Green Island Landfill Closure

Assessment of Environmental Effects

Prepared for Dunedin City Council

March 2023 (Updated October 2024)

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

Boffa Miskell

GHD

Document Quality Assurance

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Prepared by:	Maurice Dale Senior Principal / Planner Boffa Miskell Limited	
Reviewed and approved by:	Rachael Eaton Senior Principal Boffa Miskell Limited	
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1. Introduction

1.1. Brief Description of the Proposal

The Dunedin City Council (**DCC**) collects residential waste and manages the disposal of both residential and most of the commercial waste for the Ōtepoti Dunedin area and environs. The DCC has embarked on the Waste Futures Programme to develop an improved comprehensive waste management and diverted material system for Dunedin, including future kerbside collection and waste disposal options.

The Green Island Landfill (**GIL**) is the city's current landfill for the disposal of municipal solid waste and hazardous waste. The location of GIL is shown in **Figure 1**. The site also contains other waste diversion and transfer facilities for the drop off and consolidation of general waste, reusable and recyclable material, greenwaste, and household hazardous substances. The site is designated in the Proposed Second-Generation Dunedin City District Plan (**2GP**) for these activities.

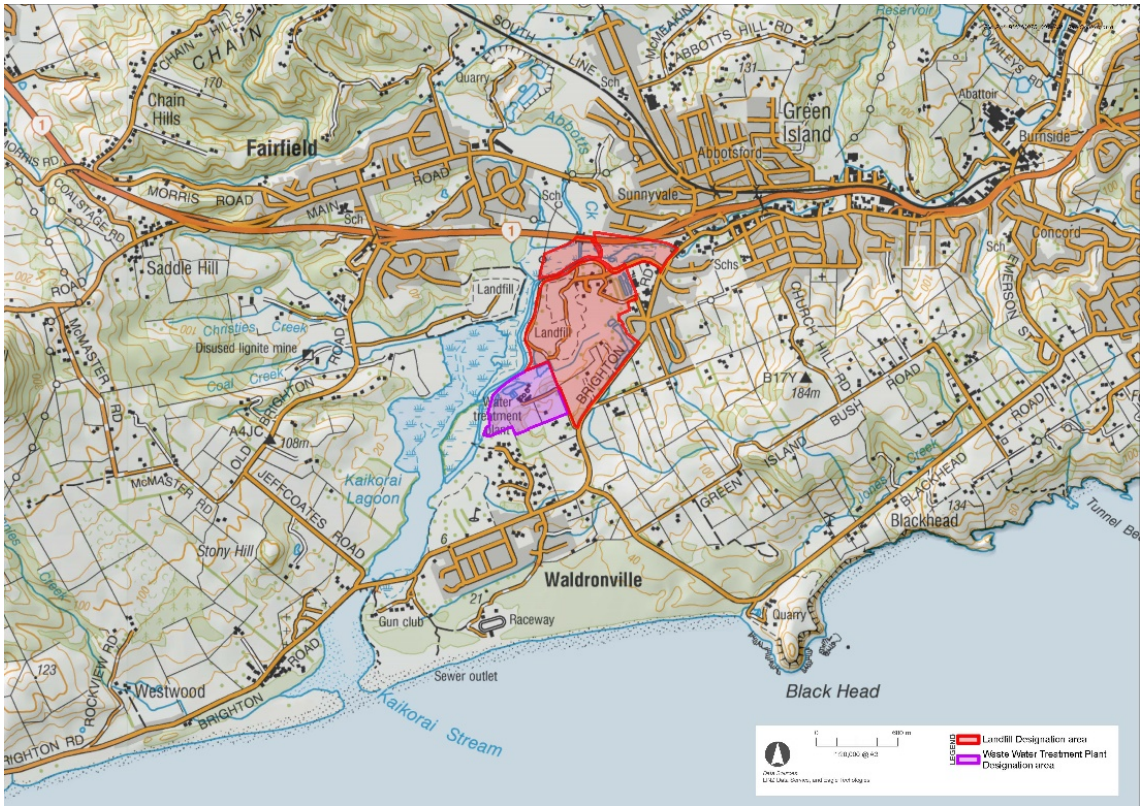
Based on current waste disposal projections, the landfill is expected to reach full capacity in approximately April 2027. DCC has been planning for this eventuality, and as part of the Waste Future's Programme has confirmed the need to replace the landfill at GIL with a new landfill located at Smooth Hill in southwest Dunedin. In May 2023, DCC obtained resource consents for the development of Smooth Hill, following resolution of appeals to the Environment Court.

The commencement of operations at Smooth Hill is contingent on undertaking 36 months of baseline monitoring, completing detailed landfill design, preparing finalised management plans, and completing the initial landfill works and associated roading upgrades outside the site. It is unlikely that Smooth Hill will be ready to accept waste until 2027 at the earliest, with risk of further delays.

In the interim, DCC needs to be able to continue to be able to dispose of waste at GIL to meet the city's waste disposal needs. DCC has evaluated several options for continued landfilling within the existing landfill footprint up until closure. The option selected involves increasing the height of the landfill to the west while remaining within the current landfill footprint. This provides increased capacity for the disposal of waste until sometime between December 2029 and March 2031 depending on actual waste disposal rates.

While the landfill will potentially close by December 2029, if waste disposal rates reduce and capacity remains post December 2029, and Smooth Hill is not available to accept waste, closure of the landfill may be delayed a short period. Waste diversion and transfer facilities are however intended to continue operating at the site following the closure of the landfill, which will be redeveloped as part of a new Resource Recovery Park Precinct (**RRPP**).

Figure 1 – Green Island Landfill Location



The GIL operates under 14 existing resource consents which all expired on the 1st of October 2023. Applications for replacement consents need to be made by 1 April 2023 to enable the landfill and waste diversion and transfer facilities to continue operating while the new consents are determined.[1] DCC is therefore applying for replacement resource consents which provide for the following:

- The continued operation of the landfill for the disposal of municipal solid waste, and hazardous waste through to closure. The proposed final landfill surface provides an estimated capacity of 670,000m^3 for the disposal of waste[2].
- Landfill infrastructure improvements including extension of the existing perimeter leachate collection trench along the southern side of the landfill, installation of internal leachate drainage in the landfill, flood and earthquake resilience upgrades of the leachate collection infrastructure, and replacement/additional landfill gas (**LFG**) flares/engines.
- The continued operation of the waste diversion and transfer facilities until which time these are replaced by new RRPP facilities.
- Closure of the landfill in approximately December 2029 depending on waste disposal rates. Any remaining open areas of the landfill will be capped and vegetated, final LFG wells installed, and any infrastructure not required for the ongoing aftercare of the landfill removed or modified.

[1] s124 Resource Management Act 1991.

[2] Calculated from June 2022.

- Ongoing aftercare of the landfill, including continued operation and maintenance of leachate collection, LFG collection/destruction, and stormwater infrastructure; maintenance of the landfill cap; and environmental monitoring in accordance with the conditions of the resource consents.

The development and operation of the RRPP (other than the continued operation of the recently constructed Organics Receival Building (ORB)) does not form part of these applications. Resource consents for the development and operation of the RRPP were separately applied for in March 2024.

Long term use of the landfill site post closure will be determined in consultation with Te Rūnanga o Ōtākou and the community. Such uses may include public walking and cycling tracks and picnic areas around the periphery of the landfill and along the estuary and incorporating mana whenua values and pūrākau associated with the Kaikorai Estuary. This is while ensuring protection and effective ongoing operation of the landfill cap, remaining landfill infrastructure, and RRPP.

1.2. Summary of Applications

DCC is applying for the following replacement resource consents from ORC for the continued operation, closure, and aftercare of the landfill and waste diversion and transfer facilities at GIL:

- Discharge of waste, hazardous waste, and leachate onto land that may result in contaminants entering groundwater for the purpose of the operation and closure of a Class 1 landfill (replacement for resource consents 94262-V1, 94693-V1, and 3839A-V1).
- Take of groundwater from the Kaikorai Stream through a leachate collection trench and take of groundwater and leachate from groundwater bores, LFG wells, and a leachate collection trench for the purpose of the operation and closure of a Class 1 landfill (replacement for resource consents 4139-V1, and 3839B-V1).
- Diversion of surface water and stormwater from working and non-working areas of the landfill for the purpose of the operation and closure of a Class 1 landfill (replacement for resource consents 3839C-V1 and 3840A-V1).
- Diversion of surface water in the Kaikorai Stream and Brighton Road Stream for the purpose of the operation and closure of a Class 1 landfill (replacement for consent no 4140 and 4185).
- Discharge of surface water and stormwater to the Kaikorai Stream for the purpose of the operation and closure of a Class 1 landfill (replacement for resource consent 3840C-V1).
- Discharge of LFG, combustion emissions from LFG flares and engine, dust, and odour into air for the purpose of the operation and closure of a Class 1 landfill (replacement for resource consent 94524-V1).
- Placement of a defence against water along the Kaikorai Stream for the purpose of diverting of floodwaters for the operation and closure of a Class 1 landfill.
- Disturbance of land at a contaminated site for undertaking capping works and landfill infrastructure for the purpose of the operation and closure of a Class 1 landfill (replacement for resource consent RM21.474.01).

The applications overall have a **discretionary** status under the RMA. A consent duration of 35 years is sought for all resource consents, except for the taking of groundwater and leachate, for which a consent duration of 6 years is sought. The 35-year term is to cover the long term after care and monitoring of the landfill once closed and capped.

1.3. Purpose of this Document

An assessment of effects on the environment (AEE) is required to accompany an application for resource consent under section 88 and prepared in accordance with Schedule 4 of the Resource Management Act 1991 (RMA). This document comprises the AEE for the resource consents in respect of the proposal introduced in **section 1.1** above.

This document:

- Describes relevant background, including the legislative framework for waste management, the history of GIL, the existing resource consents, and DCC's Waste Future's Programme (**section 3**).
- Describes the landfill closure concept design, and approach to the continued operation, closure, and aftercare of the landfill, ORB, and waste diversion facilities (**section 4**).
- Describes the alternative waste disposal options, landfill designs, and discharge options considered (**section 5**)
- Describes the resource consents applied for (**section 6**).
- Describes the existing environmental, social, economic, and cultural setting (**section 7**).
- Assesses the environmental effects of the proposal, including mitigation and monitoring measures, and proposed conditions (**section 8**).
- Assesses the proposal against the relevant planning documents and RMA statutory considerations (**sections 9 – 10**).
- Describes the consultation undertaken to date (**section 11**).

This AEE has been updated in October 2024 to incorporate the outcomes of the Human Health and Environmental Risk Assessment (HHERA), and reflect changes made to the appended technical reports in response to requests for further information from the ORC.

