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 Simonne Frances Eldridge

On behalf of Dunedin City Council

4 March 2025

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Qualifications and experience

1 My name is Simonne Frances Eldridge.

2 I am a Technical Director of Environmental Engineering for Tonkin + Taylor.

3 I hold a Bachelor of Engineering Honours Degree (BE(Hons)) in Civil Engineering from the University of Auckland and am a Chartered Engineer (CEng (UK)), a Chartered Water and Environmental Manager (C.WEM), a Fellow of Engineering New Zealand (FEngNZ), a Fellow of the Institution of Civil Engineers (FICE), a Member of the Chartered Institution of Water and Environmental Management (MCIWEM), a Member of the Hong Kong Institution of Engineers (MHKIE) and a Life Member of the Waste Management Institute of New Zealand (WasteMINZ).

4 I have thirty-five years' experience in the planning, design and construction of civil and environmental projects in the United Kingdom, Africa, the Middle East, Asia, Australia and New Zealand.

5 I spent nine years in Hong Kong specialising in landfill planning, design, construction, operation, restoration and aftercare, the last seven years of which were as the Landfill Engineering Manager for Swire SITA Waste Services Limited. I was responsible for all design (including landfill gas) and construction activities at West New Territories Landfill (60 million cubic metres capacity), and I provided technical design input into the optimisation of landfill gas extraction at North East New Territories Landfill (38 million cubic metres capacity). Both landfills utilise a landfill gas management system similar to that at Green Island Landfill.

6 I returned to New Zealand in early 2005 and joined Tonkin + Taylor. Since that time, I have been the technical lead or the technical reviewer on multiple landfill gas projects in New Zealand, Australia, Malaysia and Fiji including multiple landfill gas master plans, landfill gas assessments and monitoring, landfill gas management system design, implementation and operation, landfill gas to energy system design, implementation and operation.

7 From mid-2012 I was the Chair of the Technical Group that developed the Waste Management Institute of New Zealand ("WasteMINZ") Technical Guidelines for Disposal to Land ("WasteMINZ Technical Guidelines") and the author of the Design section. The Guidelines were first published in April 2016. Subsequently, I led the preparation of Version 2 of the document which was published in August 2018 and was involved in technical review of Version 3 and 3.1 of the document (dated October 2022 and September 2023 respectively).

8 I have been the technical lead on various engagements in relation to landfill gas management at the Green Island Landfill in conjunction with Dunedin City Council since 2019. My involvement in the current consenting process has included technical review of responses to multiple Section 92 requests in relation to landfill gas management, including the preparation of a Landfill Gas Management Letter Report[1], an update[2] and addendum[3] to the Landfill Gas Masterplan, and completion of a landfill gas risk assessment (LFGRA)[4].

9 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

10 I have been asked to prepare evidence in relation to paragraphs 58 to 70 of Mr James Colin Elliott's evidence, in his capacity as the technical reviewer for Otago Regional Council[5], in relation to landfill gas management.

Matters raised by ORC technical review

11 **Paragraph 58**: I agree that lowering leachate levels is likely to result in an increase in landfill gas generation rates and may improve landfill gas collection efficiency.

12 **Paragraph 59**: I note the following in relation to the destruction capacity of the landfill gas management system. This information is drawn from the LFG Masterplan and the LFG Masterplan Addendum:

(a) Current landfill gas flow from the landfill typically ranges from 400 to 500 m^3/hr.

(b) The gas engine at the site destroys approximately 350 m^3/hr at a maximum operating generation capacity of 600 kW.

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[1]T+T, Green Island Landfill – LFG Management Letter Report, 21 September 2023, prepared for Dunedin City Council.

[2] T+T, Landfill Gas Masterplan – Green Island Landfill, September 2023, prepared for Dunedin City Council.

[3] T+T, Green Island Landfill – Landfill Gas Masterplan – 2024 Addendum, 29 May 2024, prepared for Dunedin City Council.

[4] T+T, Green Island Landfill – Landfill Gas Risk Assessment, July 2024, prepared for Dunedin City Council.

[5] Statement of evidence of Mr James Colin Elliott on behalf of Otago Regional Council, 21 February 2025.

(c) A new enclosed flare has now been installed at the site which has a capacity of 1,000 m^3/hr. The new flare came online in January 2025. This is a significant increase compared with the capacity of the old flare of 450 m^3/hr.

(d) The old flare is being retained onsite as a backup, noting that clause 27 NES Air Quality[6] stipulates that a back up flare may only be operated if the primary flare is not operating.

