in significant additional risk of surface water ponding or increase in leachate generation over time.

32 Further, any localised differential settlement that may occur can be effectively managed within the existing monitoring and management practices of the site. This would involve monitoring the landfill cap for low spots and remediating any low spots that cause ponding of water by removing the revegetation and subsoil layers and backfilling the low spot with compacted clay to re-establish a suitable grade.

33 It is noted that DCC will maintain ownership of the property and be on site at the RRPP post closure and will be readily available to monitor and maintain the proposed cap.

34 However, as described in the application and the evidence of Mr Chris Henderson, there is uncertainty about the volumes of waste that will be accepted at the site in the future. The final achievable landform will be dependent on the available waste and may need to differ from the surface illustrated in the proposal to suit in the event lower waste volumes are received than expected.

35 To address this uncertainty, the proposed consent conditions include:

(a) a pathway for future amendments to the final landform to be made under certain conditions. This includes if the alternative design is provided to ORC or incorporated in the Landfill Closure Management Plan (General conditions 2b and 2c):

> The alternative design or methodology has been provided under General Condition 23 to the Otago Regional Council and certification is obtained from the Otago Regional Council; or
>
> The alternative design or methodology has been incorporated into the Landfill Development Management Plan required under general condition 12 or Landfill Closure Management Plan under general condition 16 and provided to the Otago Regional Council and certification is obtained from the Otago Regional Council.

(b) provision for the development of a Landfill Closure Management Plan that “must be submitted to the Otago Regional Council at least 3 months prior to the final acceptance of waste at the landfill to assess…” (General condition 19).

(c) that the Closure Plan be reviewed every three years following final acceptance of waste "*…to ensure that the management practices contained within them remain adequate to ensure compliance…*" (General condition 20).

(d) provision of a design report and specifications to the ORC for any *"final capping"* within 20 working days prior to commencing construction (General condition 23).

36 Based on the currently expected volumes of waste I have undertaken a review of the proposed landform and the proposed landform grades. A landform with slopes generally greater than 4% can be achieved with no changes to the maximum height or the external batters, by adjusting the contours of the upper platform. Based on this revision the areas graded at less than 4% could be less than 5,000 m2 or less than 5% of the proposed capping area (refer table below).

Slope range	**slope area**	**% of total**
<3%	562	1%
3 – 4	3,830	4%
4 – 5	26,497	27%

37 However, even with a revised profile, the site topography and geometry, and the aim to maintain the viewing plane and landscape requirements restricts the ability to achieve a minimum of 5% grade across the entire proposed capping area.

38 Further, a revised profile would be dependent on the waste volumes accepted at the site which will require assessment as part of the Landfill Closure Management Plan.

39 With this in mind, it is proposed that the existing proposed landform be retained as part of the consent process and that proposed ORC General Condition 36 be modified to require the final landform to target a gradient of 4% or greater, as far as is practicable, based on the final received waste tonnages and that suitable management measures requiring support of effective surface water drainage and remediate low spots, be included in the Landfill Closure Management Plan to address any areas that do not achieve a target gradient of 4%.

40 The Consent Holder recognises that management plans and ongoing maintenance of the cap will be required following closure to maintain effective surface water run-off.

Landfill Cap Profile

41 The current site practice for covering the final lift of waste (i.e. the lift directly below the final cap) is to place a 300 mm layer of compacted intermediate cover. This is then handed over to the final cap contractor who places an additional 200 mm of compacted soil cover as a subgrade for the 600 mm low permeability clay.

42 This order of material placement for these two layers is different to ORC proposed General Condition 34 but I consider this is not a material change to the proposed cover system as it still results in the same overall final cap thickness of 1450 mm and does not compromise the function of the low permeability clay or topsoil layers. It is proposed that the final cap profile in ORC proposed General Condition 34 is adjusted to reflect the current site operations (from top to bottom):

(a) 350 mm topsoil.

(b) 600 mm low permeability clay.

(c) 200 mm compacted cover soil.

(d) 300 mm compacted intermediate cover soils.

Leachate generation and management

43 I note the reviewer's concern regarding existing leachate levels and future management measures.

44 The landfill was uncapped for many years which has allowed leachate levels to build up.

45 As described in the application and the evidence of Ms Dusk Main, the existing leachate trench has been assessed as effective at intercepting leachate from the existing waste mass.

46 A network of horizontal drains is included in the proposal. This will promote the flow of leachate from future waste to the existing perimeter leachate system rather than into the existing waste mass below.

47 Pumping leachate from the landfill gas wells may be undertaken as an additional leachate extraction measure.

48 The proposal outlines a staged approach for filling and capping works. The progressive installation of the final cap will reduce rainfall infiltration and hence reduce the volume of leachate generated in the future.

49 ORC proposed Condition 4 (Schedule B) requires the Consent Holder to undertake a leachate pumping trial within 6 months 'assess the effectiveness of active leachate extraction from landfill gas wells at reducing the leachate head within the landfill cells and reducing the potential for offsite migration of leachate.' This condition assumes that the leachate head within the landfill requires reduction, at rates above what is expected from the network of horizontal drains and the staged approach to filling and capping, and that the landfill is having adverse environmental effects and/or is unstable due to the existing head of leachate within the landfill. This is contrary to the evidence provided by Ms Dusk Mains and Ms Debbie Fellows.

50 While I agree that the design of a network of pumps for leachate extraction, either via dual purpose gas wells or purposely drilled leachate wells, would require a pumping trial, I do not see the benefit in undertaking this pumping trial unless the existing and proposed measures for leachate extraction and the progressive installation of the final cap do not reduce the leachate head within the landfill and the monitoring required by the Landfill Development Management Plan and the Landfill Closure Management Plan demonstrate that the leachate head is rising above a level that would compromise stability of the landfill and/or is having an adverse environmental impact.

51 I recommend the leachate pumping trial is included as part of the Landfill Development Management Plan and undertaken, if required, to inform a potential adaptive management approach to any issues that may emerge associated with leachate at the site or management of leachate levels for geotechnical reasons as discussed in the evidence of Ms Fellows.

Adrian Roberts

4 March 2025