2. Applicant and Application Site Details

The applicant and subject site details are as follows:

<table>
<tr><td>Applicant's Name:</td><td>Dunedin City Council</td></tr>
<tr><td>Address for Service:</td><td>Anderson Lloyd
Private Bag 1959
Dunedin 9016

Attention: Michael Garbett
Phone: 03 467 7173
Email: michael.garbett@al.nz</td></tr>
<tr><td>Address for Fees:</td><td>Dunedin City Council
PO Box 5045
Dunedin 9054

Attention: Chris Henderson</td></tr>
<tr><td>Site Details:</td><td>Green Island Landfill Site (as defined by the existing designation in the Proposed Second Generation Dunedin City District Plan):
<table>
<tr><th>Site</th><th>Legal Description</th><th>Record of Title</th><th>Area</th><th>Owner</th></tr>
<tr><td>9 Brighton Road</td><td>Part Section 45-47 Green Island Bush Survey District and Section 54 and 63 Block VII and Section 119 Block VII Dunedin & East Taieri Survey District</td><td>OT11B/1241</td><td>41.8120 hectares</td><td rowspan="5">Dunedin City Council</td></tr>
<tr><td>9 Brighton Road</td><td>Part Section 45-47 Green Island Bush Survey District</td><td>OT368/19</td><td>1.0841 hectares</td></tr>
<tr><td>9 Brighton Road</td><td>Section 1 Survey Office Plan 24047</td><td>OT15C/1016</td><td>4718 square metres</td></tr>
<tr><td>9 Brighton Road</td><td>Lot 6-7 Deposited Plan 572543 and Section 1 Survey Office Plan 24040</td><td>1040235</td><td>4464 square metres</td></tr>
<tr><td>9 Brighton Road</td><td>Part Section 120 Dunedin & East Taieri Survey District and Part Section 53 Block VII Dunedin & East Taieri Survey District and Closed Road intersecting Sections 86,87,98,102 and 103 Block V Lower Kaikorai Survey District</td><td>OT16D/1193</td><td>4.0211 hectares</td></tr>
</table></td></tr>
</table>

9 Brighton Road	Section 103 Block V Lower Kaikorai Survey District and Part Section 85-87, 98 Block V and Part Section 99-101 Block V and Part Section 102 Block V Lower Kaikorai Survey District	OT16D/1194	5.5726 hectares	
9 Brighton Road	Lot 2, 4 Deposited Plan 572543 and Lot 1 Deposited Plan 20826	1040233	1837 square metres	
114 Brighton Road	Part Section 38-40, Part Section 44 and Part Section 156 Green Island Bush Survey District	OT7C/934	8.2303 hectares	
140 Brighton Road	Part Lot 4 Deposited Plan 4550	OT12C/261	10.4655 hectares	
170 Brighton Road	Lot 1 Deposited Plan 20582	OT12C/262	4.2766 hectares	
170 Brighton Road	Section 81 Block VII Dunedin & East Taieri Survey District	OT15A/266	4401 square metres	
Total Area			75.6164 hectares	

Green Island Wastewater Treatment Plant Site (location of LFG engine and flare):

Site	**Legal Description**	**Record of Title**	**Size of entire property**	**Owner**
9 Brighton Road	Section 55 and 65 Block VII Dunedin & East Taieri Survey District	OT11B/1241	7.2122 hectares	Dunedin City Council
9 Brighton Road	Lot 30 Deposited Plan 24758	OT16C/1083	3.7127 hectares	
174 Brighton Road	Part Section 48 Deposited Plan 2323	OT166/158	2.1102 hectares	
174 Brighton Road	Lot 1 Deposited Plan 22230	OT14C/1027	7.1854 hectares	
Total Area			20.2205 hectares	

Copies of the Records of Title are included in **Appendix 1**.

3. Background

3.1. Legislative Framework for Waste Management

Waste management in Aotearoa New Zealand occurs under a legislative framework and supporting national and local regulations and policy documents. Key legislation currently includes:

- The Waste Minimisation Act 2008.
- Climate Change Response Act 2002.
- Local Government Act 2002.
- Resource Management Act 1991.

This waste management framework is described in the following sections.

3.1.1. Waste Minimisation Act Framework

The Waste Minimisation Act 2008 (WMA) is the principal statute governing the management and minimisation of waste. The purpose of the WMA is to *'encourage waste minimisation and a decrease in waste disposal in order to protect the environment from harm; and to provide environmental, social, economic and cultural benefits.'*[3] The WMA incorporates several supporting tools, including:

- Responsibilities for territorial authorities in managing and minimising waste, including requirements for reviewing and implementing Waste Management and Minimisation Plans (WMMP's).
- A levy per tonne on waste disposed of at disposal facilities, to be used for funding waste minimisation activities undertaken by territorial authorities, businesses, and community groups. The current levy is $60 per tonne.
- Central government recognition of product stewardship schemes (through accreditation) and the ability to impose mandatory product stewardship schemes for priority products.
- The power to make regulations to collect information and to impose standards for various aspects of waste minimisation.

The WMA places the responsibility on territorial authorities to promote effective and efficient waste management in their districts. Territorial local authorities are required to adopt a Waste Management and Minimisation Plan (WMMP) that includes methods for reducing waste. The WMMP is required to be reviewed every 6 years, which is to be informed by waste assessment to identify the forecasted waste demands of the district. The WMA requires territorial authorities to spend funding received from the national waste levy according to the priorities set out in the WMMP.

[3] Section 3, Waste Minimisation Act 2008.

The WMMP is required to have regard to the New Zealand Waste Strategy or any equivalent replacement government policy. The New Zealand Waste Strategy outlines the government's high-level direction for waste management and minimisation by central and local government, businesses, and communities.

DCC's current WWMP was adopted in 2020. The plan is described further in **section 3.4.1**.

3.1.2. Climate Change Response Act Framework

The Climate Change Response Act 2002 (CCRA) enables New Zealand to meet its international obligations under the United Nations Framework Convention on Climate Change, Kyoto Protocol, and Paris Agreement.

The CCRA requires owners of waste disposal facilities to report total emissions, and purchase emission trading units under the government's Emission Trading Scheme (ETS) to cover LFG emissions. The amount of emission trading unit's payable can be reduced where the landfill is demonstrated to have a waste composition that generates less greenhouse gas (e.g. lower organic content), or where a landfill has a gas collection and destruction system.

Implementation of the CCRA is further supported by the Aotearoa New Zealand Emissions Reduction Plan 2022. The current plan contains strategies, policies, and actions for achieving the government's first emissions budget and contributing to global efforts to limit climate change. In regard to waste, key actions in the plan include:

- Enabling households and businesses to reduce organic waste.
- Increase the amount of organic waste diverted from landfill.
- Reduce and divert construction and demolition waste to beneficial uses.
- Explore bans or limits to divert more organic waste from landfill.
- Increase the capture of gas from municipal landfills.
- Increase waste data and prioritise a national waste licencing scheme.

The plan notes that these actions will in part be implemented through replacement of the Waste Minimisation Act 2008 (WMA), and New Zealand Waste Strategy, described in **section 3.1.1**.

3.1.3. Local Government Act Framework

The Local Government Act 2002 (LGA) empowers Council's to promote the well-being of communities. The purpose of local government in the LGA is *"to enable democratic local decision making and action, by and on behalf of communities, and to promote the social, environmental, and cultural wellbeing of communities in the present and for the future."* [4] A key method to achieve this is to provide solid waste collection and disposal facilities.

[4] Section 10, Local Government Act 2002.

The LGA requires territorial authorities to produce a 10-year Long-Term Plan, which is reviewed every three years. The Long-Term Plan describes the activities of the territorial authority, outlines the financial strategy, and provides a long-term focus for its decision-making. The desired community outcomes established through the Long-Term Plan process influence the direction of the territorial authorities WMMP and, once adopted, implementation of the WMMP is also in part achieved through the Long-Term Plan by allocating Council funding for waste management and minimisation activities.

Aspects of the DCC's current Long-Term Plan as they relate to waste management and minimisation are described in **section 3.4** in the context of the Waste Futures Programme.

3.1.4. Resource Management Act 1991 Framework

The Resource Management Act 1991 (RMA) is New Zealand's principal environmental statute, for managing the subdivision, use, and development of natural and physical resources. Implementation of the RMA is supported by a hierarchy of national, regional, and territorial authority planning documents, including:

- National Policy Statements providing policy direction on matters of national significance, including (amongst others) the coastal environment, freshwater management, and renewable electricity generation.
- National Environmental Standards setting nationally consistent provisions, that generally take precedence over regional and territorial authority planning documents. These include (amongst others) national standards on the management of freshwater, air quality, and contaminated soils. The Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NES-AQ) requires the capture and destruction of LFG.
- Regional Policy Statements prepared by regional councils that provide policy direction to achieve integrated management of natural and physical resources of the region.
- Regional Plans prepared by regional councils that provide policy direction and rules for managing the coastal marine area, freshwater resources, and air quality.
- District plans prepared by territorial authorities that provide policy direction and rules for managing the land resources. District Plans also designate land to enable and provide for public works.

This framework of planning documents establishes the resource consents that are required to be obtained from regional and territorial authorities for waste management facilities and provide policy direction guiding the assessment and determination of applications.

The government has commenced a major reform of environmental legislation that proposes replacement of the RMA.

3.2. Green Island Landfill History

Waste disposal first occurred at GIL in 1954 and the site has been used for waste disposal since that time. It became Dunedin's main municipal landfill in 1981 after the closure of Forrester Park landfill in north Dunedin. In July 2020, there was approximately 4.8M tonnes of waste in the landfill. Areas where waste has been historically placed are detailed in the Groundwater Report in **Appendix 5**. The pre-existing landform for the GIL was a tidal estuary. Landfilling commenced at the south-eastern corner of the site. Waste was originally end dumped directly onto the estuarine muds and up against the southern Kaikorai Estuary edge where the pre-existing landform rises gently to a hillside.

Landfilling of this eastern area of the landfill has been completed and now accommodates waste diversion and transfer facilities for the drop-off and consolidation of general waste, reusable and recyclable material, greenwaste, and household hazardous substances. General waste dropped off by the public is consolidated in a waste transfer station, prior to transfer to the landfill tip face. Greenwaste received from the public was previously shredded and composted on site. As of July 2024, all kerbside collected food and garden waste, and greenwaste received at the landfill is shredded in the new purpose-built **ORB** and then transported off site for composting. These facilities and operations are described in more detail in **section 4** of this AEE.

Landfilling has continued west of the facilities area over time. In the mid 1990's a soil bund was constructed that encircles the landfill on the eastern, northern, and western sides adjacent to the Kaikorai Stream and Estuary. All waste placement since this time has been within the bund, which buttresses the waste and provides a physical and hydraulic barrier from the adjacent Kaikorai Stream and Estuary. Landfilling has been completed in the northern and eastern areas of this area with final capping completed in December 2022. Clay material used for capping is sourced from a borrow area located on the adjacent hillside to the south of the landfill.[5]

The southwestern half of the landfill had up to approximately 6m – 8m depth of waste placed during the 1990's, and void exists to place a further 10 – 15m of waste in this area to fill up to the approved finished landfill surface (described further in **section 3.3** below). This is the primary area where future waste placement is proposed to occur through to closure of the landfill. The plans for future landfilling are described in more detail in **section 4.4** of this AEE.