(e) With the new flare in place, the system has a combined maximum capacity of approximately 1,350 m^3/hr.

(f) The modelled maximum landfill gas generation for the site ranges from 722 to 819 m^3/hr depending on the management of leachate levels.

13 Based on this information, I consider that the landfill gas management system has sufficient capacity to destroy all landfill gas that is captured onsite.

14 The new flare that has been specifically designed for the site and only recently installed. In my experience these flares are very reliable and have minimal downtime. As such, I consider it will be appropriate as the primary landfill gas destruction mechanism for landfill gas.

15 I further note that the retention of the old flare and the gas engine provides resilience in the event that the new flare is not operational.

16 **Paragraph 60**: As stated above, the destruction capacity has increased, and the reliability and resilience has also increased. Therefore, I consider that the landfill gas management system has sufficient capacity to destroy all landfill gas that is captured onsite.

17 **Paragraph 61**: In my experience, landfill gas wells are often installed in active areas and are always subject to settlement and at risk from damage. Therefore, it is standard practice for landfill gas extraction wells to be designed for these conditions.

18 **Paragraph 62**: In my experience it is normal for landfill gas extraction wells to be designed such that they are able to extract landfill gas from the full waste depth. As shown in the Landfill Gas Masterplan, the vertical extendable wells are constructed with continuous perforated pipework. In

[6] Resource Management (National Environmental Standards for Air Quality) Regulations 2004, amended 1 June 2011.

between lifts, the near surface sections of pipework are covered by the steep slip casing which is moved up as filling occurs around the well. This method was developed under my technical direction in Hong Kong and has now been used successfully on a number of landfills in New Zealand.

19 **Paragraph 63**: I agree that landfill gas extraction should commence as soon as possible after the waste reaches final height. This is consistent with the approach for future expansion of the landfill gas extraction system as outlined in the Landfill Gas Management Letter Report.

20 A high-level outline of the expansion of the landfill gas extraction system is provided in this report, along with staging plans. Expansion of the system has been divided into three future stages as described below. In line with good practice, the new wells will be constructed as soon as sufficient waste has been placed in these areas and extended as filling progresses. They will be temporarily connected to the extraction network during filling, with the cross headers and final connections installed once the final fill profile has been reached. As is normally the case, more specific timing cannot be provided at this time as the timing will be dependant on filling rates and operational considerations which will be determined by the Council and their contractor.

(a) Stage 4 – Eastern ringmain, cross header 1 and additional well installations. This stage will complete the full ring main and increase gas collection from the northern part of the current fill area with approximately 6 new wells.

(b) Stage 5 – Cross header 2 and additional well installations. This stage will provide another cross connection to the ringmain and increase gas collection through the central part of the site with approximately 12 new wells.

(c) Stage 6 – Cross header 3 and additional well installations. This stage will complete the well field in the southern part of the site and include installation of a third cross header, and approximately 16 new wells.

21 **Paragraph 64**: I agree that horizontal landfill gas collectors can be a useful part of an extraction system and confirm it is my understanding that they will be installed at the site where appropriate.

22 **Paragraph 65**: The proposed consent limit of 5,000 ppm of methane at the surface within areas of the landfill with intermediate or permanent final

capping is consistent with Clause 26 of the NES Air Quality[7] which the site is required to comply with. I consider this is the most appropriate standard for the monitoring of potential adverse effects from surface methane emissions and is consistent with similar air discharge consents in New Zealand. Therefore, I do not support the change to condition 27 proposed by ORC to reduce the allowable emission limit from 5,000 to 1,000 ppm.

23 Draft condition 28, as updated by ORC to refer to an overseas standard which relates to a different regulatory environment than New Zealand. Based on my experience, I am also unclear why it is proposed to undertake surface emission monitoring during strong wind speed as in my experience it is unlikely to produce accurate results of emission rates due to dispersion effects. Furthermore, I agree that there can be an increase in risk from surface emissions as a result of significant rain events, but in my experience cap damage is more appropriately identified by daily walkovers than undertaking an emissions survey. Therefore, based on my experience, I propose alternative consent conditions, more consistent with the New Zealand regulatory environment, namely

(a) Revised draft Condition 28: "During operation, closure, and aftercare of the landfill, LFG a Flame Ionisation Detector (FID) or equivalent shall be used to carry out surface emissions monitoring for methane over the entire surface of the landfill on at least a 30 m by 30 m grid basis excluding the working face at least once every three months on areas with final cover, reducing to six-monthly after five years of landfill closure, and at least once every month on areas with thickened daily cover or intermediate cover. The results must be reported annually to Te Rūnanga o Ōtākou and Otago Regional Council in accordance with General Condition 585.