A number of improvements to the environmental management of site were made following the 1994 resource consent process, including construction of a perimeter leachate collection trench, stormwater sediment ponds (the *eastern* and *western sedimentation ponds*), and works associated with the conveyance of stormwater into these ponds. Realignment of a section of the Kaikorai Stream was also undertaken to facilitate construction of the existing site access, and stormwater infrastructure.[6]

Expansion of the landfill footprint under the 1994 resource consents, also filled a number of small channels that drained the floodplain and blocked the flow path from the catchment to the southeast of Brighton Road, resulting in the construction of new wetlands (the *south eastern constructed wetlands*) and the connection of this wetland (via a culvert) to another new wetland

[5] The capping and borrow area are authorised by resource RM22.511.01 issued 27 October 2022.

[6] Authorised under resource consent 4140 issued 28 October 1993

(the *eastern constructed wetland*) located in a remnant branch of the original channel adjacent to the Brighton Road access to the site.[7]

The leachate collection trench is located outside of the soil bund on the eastern, northern, and southern sides of the landfill. The leachate trench is not present along the southern side of the landfill against the rising ground of the adjacent hillside. A surface drain between the landfill and hillside instead intercepts leachate impacted runoff and groundwater from the landfill and directs it to the leachate collection trench. Leachate from the leachate collection trench, surface drain, and from other drains located within the landfill waste is pumped and piped to the adjacent Green Island Wastewater Treatment Plant (**GIWWTP**) for treatment and disposal.

LFG has been collected at wells within completed capped areas of the landfill since 2009 from where it is piped to the GIWWTP and either used to generate electricity or is otherwise destroyed by flaring. Additional wells are established and connected in a continuous manner as waste filling is undertaken with final pipework installed as areas of the landfill are completed and capped.

3.3. Existing Green Island Resource Consents

The operation of GIL including the waste diversion and transfer facilities is currently subject to 14 existing resource consents issued by ORC. These consents were issued in 1993 – 1994, except for a resource consent granted in 2021 for the disturbance of contaminated land for the purposes of landfill capping. All consents expired on 1 October 2023. The resource consents are listed in **Table 1** below.

Table 1 – Existing Green Island Resource Consents

Consent Type	Consent Reference	Description
Discharge to land	94262 V1	Discharge up to 270 cubic metres per day of municipal, domestic, hazardous, industrial waste and organic waste to land. For the purpose of operating a sanitary landfill and composting operation.
Discharge to water	94693 V1	Discharge up to 270 cubic metres per day of municipal, domestic, hazardous and industrial waste, including a composting operation, to land in circumstances which may result in contaminants entering natural water. For the purpose of operating a sanitary landfill.
Discharge to water	3839A V1	Discharge landfill and composting leachate to land in a manner that may enter water. For the purpose of sanitary landfill and composting operation.
Water permit	3839B V1	Take groundwater and leachate from groundwater bores and from a leachate collection drain located at and around the Green Island Sanitary Landfill. For the purpose of managing a sanitary landfill and composting facility leachate discharge from the Green Island Landfill.
Water permit	4139 V1	Take groundwater (originating from the Kaikorai Stream) through a leachate collection drain. For the purpose of maintaining groundwater levels within the surrounding ground at the Green Island Landfill.

[7] Authorised under resource consent 4185 issued 28 October 1993.

Consent Type	Consent Reference	Description
Water permit	3839C V1	Divert stormwater at a landfill and composting facility within a 38-hectare area bounded by a leachate collection drain. For the purpose of control of landfill and composting leachate at the Green Island Landfill.
Water permit	3839D V1	Take stormwater from a landfill and composting facility within a 38-hectare area bounded by a leachate collection drain. For the purpose of control of landfill and composting facility leachate at the Green Island Landfill.
Water permit	3840A V1	Divert stormwater from the non-working areas of a landfill. For the purpose of intercepting clean stormwater and silt control of stormwater at the Green Island Landfill.
Water permit	3840B V1	Take diverted stormwater from the non-working areas of a landfill. For the purpose of silt control of stormwater at the Green Island Landfill.
Water permit	4140	Divert the Kaikorai Stream for the purpose of realignment of this natural watercourse to allow for the installation of the Green Island Landfill leachate collection drain and sumps.
Water permit	4185	Divert the existing Brighton Road Stream for the purpose of realignment of this watercourse to allow for the installation of the Green Island Landfill leachate collection drain and sumps.
Discharge to water	3840C V1	Discharge stormwater to the Kaikorai Stream. For the purpose of disposal of stormwater from a landfill facility, after treatment in silt retention ponds at the Green Island Sanitary Landfill.
Discharge to air	94524 V1	Discharge to air landfill gas, dust and odour generated from landfilling up to 100,000 cubic metres a year of compacted municipal, domestic, hazardous and industrial waste and including a composting operation. For the purpose of operating a sanitary landfill.
General/structure land use consent	RM21.474.01	Land use consent for the disturbance of land at a contaminated for the purpose of undertaking capping works at the Green Island Landfill Green Island.

The existing consents limit the extent of landfilling through the combination of a maximum 38ha footprint, and conditions limiting the deposit of waste to 270m^3/day and 100,000m^3/year.[8] The consent conditions do not impose any specific limit on the overall finished height, shape, or contour of the landfill, however the plans included in the 1994 resource consent applications show a finished landfill surface rising to a maximum height of 25m above mean sea level (**amsl**).

The consent conditions also require the consents are exercised in conformity with a Landfill Work Programme prepared by the consent holder, which is to be reviewed annually or at such lesser frequency as the consent authority may approve.[9] A Landfill Development and Management Plan (**LDMP**) developed following the issuing of the consents serves the purpose of the Landfill Work Programme. The LDMP was first provided to ORC in 1994 and was subsequently updated in 2004, and 2007. Further updates of the LDMP were completed and provided to ORC in February and September 2023, the latest of which is attached as **Appendix 4**.

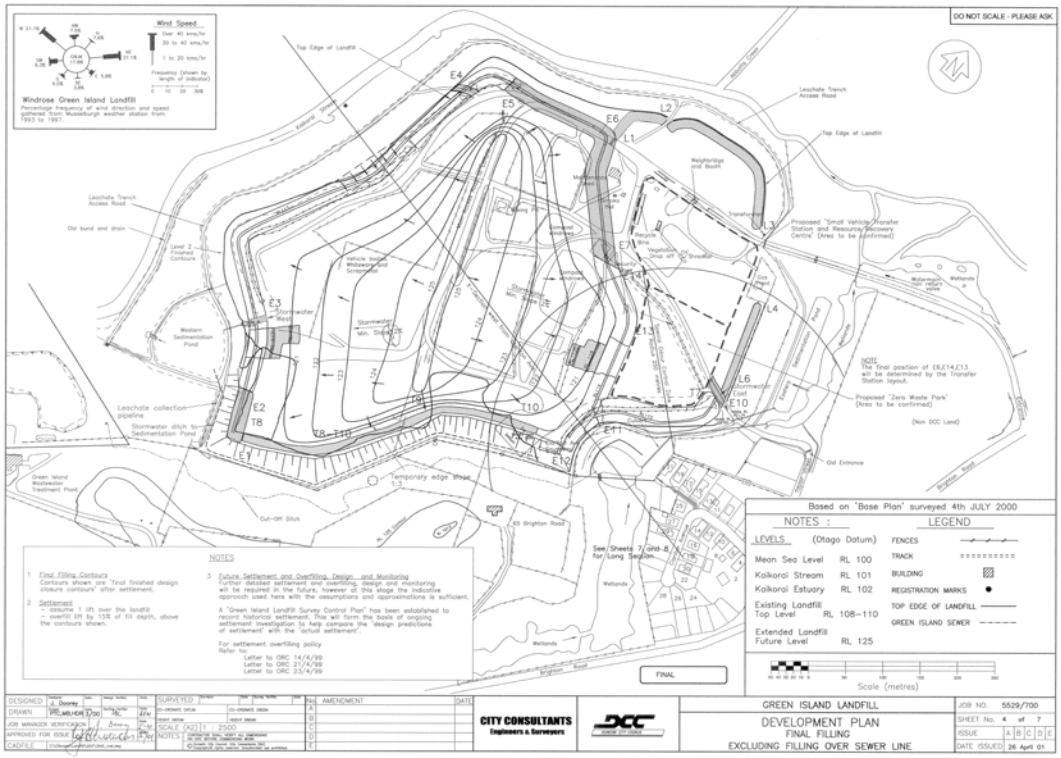
[8] Resource consents 3839A V1, 3839C V1, 3839D V1, 94524 V1, 94693 V1, 94262 V1.

[9] Resource consents 3839A V1, 3839B V1, 3839C V1, 3839D V1, 3840A V1, 3840C V1, 4139 V1.

The historical versions of the LDMP, and other information provided to ORC in administering the consents have also included plans showing a finished landfill surface rising to 25m amsl along a central ridge running northwest to southeast, in general accordance with the plans included in the 1994 resource consent application. In 1999 a revised filling plan was developed and formalised with ORC which focussed landfill development north of the main sewer line between Dunedin and the GIWWTP.[10] At the same time filling of the landfill by 2.25m above 25m amsl to allow for long-term waste settlement was formalised.

The 1999 plan was further updated in 2001 removing filling in the area where, until recently the greenwaste composting operation was located, which was not considered efficient from a landfill operations perspective. The 2001 finished surface shown in **Figure 2** represents the existing consented closure scenario for the landfill.

Figure 2 – 2001 Approved Finished Landfill Surface



3.4. Dunedin Waste Futures Programme

The DCC embarked on the Waste Futures Programme in 2018 to develop a comprehensive waste management and diverted material system for Dunedin that aligns with its responsibility under the WMA to '*promote effective and efficient waste management and minimisation'*. The aim of the Waste Futures Programme is to improve Dunedin's whole waste system, including what is collected, recycled, or reused, and what must be disposed to a landfill. It is based around a circular

[10] Correspondence with ORC dated 14 and 21 April 1999 – Green Island Landfill Future Filling Programme.

economy approach [11] and will help the DCC achieve its carbon emissions and waste reduction goals.

The Waste Futures system is graphically shown in **Figure 3** below.

The Waste Futures Programme includes several work streams, including:

- Implementation of the updated Dunedin City Council Waste Minimisation and Management Plan (2020)[12].
- Improvements to the kerbside collection service, recycling system and waste diversion and transfer facilities to be included in the DCC 10-year plan 2021-31.
- Preparing for the closure of the Green Island landfill after 2023 with a new Class 1 landfill at Smooth Hill.