(b) Revised draft Condition 29: "Following a significant rain event of 130mm/24 hour, the Consent Holder shall undertake daily walkovers for 3 consecutive days. Any evidence of actual or potential landfill gas leaks such as odour, cracks in the landfills surface, gas bubbles, leaks in the gas extraction system or vegetation damage or evidence of leachate seeps shall be investigated."

24 Draft condition 30, proposed by ORC, relates to action to be taken by the Consent Holder "*Where surface methane is detected at more than 500 ppm and less than 1,000 ppm…*". In my experience it is not common in New Zealand to have such a consent condition imposing a trigger level prior to

[7] Resource Management (National Environmental Standards for Air Quality) Regulations 2004, amended 1 June 2011.

a consent limit being exceeded. I therefore do not support the inclusion of the additional consent condition but if it was considered necessary it would need to be adjusted to "*…more than 4,500 ppm and less than 5000 ppm…*" to be consistent with New Zealand regulatory requirements noting there is not trigger limit stipulated in the NES Air Quality.

25 **Paragraph 66**: Remedial works in the event that the consent limit for surface methane emissions is exceeded are documented in the Landfill Management Plan[8]. Section 3.5.10.5.7 provides guidelines for this situation including remedial works and re-monitoring as suggested in Paragraph 66. I consider the approach proposed is appropriate.

26 **Paragraph 67**: I agree that, where practicable, landfill gas monitoring should be undertaken during falling or low atmospheric pressure conditions and support the Advice Note below draft condition 25 of the Air Discharge consent being updated to reflect that requirement.

27 **Paragraph 68**: Draft condition 11 states that landfill gas wells must be "…*installed progressively as soon as practicable…*", and "…*no later than 2 years following the final acceptance of waste at the landfill*". The timing for installation of landfill gas extraction wells will be dependent on the timing of filling and capping in each of the landfill areas. This timing is uncertain and therefore stating specific timeframes for installation of the new infrastructure may conflict with other critical activities for the operation of the landfill. To capture the intent of installing extraction wells at the earliest opportunity, the subclause a. of condition 10 could be amended to state "*Be installed progressively as soon as practicable as the placement of waste occurs in each stage, and no later than 2 years following the final acceptance of waste at the landfill*".

28 Draft condition 13 relates to the connection of landfill gas extraction wells to the landfill extraction system which I understand has been amended by ORC to stipulate that "*…as soon as practicable and in any case not longer than three months after placing wastes within the radius of influence of the wells, with care taken not to introduce oxygen into the waste mass…".* Although I agree that the wells need to be connected as soon as practicable, I do not support the time period being included in the condition. In my experience ensuring adequate depth of waste is essential to limit air being drawn into the waste mass. The time for suitable waste depth within the radius of influence of an extraction well will be subject to a number of factors including the location of the extraction well relative to ongoing waste

[8] WM New Zealand Ltd, Green Island Landfill – Landfill Management Plan, October 2018.

placement, the rate of waste acceptance and the extent of the waste lift. Furthermore, the surface landfill gas monitoring will determine if there is unacceptable fugitive landfill gas emissions thereby providing a mechanism for ensuring action is taken in the event of unacceptable emissions. I therefore consider the time requirement should be removed.

29 **Paragraph 69**: Noted and agree is a reflection of the LFGRA conclusion.

30 **Paragraph 70**: The LFGRA was prepared in response to a Section 92 request from Mr Elliot[9] which raised the potential for environmental impacts of subsurface landfill gas migration with specific reference to surrounding geology and buried services. I note the following in response to Mr Elliott's questions:

(a) As stated in the LFGRA, landfill gas monitoring data is available from a small number of locations. Some of the data is limited, including groundwater level, flow readings and details of how the work was carried out. The limitations of the data were taken into account during the preparation of the LFGRA and this data forms one line of evidence which supports the conclusion.

(b) A plan showing the landfill gas monitoring wells and two conceptual cross sections is attached in relation to potential receptors to the east and southeast of the site respectively.

(c) The LFGRA was completed in accordance with the CIRIA guidance. The likelihood and consequence tables, and the risk matrix presented in the LFGRA paraphrase the definitions from the CIRIA guidance to be more focused on landfill gas and include some minor additions.