Figure 3 – Waste Futures System

3.4.1. Implementation of Waste Minimisation and Management Plan 2020 (WMMP)

Dunedin's WMMP establishes the DCC's high-level strategic vision and guiding principles to promote waste minimisation and management. The WMMP was adopted by DCC in May 2020 as part of the Waste Futures Programme. The WMMP sets out DCC's commitment to reduce and divert waste away from landfill. It supports its aim to reduce Dunedin's net carbon emissions to zero by 2030 and achieve a zero-waste economy (circular economy) by 2040.

[11] A circular economy is a system that aims to keep resources in use for as long as possible, extracting the maximum value from them whilst in use, then recovering and regenerating products and materials at the end of each service life.

[12] https://www.dunedin.govt.nz/council/policies,-plans-and-strategies/plans/waste-minimisation-and-management-plan-2020

The WMMP covers waste minimisation promotion and education, whether provided by the DCC or others, waste collection, recovery, recycling, treatment and disposal, services, and facilities. It outlines how waste minimisation and management will be funded and sets measurable performance indicators.

The vision of the WMMP is:

> *We have a duty to protect and enhance Dunedin's natural environment and resources for those generations who come after us (mō tatou, ā, mō kā uri ā, muri ake nei).*
>
> *Dunedin is actively committed to zero waste, inclusive of a circular economy, to enhance the health of our environment and people by 2040.*

To achieve this vision the WMMP has set three targets as described below:

- *Reduce the municipal solid waste generation per capita by at least 15% by 2030 compared to 2015.*
- *Reduce the amount of municipal solid waste disposed to landfill and incineration by at least 50% by 2030 compared to 2015.*
- *Increase the diversion rate away from landfill and incineration to at least 70% by 2030.*

Using information and data from the Waste Assessment 2018, a Suitability of Options Assessment and the Waste Futures Programme Business Case, the WMMP also describes the existing and future demand for waste and diverted materials facilities and services in Dunedin and identifies the demand for the future provision of a landfill in Dunedin.

3.4.2. Improvements to Kerbside Collection, Recycling services, and Waste Diversion and Transfer Facilities

The DCC consulted with the community on changes to kerbside collection options over March – April 2020. Two kerbside collections options were consulted on: a three-bin option consisting of separate glass, refuse, and recycling bins; and a four-bin option which adds a "green" bin for food and garden waste. The consultation was used to inform further development of kerbside options and costs suitable for inclusion in the DCC's draft 10-year plan 2021-2031.

During March to April 2021, as part of DCC's 10-year plan consultation document 2021-31 (tō tātou eke whakamuri – the future of us) it consulted the community on the two final options for new kerbside collection systems; a 'three-bin' option consisting of separate glass, refuse, and recycling bins; and a 'four bin plus one' option which adds a "green" bin for food and optional garden waste bin in addition to separate glass, refuse, and recycling bins. Following consideration of submissions, DCC adopted the 'four bin plus one' option, as the new kerbside collection service, with these services commencing in July 2024.

Alongside the adoption of the new kerbside collection system, the DCC has also allocated funding for the development of a Resource Recovery Park Precinct (**RRPP**) consisting of new waste diversion and transfer facilities, to be constructed at the GIL site. These facilities will include:

- An Organics Processing Facility (**OPF**) for composting food and garden waste.
- A Material Recovery Facility (**MRF**) for mixed recyclables.

- A Construction and Demolition Recovery Facility (**CDRF**) for construction and demolition waste.
- A Bulk Waste Transfer Station (**BWTS**) for depositing general waste, prior to transfer to the landfill tip face at Green Island (current) or Smooth Hill (future).
- Retention of the existing rummage store and recycling drop off, and household hazardous substances drop-off.

Development of the **ORB** has occurred in advance of the rest of the RRPP. Construction of the building was completed in June 2024 in time for the commencement of the new kerbside collection system.[13]

The ORB is an enclosed receival and consolidation hall for food and garden waste collected under the new kerbside collection system, and for any greenwaste dropped off by the public at the GIL site. Food and garden waste waste is shredded within the enclosed building and then loaded onto trucks to be transported for composting off-site. The existing garden greenwaste composting operation on the site has ceased operation. Ultimately it is intended that a new composting operation for organic waste will be established at GIL as part of the wider RRPP development, replacing the transport and composting of material off-site. Resource consents for the RRPP, including the composting operation, were separately applied for in March 2024.

Providing residents with options for the kerbside collection of food and garden waste will significantly reduce the amount of organic waste entering the general waste stream. In addition, general waste from kerbside collections, commercial collections, and the public will ultimately be deposited at the BWTS. This will enable physical intervention to remove residual organic waste from the general waste stream prior to consolidation and transport to landfill. The removal of most of the organic waste from the waste stream, combined with the additional waste diversion facilities, will result in a reduction in waste to landfill and associated carbon emissions.

3.4.3. Preparing for the Closure of the Green Island landfill.

The GIL plays a significant role in Dunedin's waste management system, being the only landfill in Dunedin that can accept municipal solid waste and hazardous waste. Whilst the DCC is actively committed to achieving its waste reduction and diversion targets, as described in the WMMP, there is demand for the future provision of a landfill for waste disposal in Dunedin once it reaches capacity. DCC is therefore progressing the establishment of a modern landfill facility at the designated Smooth Hill site in southwest Dunedin to meet this future demand.[14]

The DCC applied to ORC and DCC's consenting arm for resource consents for the development of Smooth Hill and associated roading upgrades in August 2020. Following public notification, and submissions from the community and stakeholders, the applications were heard by an independent hearings panel in May 2022. A decision granting the consents was issued on the 9th of September 2022, and subsequent appeals to the Environment Court were resolved in May 2023.

[13] The existing resource consents for the Green Island landfill enabled the construction and operation of the OPF organics receival building.

[14] Te mahere whakamimiti para | Waste Minimisation and Management Plan 2020, pg 35

The DCC consulted on funding for development of Smooth Hill as part of the it's 10 Year Plan process for 2021-2031. Under the approved 10 Year Plan, development. of Smooth Hill (subject to resolving appeals) is scheduled to occur from 2024/25 onwards, for a projected completion in 2027.

4. Landfill Design, Operation, Closure, and Aftercare

4.1. General Description

DCC is applying for replacement resource consents to enable the continued operation, closure, and aftercare of the landfill and waste diversion and transfer facilities at GIL, the ultimate closure of the landfill in approximately December 2029 depending on waste disposal rates, followed by ongoing aftercare of the landfill. The general arrangement of the landfill at closure is shown in **Figure 4** below, and on the General Arrangement Plan in **Appendix 2**.

Figure 4 – Green Island Landfill General Arrangement at Closure

Various existing site facilities support the operation of the landfill and waste diversion and transfer activities, including:

- Site access road from Brighton Road, and internal access roads within the waste diversion and transfer facilities, landfill footprint, and to the soil borrow area (described in **section 4.3**).
- Vehicle weighbridge and staff kiosk located at the entry to the waste transfer station, greenwaste drop-off, and active landfill (described in **section 4.3**).
- Rummage shop building for resale of preowned and reusable household goods (described in **section 4.3**).
- Recycling drop-off area (described in **section 4.3**) for scrap steel, glass, cans, cardboard, paper, plasterboard, polystyrene, E-waste, and whiteware.

- Household hazardous substances drop-off area and dangerous goods store (described in **section 4.3**).
- ORB for the receipt and shredding of kerbside collected food and garden waste, and greenwaste received at the landfill (described in **section 4.3**)
- Waste transfer station for drop-off of general waste, prior to transfer to the landfill (described in **section 4.3**).
- Vehicle wheel wash located at the exit from the landfill footprint (described in **section 4.3**).
- Landfill operators' office, staff facilities, and associated car parking.
- Equipment storage and maintenance sheds.
- Leachate collection system, consisting of a perimeter leachate collection trench, drains within the waste, surface drain (along the southern side of the landfill), and pump stations connecting via a pipeline to the adjacent GIWWTP (described in **section 4.5**).
- Landfill stormwater systems, consisting of drains, pipes and sediment ponds for the conveyance and treatment of stormwater prior to discharge to the Kaikorai Stream (described in **section 4.6**).
- LFG collection and destruction system, consisting of wells and pipes connecting to solar flares on the landfill site, and an engine (for electricity generation) and flare located at the adjacent GIWWTP (described in **section 4.7**).
- Groundwater and LFG monitoring wells and surface water monitoring stations (described in **sections 4.5, 4.6, and 4.7**).
- Landfill cap (described in **section 4.3**), soil borrow area (described in **section 4.3**), and landscape planting (described in **section 4.8**).

In addition, as noted in **section 3.4.2**, the DCC has allocated funding for the development of replacement waste diversion and transfer facilities at the GIL site, known as the RRPP. The RRPP does not form part of these applications for replacement consents.

The following sections of the AEE provide a summary of the intended future operation, closure and aftercare of the landfill and waste diversion and transfer facilities as described and shown on the design plans in the Design Report in **Appendix 3**, and current LDMP in **Appendix 4**.

4.2. Waste Types Accepted

The GIL site currently receives a mix of municipal solid waste, hazardous waste, reusable and recyclable material, greenwaste, and household hazardous substances. This includes from local residential and commercial sources from Dunedin City and environs and two DCC waste transfer stations in Waikouaiti and Middlemarch.

The existing and proposed waste types to be accepted at GIL are described the Design Report in **Appendix 3**. Materials that can be reasonably recovered, recycled, or composted are directed to the existing waste diversion facilities on the site (described in **section 4.3)**. This includes:

- Preowned reusable household goods

- Scrap steel and whiteware
- Glass, steel and aluminium cans, plastics (grades 1, 2 and 5), paper and cardboard
- Plaster board and polystyrene, children's car seats, and E-waste
- Household hazardous chemicals, batteries and gas bottles.
- Greenwaste (for shredding within the ORB)

General waste is disposed of in the landfill. GIL is classified as a Class 1 municipal solid waste (**MSW**) landfill under the WasteMINZ guidelines.[15] The existing resource consents enable the disposal of municipal, domestic, hazardous, industrial, and organic waste to land.[16] The continued operation of the landfill is proposed to broadly accept the same types of waste, and which meet the waste acceptance criteria set out in the LDMP[17], including:

- General waste
- Cleanfill
- Cover soils
- Rubble
- Construction and demolition waste
- Special and hazardous waste
- Asbestos
- Contaminated soil
- Household mattress
- Sludges and liquids (including WTPP biosolids and some used oil)
- Tyres

Waste acceptance criteria and procedures for the landfill are described in **section 8.2**. The overall composition of waste disposed of in the landfill is expected to include (by weight):

- General waste 46%
- Special/hazardous waste 4%
- Contaminated or non-contaminated soils 50%

Additional waste minimisation is expected to occur during the remaining operating life of the landfill. As described in **section 3.4.2**, implementation of kerbside diversion (from July 2024), and development of the RRPP at the GIL site is anticipated to result in a reduction in food and garden waste being deposited in the landfill. Furthermore, DCC intends to stop receiving liquid wastes in the future, and a review of DCC's long-term biosolids strategy is being undertaken with a view to reducing (but not necessarily eliminating) biosolids disposal to landfill long term. These changes will change both the quantity and composition of waste disposed at the landfill, preserving void space, and reducing LFG generation.

[15] Technical Guidelines for Disposal to Land, Waste Management Institute of New Zealand, October 2022

[16] Resource consents 94693-V1 and 94262-V1

[17] Section 4.9.3 of the LDMP, dated February 2023

4.3. Landfill and Waste Diversion/Transfer Facility Operation

Operational activities at the GIL site include:

- Vehicle entry, access control, waste drop off, and exit from the site.
- Operation of the waste diversion and transfer facilities.
- General waste filling and compaction.
- Placement of daily and intermediate cover, and the final capping layer on the landfill.
- Management of odour, dust, litter, birds and pests.

The existing and proposed operation of the GIL site is described in the Design Report in **Appendix 3**. Waste Management Ltd is currently contracted by DCC to operate the landfill and waste diversion and transfer facilities. GIL is open for waste deliveries Monday to Saturday 8.00am - 5.30pm, and Sunday 9.00am - 5.30pm.[18] The landfill is closed Christmas Day, Easter Friday, and Anzac Day (until 1pm). All waste is transported to the GIL via Brighton Road. Upon entering the site, vehicles carrying reusable household goods, scrap steel, recyclables, whiteware, and household hazardous substances are directed by signage to the waste diversion drop off area. The waste diversion facilities include the following:

- Rummage shop for the receipt and on-sale of pre-owned reusable household goods.
- Recycling drop-off area consisting of separate areas/bins for scrap steel, whiteware, steel and aluminium cans, different coloured glass, plastics (grade 1, 2 and 5), cardboard and paper, plasterboard and polystyrene, children's car seats and E-waste. All fridges are degassed prior to leaving the site. Consolidated recyclables are transported for processing off-site.
- Household hazardous substances drop-off area for chemicals, batteries, and gas bottles. Materials are transferred to a dangerous goods store on the site, and gas bottles degassed. Hazardous substances are routinely removed for disposal off site at specialist facilities.

Vehicles carrying greenwaste and general waste are directed by signage past the entry kiosk and weighbridge where they are weighed and categorised against the relevant waste type for charging purposes. Verification also occurs that the load does not contain prohibited wastes or and hazardous wastes that have not been pre-approved for acceptance by DCC (described in **section 8.2**). Greenwaste loads were previously directed to the greenwaste drop-off pad where they were stockpiled, routinely shredded, and then transferred to a compositing maturation area in the south-eastern corner of the site.

As described in **section 3.4.2**, from July 2024, all acceptable greenwaste received at GIL is now instead transferred to the new ORB located on the western side of the waste diversion facilities area. Greenwaste is shredded and mixed in the building with food and garden waste collected under the kerbside collection system and then loaded onto trucks from where it is transported for composting off-site. The existing greenwaste composting operation has ceased operation.

[18] Staff or contractors may be on-site outside these hours for required work, monitoring or maintenance.

Only pre-approved commercial contractors take general waste directly to the landfill tip face. All other general waste is dropped off at waste transfer station where it is transferred by truck to the landfill tip face. Vehicles access the tip face via an unsealed all-weather access road that traverses the landfill surface and connecting temporary access tracks that are altered as landfilling progresses. Waste is then off-loaded under supervision to identify inappropriate loads, spread in layers by a bulldozer, and compacted by multiple passes of a waste compactor.

Empty vehicles returning from the tip face that have deposited hazardous wastes pass through a wheel wash to ensure any tracked waste or sediment is removed before departing from the site. Wastewater from the wheel wash facility is conveyed to a soakage pit which infiltrates to ground and is intercepted by the leachate collection trench.

Waste placement occurs over a limited area, with the landfill being progressively completed to reach the finished landfill surface level. Three stages of landfilling through to closure are proposed extending north to south as shown on Drawing 12547621-C203 in **Appendix 3** and described in **Table 2.** For each stage, waste will be placed from east to west in 30m strips up to the finished landfill surface level, plus filling to allow for 10% long term waste settlement. Such additional filling (which has been previously approved by ORC) prevents the deeper fills becoming depressions over time resulting in rainfall ponding and infiltration into the landfill, generating leachate.

Table 2 – Proposed Filling Stages

Stage	Landfill capacity[19] (m3)	Estimated completion date[20] (year)	Cap area (m2)
1	41,000	2023/2024	26,750
2	252,000	Mid 2025	38,000
3	377,000	Late 2026	50,500
Total	670,000	December 2029	115,250

Only one tip face is operated at any one time, except for the disposal of some special and hazardous waste which requires their own dedicated disposal pits. The current LDMP restricts the width of the tip face to typically 30m and requires the size of the tip face to be no larger than 900m^2. As per the current LDMP the tip face may however be expanded to 1200m^2 in special circumstances.[21] As part of continued landfilling it is proposed to reduce the maximum size of the tip face to 300m^2 at any time when the daily fire danger rating for the landfill is very high, extreme, or very extreme to reduce fire risks.

At the end of each day's operation, the waste placed and compacted that day is covered with daily cover such that there are no uncovered areas of waste while the site is not operating. Daily cover is placed in layers not less than 150mm thick and consists of imported soils, including low level contaminated soils that are non-odorous and meet the landfill waste acceptance criteria. Daily cover is stripped at the beginning of each day as required to enable continued filling.

Intermediate cover is placed where waste will not be overlaid with fresh waste for more than 3 months to minimise rainfall infiltration into the landfill and LFG escape. These cover soils are mostly imported materials which are and stockpiled on site, then placed in compacted layers not

[19] Landfill capacity is the total volume minus the volume of capping for the stage.

[20] Based on a filing rate of 89,000 m^3 /annum.

[21] Special circumstance where the tip face may be expanded to 1200m^2 are when the rate of truck arrivals is 25% more than average, during waste placement in areas with unusual constraints, and where LFG escape and odour are unlikely.

less than 300 mm thick and grass/vegetative cover established. Intermediate cover is stripped and stockpiled before placement of fresh waste to allow leachate to migrate downwards.

As each stage is completed, placement of the final cap occurs. As of October 2022, final capping of 3ha of the 13ha portion of the current landfill operation has been completed, as shown on Drawing 12547621-G101 in **Appendix 3**. The final cap placed to date has been designed to meet the WasteMINZ guidelines and comprises 350mm of topsoil and sub-soil, 600mm of compacted low permeability clay (permeability < 1 x 10^{-7}), overlaying the 300mm of compacted intermediate cover soils. The final cap is graded to conform to the finished landfill surface described in **section 4.4**.

Final capping of each of the final three stages will meet these same requirements and will be placed as the final waste level for each stage is reached plus filling to allow for 10% long-term settlement of the waste back to the finished landfill surface level. Surface contour drains will be constructed on the capped surface to convey clean runoff for discharge to the Kaikorai Stream either directly via swales and culverts, or via a sedimentation pond. Grass or shallow rooted vegetation which will not affect the integrity of the landfill cap will then be established.

Soils for the final cap is obtained from an existing borrow area on the site located on the hillside to the south of the landfill footprint accessed via a haul road. Clay soils from this borrow area have been tested to confirm they meet the < 1 x 10^{-7} low permeability requirements of the WasteMINZ guidelines. Approximately 73,000m^3 of material will be required from the borrow area to complete the final cap over the entire landfill. Upon closure of the landfill, the final contour of the borrow area will consist of a flat bottom with an undulating slope that is generally between 20 and 26 degrees and covered in grass or other vegetation.

The existing resource consents require the landfill and waste diversion and transfer facilities to operated so there is no objectionable or offensive odour or dust beyond the boundary of the site, no burning of material on the site, and the extinguishment of any landfill fires.[22] The LDMP includes management measures addressing these matters, as well as the management of fire risks, litter, birds, pests, and emergencies (such as flooding and earthquakes). The management measures proposed for the continued operation, closure, and aftercare of the landfill are described in **section 8**.

4.4. Landfill Capacity and Finished Surface

The capacity and form of the landfill are currently constrained by a maximum 38ha footprint and limits on the deposit of waste to 270m^3/day and 100,000m^3/year in the existing resource consents, and a revised 2001 filling plan showing a finished landfill surface rising to a maximum height of 25m amsl along the spine of the landfill. Waste is placed within a soil bund constructed in the mid 1990's that encircles the landfill on the eastern, northern, and western sides. The southwestern half of the landfill had up to approximately 6m – 8m depth of waste placed during the 1990's, and remaining void exists to place a further 10 – 15m of waste in this area to achieve the approved finished landfill surface.

[22] Resource consents 94524-V1 and 94262-V1

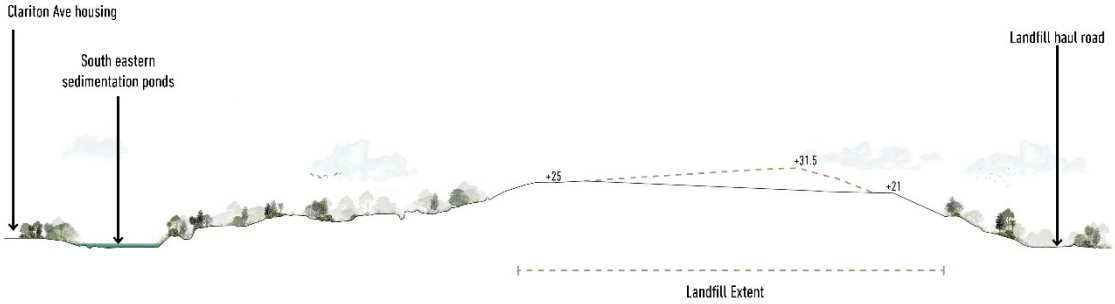
The existing and proposed landfill capacity and finished shape are described in the Design Report in **Appendix 3**. Between 2019 and 2021, the average annual volume of waste disposal/void consumption at the landfill has amounted to 89,000m^3/year.[23] Looking to the future this average annual waste volume is likely to represent a maximum. Planned kerbside diversion of most of the food and garden waste is anticipated to result in the average volume of waste disposal/void consumption reducing to 76,000m^3/year. However, future waste disposal rates are uncertain and achieving this lower rate is however contingent on the success of diversion efforts and any reduction may be offset by a corresponding increase in general waste from the provision from rates funded "red" bins and unforeseen one-off events such as natural disasters.

Based on an annual disposal/void consumption rate of 89,000m^3/year, filling of the remaining void to reach the consented finished shape is expected to occur in April 2027, approximately 4 years and 7 months after the expiration of the current resource consents on the 1st of October 2023. Alternatively with a reduction in the annual disposal/void consumption rate of 76,000m^3/year, filling of the remaining void is expected to occur in July 2029, approximately 5 years and 10 months after expiration of the resource consents.