(i) The likelihood definitions (referred to as probability in the CIRIA guidance) have been shortened and an additional classification of "*rare*" has been added to reflect a situation where there may not be a pathway between the source and the receptor.

(ii) The consequence definitions have been shortened to focus on the potential consequences of receptors interacting with a landfill gas source, and an additional classification of "*insignificant*" has been added to reflect a situation where no damage is caused as a result of an interaction between the source and receptor.

[9] SLR, 5 December 2023, Technical Memorandum – RE: RE23.185 – Green Island Landfill Design and Management Technical Review.

(iii) As a result of these additional classifications, additional outcomes have been added to the risk matrix which follow the same rationale, and provide additional "*very low risk*" outcomes, and a potential "*negligible*" outcome for the lowest likelihood and consequence scenarios. The additional classifications are considered to provide a more complete assessment for lower risk situations.

(d) Information pertaining to landfill gas hazards is provided in Section 3.4 of the LFGRA. These hazards include the flammability and explosivity of methane, the asphyxiation hazard and toxicity hazard associated with landfill gas and the individual constituents, and the odour hazard. The consequences that could occur are presented in Table 5.2 of the LFGRA. These are paraphrased from Table 8.2 in CIRIA C665, with the addition of an "*insignificant*" consequence, where no damage occurs.

(e) Acute risk is described in the CIRIA guidance as an event which could result in "significant harm", with the example of an "explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied)". I consider that given the types of activities and scenarios that are included in the risk assessment, an explosion is unlikely to result in significant harm and therefore, a medium consequence is the highest consequence that could occur.

(f) The LFGRA was requested in relation to the potential for environmental impacts of subsurface landfill gas migration. As such risks to onsite receptors are not addressed. Such risks are managed via normal operating practices and management plans.

(g) The receptor groups considered to be most at risk from lateral migration of landfill gas are people and property in the vicinity of the site. In my opinion given the assessment shows a negligible to low risk from offsite migration, I do not anticipate any effects on flora and fauna or infrastructure beyond the boundary of the landfill. In terms of impacts on the atmosphere, the most significant impact on the atmosphere is direct discharges from the landfill itself. This is being actively managed with the landfill gas collection system.

(h) The additional information provided above supports the conclusion of the LFGRA that the risk from lateral migration of landfill gas from the site is considered to be negligible to low. This conclusion has been reached using multiple lines of evidence and using internationally recognised methods for landfill gas risk assessment.

31 Draft condition 25 relates to the provision of an updated LFGRA within three years of the issue of this consent which I understand has been proposed by ORC. Given the LFGRA has identified a negligible to low risk, the lateral extent of the waste is not changing, the landfill gas extraction system will continue to be operated and the monitoring wells will continue to be monitored and will provide evidence of any change to the risk profile. I therefore do not see the need for an update to the LFGRA as proposed.

Simonne Frances Eldridge

4 March 2025

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NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR 2000.
3. DATUM: DUNEDIN 1958.
4. AERIAL IMAGE IS COMBINED WITH SURVEY BY DOWNER ON 24/04/2024, AND LINZ .

LEGEND

- WASTE BOUNDARY
- GAS — EXISTING LFG EXTRACTION SYSTEM
- GAS WELL

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DESIGNED	DES	DATE	FIGURE STATUS
DRAWN	CAD	DATE	PRELIMINARY DRAFT
DESIGN CHECKED			PROJECT PHASE
FIGURE CHECKED			PROJECT PHASE