The actual annual disposal/void consumption rate is likely to fall somewhere between this upper and lower limit. Regardless, filling of the remaining void to reach the approved finished landfill surface could potentially occur before the replacement Smooth Hill landfill is ready to accept its first waste, which is expected to be 2027 at the earliest. Commencement of operations at Smooth Hill is contingent on completion of baseline monitoring, detailed design, management plans, and initial construction.

DCC has evaluated several alternative options to meet the City's waste disposal demands until operations at Smooth Hill commence, which are described further in **section 5**. This has led to the selection of an option which continues the filling of the southwestern area of the landfill within the existing 38 ha footprint and perimeter bund. However rather than filling to the same approved finished landfill surface, it is proposed to instead extend the final landfill surface to the west, reaching a maximum height of 31.5m amsl at the western edge of the landfill as shown in **Figure 5**.

Figure 5 – Cross Section of Proposed Final Landfill Surface



[23] Including daily and intermediate cover soils, and allowing for initial waste settlement of 10% plus 15% settlement long term

The increased height of the final landfill surface provides an available landfill void of 670,000m^3 for the disposal of waste compared to a void of 529,000m^3 for the approved finished landfill surface.[24] Based on a maximum annual void consumption of 89,000 m^3, the projected life of the landfill would be until December 2029, approximately 6 years after the expiration of the current consents on 1 October 2023. Based on a minimum annual void consumption of 76,000 m^3, the projected life of the landfill would be until March 2031, approximately 8 years and 5 after consent expiry.

Ultimately the additional capacity provides flexibility to fluctuating waste demands and ensures there is a viable option available for the continued disposal of waste until which time operations at Smooth Hill commence. This includes accommodating the potential for further delays to Smooth Hill development and allowing for a period of transition in operations at the two landfills. While the void will therefore potentially be consumed and the landfill therefore close by December 2029, should waste disposal rates reduce closure of the landfill may be delayed a short period.

The selected option has the effect of the western most part of the landfill surface being approximately 6.5m higher than the current approved surface. The shape of the final surface has been designed to ensure it reduces the risk (relative to the approved surface) of ponding due to cap settlement, remains below the viewing plane of residential properties at Clariton Ave towards Pukemakamaka/Saddle Hill, and is sympathetic to the surrounding predominately rural landscape. The landscape and visual implications of the proposed shape for the surrounding environment are addressed in **section 8.10**.

4.5. Leachate and Groundwater Management

Leachate is the liquid by-product of waste degradation which typically combines with rainwater percolating through the placed waste. As these liquids percolate downwards, they further combine and collect dissolved and/or suspended matter from the waste profile.

The existing resource consents require the installation and operation of a perimeter leachate collection trench to ensure the effective long-term containment, collection, and monitoring of contaminated leachate and to protect the Kaikorai Stream and Estuary, coastal waters, and uses and values associated with these waters.[25]

The existing and proposed approach to managing landfill leachate and groundwater are described in the Design Report in **Appendix 3,** and the Groundwater Report in **Appendix 5**.

The volume of leachate within the landfill is minimised through measures included within the LDMP, including control of stormwater, placement of intermediate and final cover, and maintenance of the leachate collection system and landfill cap. Rates of leachate generation and contaminant concentrations are highest during operation where waste is being placed. On closure of the landfill and final capping, leachate flows will be greatly attenuated, and contaminant concentrations will decrease as the landfill ages.

Leachate within the landfill is intercepted by a leachate collection trench that was installed from the mid 1990's as shown on Drawing 12547621-G101 in **Appendix 3**. The system currently comprises the following components:

[24] Calculated from June 2022.

[25] Resource consents 3839A-V1 and 3839B-V1

- A gravel filled leachate collection trench containing a perforated 150mm uPVC collector pipe that extends around the eastern, northern, and western sides of the landfill. A 1.5mm HDPE liner placed on the outer face of the leachate collection trench restricts the influx of groundwater seepage from the adjacent Kaikorai Stream.
- Gravel drains at the base of the perimeter bund and internal leachate drains within the waste in the southern portion of the landfill and in the northern sector of waste placed in 2019 – 2022 to manage leachate levels and prevent seepage breakouts. Leachate from these drains discharge to the leachate collection trench.
- Nine pump stations (PS1 through PS9) at approximately 200m spacings along the leachate collection trench which pump the collected leachate and groundwater to a buried 125mm rising main that discharges to the main sewer line to the GIWWTP to the south of the landfill. Manholes (MH0 through MH8) exist between the pump stations to allow inspection access and clearing of the uPVC pipe.

The leachate collection trench extends around the full perimeter of the landfill except for the southern side of the landfill where a shallow surface drain intercepts leachate impacted surface and groundwater runoff and directs it to PS1 from where it discharges to the main sewer line and GIWTTP. There is also a 90 m gap on the eastern side of the landfill which aligns with a short ridge of land that extends into the estuary based on historical maps and photos.

The existing resource consents limit the rate of take of leachate and groundwater through the leachate collection system to nominally 23,400 L/hour and a maximum of 72,000 L/hour.[26] Stormwater runoff from some catchments is also conveyed to the leachate collection system as described in **section 4.6**. The volume of pumped leachate, groundwater, and stormwater over the 2021 – 2022 monitoring year was 1.6 L/s or 5,780 L/hour. In the past five years the combined pumping rates from the leachate collection system have been between 1 and 2 L/s, peaking up to 8 – 9 L/s after periods of rainfall.

Given these historical rates, the rate of take under the current consent is proposed to be reduced to an average of 5 L/s (18,000 L/hour) and a maximum of 20 L/s (72,000 L/hour), or 432m^3/day and 1,728m^3/day respectively. These rates accommodate stormwater runoff flows from those catchments which are conveyed to the leachate collection system and contingency for potentially extended periods of rainfall.

The following changes which are described in more detail in **sections 8.3 and 8.7,** and **8.8** are proposed to the existing leachate collection system to address potential leachate migration risks as part of the continued operation, closure, and aftercare of the landfill:

- Extension of the leachate collection trench along the southern side of the landfill where the existing surface drain exists, with three additional pump stations. The existing surface drain will be shifted downslope and revert to receiving only stormwater runoff from the landfill, borrow area, and hillside to the south. These works, which are shown on Drawing 12547621-C204 in **Appendix 3**, will be completed within 3 years of replacement consents being granted.

[26] Resource consent 4139-V1.

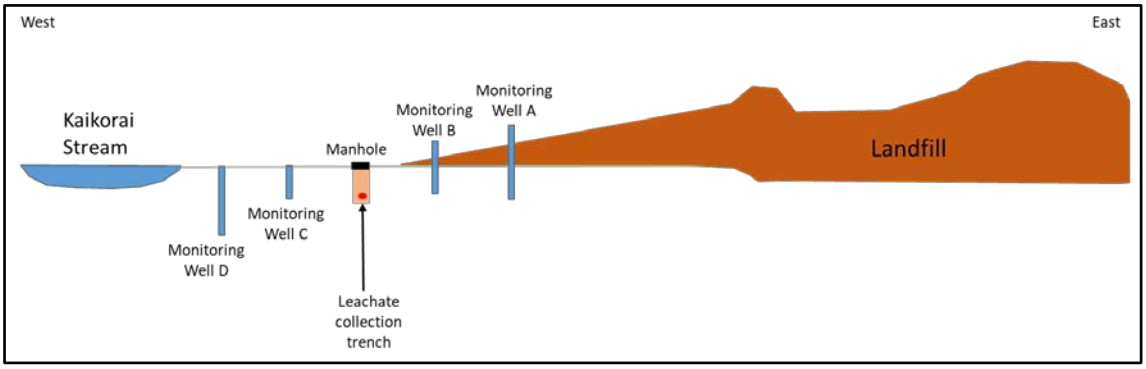
- Progressive installation of additional internal landfill leachate drains over the proposed waste filling area in advance of waste placement to manage leachate levels within the waste. The drains will discharge by gravity to the leachate collection trench. These works are shown on Drawing 12547621-C204 in **Appendix 3**.
- The infrastructure to allow use of submersible air powered pumps in LFG wells to extract leachate if required to reduce leachate mounding in the completed sections of the landfill.
- Installation of an additional leachate rising main connecting the pump stations to the sewer to the GIWTTP above ground surface, and installation of additional power cable for the pump stations on the ground surface so that they are more resistant to earthquake land deformation and any failures can quickly identified and remedied. These works will be completed at least 6 months prior to the final acceptance of waste.
- Raising the level of the perimeter road berm that extends around the landfill between the adjacent Kaikorai Stream and the leachate collection trench by approximately 1m to minimise the risk of inundation of the leachate collection trench by floodwaters.[27] These works will be completed at least 6 months prior to the final acceptance of waste.
- Raising the manholes, chambers, and electrical controls for the leachate pump stations above the predicted future flood level. These works will be completed at least 6 months prior to the final acceptance of waste.

The existing consents include a comprehensive regime for the monitoring of groundwater levels and groundwater and surface water quality in the Kaikorai Stream, including to confirm the effective operation of the leachate collection system, and detect any leachate migration from the site. The groundwater monitoring network is shown on Drawing 12547621-C601 in **Appendix 3** and comprises:

- 8 lines of groundwater monitoring wells intersecting the leachate collection trench as shown in **Figure 6** below.
- Each well line is located at mid-distance between two pump stations and each line comprises three shallow wells, except Line 7, where one well is absent.
- At each well line, monitoring wells A and B are located on the landfill side of the leachate trench, approximately 20 m and 5 m from the trench respectively. Monitoring well C is located between the trench and the Kaikorai Stream, *eastern sedimentation pond*, and eastern boundary.
- At well lines 2, 4 and 7, a deep monitoring well D is located between the leachate collection trench and the stream.
- An additional well C is located at the end of the leachate collection trench at Well Line 0, to the south of PS1.

Figure 6 – Schematic of Typical Monitoring Well Transect

[27] Raising of the berm to divert floodwaters constitutes the placement of a *defence against water* under the Regional Plan: Water.



Monitoring includes:

- Monthly monitoring of groundwater/surface water levels.
- Continuous monitoring of pumped leachate/groundwater volumes.
- Annual monitoring of leachate chemistry against a range of analytes.
- Quarterly monitoring of groundwater/leachate quality from the leachate collection trench and the groundwater monitoring wells against a range of analytes.
- Quarterly surface water quality in the Kaikorai Stream and Estuary against a range of analytes.[28]

The same monitoring regime (with some modifications) is proposed for the continued operation, closure, and aftercare of the landfill and is described in **section 8.3**.

4.6. Stormwater Management

The existing resource consents require all practicable steps are taken to prevent contamination of stormwater by suspended solids or exposed landfill material or runoff by implementing appropriate landfill management practices, including silt retention ponds designed for the runoff arising from a 1 in 2-year storm event, with a design duration of 24 hours.[29]

The existing and proposed approach to managing stormwater are described in the Surface Water Report in **Appendix 6**.

Stormwater is managed by measures included in the LDMP, including the interception and diversion of stormwater, separation of clean and contaminated runoff, and minimisation of erosion and sediment transport. Clean and contaminated runoff from the landfill is separated and managed in the following way:

- **Clean** non-contaminated runoff from the landfill margins, completed grassed capped areas, and the waste diversion and transfer facilities are conveyed by sheet flow or by swales and pipes to perimeter drains which either discharge to the Kaikorai Stream via the *eastern* and *western sedimentation ponds* or, in the case of the western side of the landfill via culverts directly to the stream.

[28] Resource consents 3839A-V1 and 3839B-V1

[29] Resource consents 3839C-V1, 3839D-V1, 3840A-V1, 3840B-V1, and 3840C-V1.

- **Stormwater** runoff potentially containing elevated sediment concentrations from exposed earthworks, or areas where capping is in progress are conveyed by grades on the landfill surface and temporary stormwater drains to the *eastern and western sedimentation ponds* prior to discharge to the Kaikorai Stream. Some stormwater runoff is also conveyed to the leachate collection system for discharge to the GIWTTP.
- **Leachate** contaminated stormwater in the active landfilling area that has or has potential to encounter waste or leachate is left to infiltrate the landfill or is conveyed by leachate drains to the *northern leachate pond* or the leachate collection system for discharge to the GIWTTP.

The site is split into a series of stormwater catchments shown in **Figure 7** employing the different stormwater management approaches, described as follows:

- **Catchments 1, 3a, 3b, and 6b** comprise perimeter bund, or areas that have been permanently capped and vegetated. **Clean** runoff from these areas is conveyed to perimeter drains which discharge to the Kaikorai Stream via culverts directly to the stream. This will remain the case post closure.
- **Catchments 2, 2a, and 5a** comprises areas where capping has been recently completed (2022), and the tip face access road. Sediment laden **stormwater** and potentially **leachate** contaminated stormwater from the tip face access road are conveyed to the *northern leachate pond* which discharges to the leachate collection system. Post closure this pond will revert to a sediment pond that will discharge to the Kaikorai Stream.
- **Catchments 4, 4a, 5b, 8, and 9** comprise areas that have been permanently capped and vegetated or have exposed earthworks. **Clean** runoff and sediment laden **stormwater** from these areas are conveyed to the *eastern sedimentation pond* which discharges to the Kaikorai Stream. This will remain the case post closure.
- **Catchments 6a, 7a, 7b, and 10** comprise the active landfilling area, or areas with intermediate cap where there is the potential for stormwater to contact with waste or leachate, and the exposed borrow area. **Leachate** contaminated stormwater and sediment laden **stormwater** from these areas is conveyed to the leachate collection trench. Post capping and closure, these catchments will be directed to the *eastern or western sedimentation ponds* that discharge to the Kaikorai Stream.
- **The waste diversion and transfer facilities** area comprise predominately paved areas. **Clean** runoff and **Stormwater** from this area is directed via a swale to the *eastern constructed wetland* that discharges to the Kaikorai Stream, or discharges to ground.

Figure 7 – GIL Site Stormwater Catchments

The *eastern* and *western sedimentation ponds* receive a mix of **clean** and **stormwater** runoff. They have been constructed for the design storm required by the existing resource consents, and enable sediment to settle out, with clean stormwater then being discharged via culverts to the Kaikorai Stream. Surveying of the ponds to determine their ability to receive design storm flows and the need for desilting is routinely carried out as described in the LDMP.

The *northern leachate pond* near the site entrance receives potentially **leachate** contaminated stormwater from the tip face access road, and sediment laden stormwater from recently capped areas on the northern side of the landfill, from where it is then discharged to the leachate collection system. During prolonged high rainfall events, water from this pond may overflow to the perimeter swales and discharge to the Kaikorai Stream via a culvert. Upon closure of the landfill, this pond will revert to a sediment pond that will discharge to the Kaikorai Stream.

An additional sediment pond (the *borrow area sedimentation pond*) receives stormwater runoff from a swale running along the base of the borrow area, from where it discharges to the leachate collection system. This pond will be disestablished upon closure of the landfill and rehabilitation of the borrow area, with clean runoff then being directed to the *western sedimentation pond*.

Diversions of both the Kaikorai Stream and Brighton Road Stream were completed in the mid 1990's to enable further construction of the landfill, existing site access, leachate collection trench, and stormwater infrastructure. These works resulted in the formation of the *south eastern constructed wetlands* and *eastern constructed wetland* connected via a long culvert. The *eastern constructed wetland* discharges under the landfill access road to the Kaikorai Stream. These diversions will remain in place in perpetuity during the ongoing operation of the landfill, and the closure and aftercare period.

The existing resource consents require the quarterly monitoring of stormwater quality at the outlet into the sediment ponds before any settlement of sediment and adsorbed contaminant occurs, and at four sites (ref GI1, GI2, GI2 and GI5) in Abbot's Creek and Kaikorai Stream, against a range of analytes to confirm the effective operation of the leachate collection system and stormwater controls, and detect any leachate migration from the site.[30] The same monitoring regime (with some modifications) is proposed for the continued operation, closure, and aftercare of the landfill and is described in **section 8.3**.

Monitoring has detected apparent leachate seepage into the culvert that extends from the *south eastern constructed wetlands* to the *eastern constructed wetland*. As of October 2024, work is underway to repair this culvert with work expected to be completed by the end of March 2025. This is described in more detail in **section 8.3**. Also proposed as part of these applications is the fitting of shut of valves to the outlets to the *eastern* and *western sediment ponds* to enable the containment of any contaminant spills entering the downstream environment.

4.7. Landfill Gas Collection and Management

Degradation of biodegradable waste within a landfill result in the generation of LFG, primarily consisting of methane, carbon dioxide, oxygen, and nitrogen with trace amounts of reduced sulphur compounds and volatile organic compounds.

The existing resource consents require all practicable steps to collect LFG from refuse less than 12 years old at the commencement of the consents and to minimise the emission of LFG.[31] Furthermore the NES-AQ gazetted in 2004 requires the collection and destruction of LFG in a landfill that will exceed 1M tonnes of waste and contains more than 200,000 tonnes of waste.

The existing and proposed approach to managing LFG are described in the Design Report in **Appendix 3**. LFG is managed by measures included in the LDMP, including the placement of intermediate and final cover, and the operation of an LFG collection and destruction system. The LFG collection and destruction system was installed from 2009 onwards, and comprises the following components:

- 38 vertical LFG collection wells installed in capped areas of the landfill and connected to the network.

[30] Resource consent 3840C-V1

[31] Resource consent 94524-V1

- A network of lateral connector pipes connecting to header or ring main pipes which coneys the LFG to destruction systems located at the adjacent GIWWTP.
- An LFG engine at the GIWWTP that uses the LFG as a fuel to generate electricity which is fed back into the power grid. The engine has a capacity of 600kW and operates at an LFG flowrate of 350m^3/hour.
- An LFG candlestick flare at the GIWWTP to serve as a back up to the engine and destroy the LFG that cannot be used by the engine. The flare has a capacity of 450m^3/hour.
- A small mobile solar powered flare located on the landfill footprint to destroy LFG from wells close to the tip face that cannot be connected to the wider LFG network.

Additional wells will be installed and connected to the LFG network as areas of landfilling are completed and permanently capped as shown on Drawing 12547621-C501 in **Appendix 3**, which is expected to result in an increase in the volume of LFG that is recovered and destroyed. An enclosed flare with a capacity of 1,000m/hr is proposed to be installed to replace the candlestick flare at the GIWWTP to manage the predicted increase in LFG generated. A second mobile solar flare is also proposed to ensure LFG from wells that are not connected to the LFG network is appropriately managed.

Regular monitoring of LFG is undertaken at the site to confirm the effectiveness of the gas collection system and enable detection of any LFG escape that may present a hazard or nuisance to sensitive receptors. This includes quarterly visual inspections of the LFG system and landfill surface, annual surface emission (ISM) monitoring using a portable gas detector, and monthly monitoring of LFG in three perimeter monitoring wells outside the landfill footprint. The same monitoring regime (with some modifications) is proposed for the continued operation, closure, and aftercare of the landfill and is described in **section 8.4.**

4.8. Landscape Planting

The existing landfill is surrounded by extensive screening vegetation largely comprised of mature exotic tree species. This vegetation is of a height and density which reduces views into the operational areas of the site and mitigates the landscape, visual, and natural character effects of the landfill. The importance of the screening function of the trees will reduce post closure once the landfill is capped and grassed, however will continue to assist with integrating the landfill landform, and future RRPP facilities are integrated into the surrounding landscape.

The cultural aspirations of Te Rūnanga o Ōtākou expressed through engagement and the development of the cultural impact assessment described in **section 8.13**, seek restoration of the ecological values of the Kaikorai Estuary, provision of habitat for taoka species and rebalancing of mauri.

A long-term Vegetation Restoration and Management Plan (**VRMP**) described in **section 8.10** is proposed to be prepared setting out:

- The routine monitoring and maintenance necessary to promote the health and long-term stability of the existing trees.

- Proposed long-term post closure actions for replacement of the existing trees, incorporating native tree species to enhance natural character, landscape, amenity, and cultural values.
- Riparian planting and pest management to support restoration of the ecological values of the Kaikorai Estuary, provision of habitat for taoka species and rebalancing of mauri.

The plan will involve establishing eco-sourced native tree species within the existing vegetation, and as they mature gradually felling and removing the exotic trees. Planting will consist of low flammability species and may include fast-growing lowland ribbonwood and narrow-leaved houhere to provide ongoing screening and lower native plantings in riparian margins to further improve habitat values.

The VRMP will be prepared in consultation with Te Rūnanga o Ōtākou within 1 year following the granting of the replacement resource consents. A framework for the VRMP has been developed and is attached to the Landscape, Natural Character, and Visual Effects Report in **Appendix 13**.

4.9. Landfill Closure and Aftercare

Closure of the landfill for the disposal of waste will occur in approximately December 2029 depending on waste disposal rates. The proposed approach to landfill closure and aftercare is described in the Design Report in **Appendix 3**. Finalised requirements for the closure and ongoing aftercare of the landfill will be detailed in a Landfill Closure Management Plan (**LCMP**) which will be developed prior to closure.

Closure activities are expected to take approximately 2 years to complete and will include:

- Placing the capping layer on the final stage of the landfill.
- Complete installation of the LFG wells and associated pipework.
- Establishing any final vegetation and landscape planting.
- Establishment of grass cover or other vegetation over the soil borrow area.
- Removing any site facilities and infrastructure that is not required during the aftercare period or modifying such infrastructure for the aftercare period.

Aftercare activities will include:

- Ongoing operation and maintenance of the LFG collection and destruction systems.
- Ongoing operation and maintenance of the leachate collection system.
- Maintenance of the permanent site stormwater systems.
- Maintenance of the landfill cap, including filling any areas that may have been subject to differential settlement, repair of any surface erosion, and mowing maintenance of vegetation as required.
- Maintenance of any remaining site infrastructure, including fences, and buildings not removed following closure.
- Maintenance of landscape plantings and weed management.