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APPROVED DATE

CLIENT **DUNEDIN CITY COUNCIL**

PROJECT **LANDFILL GAS RISK ASSESSMENT**

TITLE LANDFILL GAS CONCEPTUAL PLAN

DRAFT

SCALE (A1) 1:1500 FIG No. 1008787-F10 REV 0

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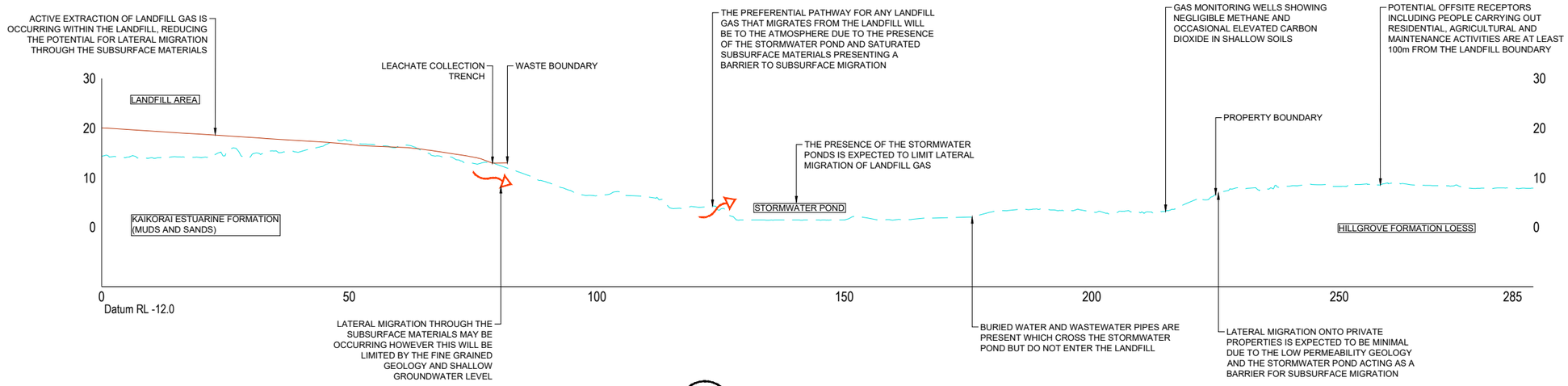
NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR 2000.
3. DATUM: DUNEDIN 1958.

LEGEND

- SV 20240424 PROFILE
- LANDFILL FILL TARGET PROFILE
- POTENTIAL MIGRATION OF LANDFILL GAS



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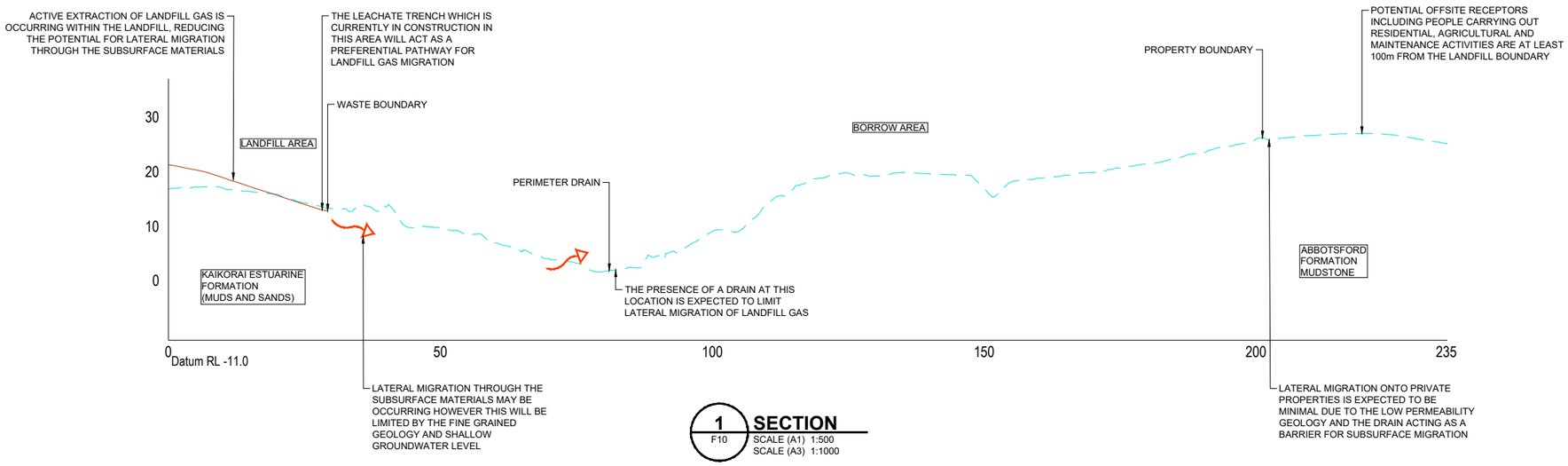
SCALE (A3) 1:1000



1 / F10 SECTION
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SCALE (A3) 1:1000

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1:500 (A1)
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DESIGNED	DES	DATE	FIGURE STATUS
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CLIENT **DUNEDIN CITY COUNCIL**
PROJECT **LANDFILL GAS RISK ASSESSMENT**
TITLE LANDFILL GAS CONCEPTUAL CROSS SECTIONS

DRAFT

SCALE (A1) 1:500 FIG No. 1008787-F11 REV 0