- Ongoing environmental monitoring, reporting, and event response, as required by the resource consents and the LCMP.

The existing waste diversion and transfer facilities will be redeveloped as part of the RRPP during the remaining operating life of the landfill and along with the existing ORB building will continue to operate post closure and during the aftercare period.

Long term use of the landfill site post closure will be determined in consultation with Te Rūnanga o Ōtākou and the community and confirmed plans will be included in the LCMP. Any such use will need to ensure the protection and effective ongoing operation of the landfill cap, remaining landfill infrastructure, including the leachate and LFG collection systems, and the RRPP. Such uses may include walking and cycling tracks and picnic areas around the periphery of the closed landfill making the estuary more accessible to the public. This includes incorporating mana whenua values and pūrākau associated with the Kaikorai Estuary developed through a codesign process consistent with the aspirations of Te Rūnanga o Ōtākou expressed through engagement and the development of the cultural impact assessment described in **section 8.13**.

4.10. Landfill Management and Development Plan (LDMP)

The operation, closure, and aftercare of landfills in accordance with a comprehensive management plan follows contemporary best practice. The purpose of such a management plan is to document site-specific procedures, including monitoring and contingency actions to be implemented to ensure the landfill achieves the conditions set out in the resource consents. Policy 7.4.11 of the Otago Regional Plan: Waste requires a site-specific management plan is prepared and implemented in accordance with the WasteMINZ guidelines.

The existing resource consents require the consents are exercised in conformity with a Landfill Work Programme prepared by the consent holder, which is to be reviewed annually or at such lesser frequency as the consent authority may approve. Among other matters, the Landfill Work Programme is required to describe present projections and intentions for landfill operations, and the sequencing of works.[32]

A Landfill Management and Development Plan (**LDMP**) was developed following the issuing of the existing resource consents to serve the purpose of the Landfill Work Programme. The current update to the LDMP was provided to ORC in September 2023 and is attached as **Appendix 4**. The LDMP subsumes and cross references to the separate Landfill Operations Plan (**LOP**) maintained by Waste Management Ltd which more specifically addresses the day-to-day operational management of the landfill.

The continued operation of the landfill and waste diversion and transfer facilities through to closure will continue to occur in accordance with the LDMP and LOP. The content of the LDMP addresses:

- **Introduction** – the existing resource consents, designation, and status and review of the LDMP.
- **Site Management –** management structure, responsibilities, requirements for staff training, and community liaison.

[32] Resource consents 3839A V1, 3839B V1, 3839C V1, 3839D V1, 3840A V1, 3840C V1, 4139 V1

- **Landfill Development** – including design principles, landfill capacity, and the filling programme and sequence.
- **Site Operations** – including controls and procedures for access control, stormwater management, leachate management, LFG management, greenwaste mulching and composting, salvage and management of diverted materials, roading and traffic management, waste acceptance and placement, waste cover, and control of nuisances.
- **Environmental Monitoring** – including monitoring, recording, and reporting for surface water, groundwater, LFG, leachate, odour, and weather.
- **Emergency Management** – including procedures for management of fires, hazardous waste/materials, leachate and LFG escape, extreme weather/flooding, machinery failure, accidents, and earthquakes.
- **Closure, Reinstatement, and Aftercare** – including final capping, continued operation and maintenance of landfill infrastructure, and ongoing monitoring.

The current LDMP and LOP reflect the current approach to operating the landfill and waste diversion and transfer facilities. They have yet to be updated to align with the intended approach to the continued operation, closure and aftercare of the landfill described in the Design Report in **Appendix 3**, and recommended amendments described in the technical reports supporting this AEE.

The proposed amendments to the LDMP have been compiled in a memorandum included in **Appendix 18**. Both documents will be updated after the granting of any replacement resource consents to capture these amendments and ensure that they align with the final approved consent documentation, and any resource consent conditions. The updated LDMP will be developed in consultation with Te Rūnanga o Ōtākou.

The LDMP and LOP will be reviewed and updated over the remaining life of the landfill as required to ensure that management practices result in compliance with the conditions of resource consent and respond to any changes in waste demands, best practice management, regulatory requirements, and any environmental changes. As noted in **section 4.9**, prior to closure of the landfill, a specific LCMP will be developed which will specify the final requirements for closure and aftercare of the landfill.

While the RRPP does not form part of these applications, separate management plans will be prepared addressing the operational management of the RRPP facilities.

5. Description of Alternatives Considered

5.1. Alternative Waste Disposal Options

The continued operation of GIL sits within the context of the DCC's wider Waste Future's Programme which aims to ensure effective reduction and management of solid waste; and to identify and procure the best solid waste solution for Dunedin to enable the city to move towards a zero-waste future and a more circular economy. As part of the programme, the DCC has committed to implementing improved kerbside collection, recycling services, and development of new waste diversion and transfer facilities (including the RRPP at GIL), as described in **section 3.4.2**.

Despite these waste minimisation efforts, there will be a continued need for a facility for the disposal of municipal solid waste and hazardous waste. Currently GIL is the only existing landfill in Dunedin which is able to accept these wastes for disposal. Through the Waste Futures Programme there has been an extensive investigation of potential sites, and consideration of a range of alternative options, ultimately leading to the selection of the Smooth Hill Landfill as the preferred future disposal option.

The ORC and DCC's consenting authority granted resource consents for the development of Smooth Hill in September 2022, with Environment Court appeals being resolved in May 2023. As described in **section 4.4**, the resource consents needed to authorise the filling of the remaining void at Green Island will expire before the replacement Smooth Hill landfill is ready to accept its first waste, which is expected to be 2027 at the earliest. In the interim, DCC needs somewhere to continue deposing of waste to meet the city's needs.

Various alternative waste disposal options have been considered by the DCC as part of the Waste Futures Programme including:

- Out-of-district-disposal at another landfill.
- Waste incineration.

The DCC has considered the option of disposing waste to an out-of-district landfill (e.g. AB Lime in Winton, Victoria Flats in the Queenstown Lakes area, Mt Cooee landfill in Clutha or Redruth's in Timaru). The closest alternative Class 1 landfill with capacity to accept waste from Dunedin is AB Lime landfill near Winton in Southland, which is approximately 200 km (2 ½ driving hours) southwest of Dunedin.

The out-of-district option requires DCC to have a long-term contract for the disposal of waste, with security of gate rate for a fixed period; and arrangements for the bulk haulage of waste from DCC owned and operated transfer stations. The main advantages of an out-of-district option relate to the divestment of any risks of DCC ownership (including commercial, financial, health and safety, and compliance risks); coupled with the lack of need for DCC capital investment in a local landfill.

However out-of-district disposal, would result in DCC losing its ability to control the full waste cycle, thereby limiting carbon emission reduction and waste diversion initiatives. Furthermore, out-of-district disposal is more expensive than in-district disposal and would expose DCC to risks of price increases for disposal, and changes in haulage costs, especially in relation to fuel price

volatility. Haulage costs could account for up to 40% of the cost of waste disposal to an out of district facility, with fuel costs accounting for approximately 25% of the total haulage costs. Out-of-district disposal is also understood to be unacceptable to mana whenua, in accordance with the principles of kaitiakitaka.

The Economic Report in **Appendix 13** considers that continued disposal at the Green Island site is at least 33% more cost effective than out of district disposal. Out of district disposal would also result in higher emissions. Disposal of an estimated 35,000 tonnes of DCC managed waste each year would equate to 1,000 truckloads each carrying 35 tonnes making the trip each year, or 750 tonnes of CO_2 equivalents a year. Additional truck movements would also impose higher costs on the road network in terms of wear and tear, and increased road congestion.

The DCC has also previously evaluated the option of establishing a municipal waste incinerator in Dunedin as a waste to energy (WTE) facility. However, this was not preferred due to high capital establishment cost, the need to secure large sources of combustible waste, burning of waste being unacceptable to mana whenua, and the continued need for ash disposal (20% of incoming waste) to landfill. These same disadvantages would apply to interim disposal of waste, with interim disposal via WTE considered unfeasible due to the high capital cost of developing a WTE facility and the relatively short time before Smooth Hill is anticipated to commence operation.

Given the above, the continued disposal of waste at GIL until which time Smooth Hill is available is preferred by the DCC.

5.2. Alternative Green Island Landfilling Options

The DCC has considered and evaluated several alternative landfilling options to meet the City's waste disposal demands until operations at Smooth Hill commence, including:

- Extension of the GIL landfill footprint to the south across the main sewer to the GIWTTP.
- Filling within the current landfill footprint, either to the existing approved finished landfill surface, or greater.

Extension of the landfill footprint to the south across the 1050mm main sewer line to the GIWTTP has been an option since the first assessment of potential landfill sites in 1992, which led to the selection and designation of Smooth Hill as the city's future landfill site. The DCC engaged Stantec to further consider an extension to the landfill footprint in 2019. Stantec concluded that this would require landfilling waste over the sewer to a depth of approximately 25m, making future maintenance extremely difficult and could ultimately result in the pipe collapsing. The proximity to neighbours, inability to meet Class 1 landfill design standards, and being located in a low-lying area in close proximity to the Kaikorai Stream and Estuary were also considered significant consenting constraints. For these reasons DCC considered that an extension of the landfill footprint was not a suitable option.

This option was further considered in 2021 by GHD and Boffa Miskell which reconfirmed this earlier assessment. Any extension would require relocation of the sewer outside the footprint, likely requiring micro tunnelling at significant cost.

The DCC has considered three design options for landfilling within the current landfill footprint as outlined in **Table 3**.

Table 3 – Green Island Landfill Design Options Considered

	Option	Estimated Net Void (m3) (excluding cap) as at June 2022
1	Fill to approved 1999 final landfill surface with a 2% grade to the east and west (status quo).	529,000
2	Raise the final landfill surface by 9m over Option 1 with a 10% grade to the east and west	667,287
3	Extend the final landfill surface to the west at a grade of approximately 4.5% below the viewing plane of residential properties at Clariton Ave towards Pukemakamaka/Saddle Hill, reaching a maximum height of 6.5m over Option 1 at the western edge of the landfill (the selected option).	664,197

These options were assessed by GHD and Boffa Miskell technical specialists in regard to:

- Engineering and geotechnical stability
- Groundwater management
- Stormwater management
- LFG management
- Air Quality effects
- Acoustic effects
- Ecological effects
- Landscape and visual effects

Overall, little disenable difference between options was identified through the assessment. In particular, the management of groundwater, and LFG, and potential ecological, air quality, and acoustic effects were expected to be virtually the same for all options. From a geotechnical stability perspective, initial slope stability assessments were undertaken which concluded there was no significant difference in slope performance between them. Anticipated landfill stability and deformations under static and earthquake loadings were similar.

Ongoing differential settlement of the shallow 2% grades of Option 1 (status quo) was however considered likely to result in low lying areas and poor drainage requiring ongoing cap maintenance. While the steeper 10% grades of Option 2 would slightly increase the peak rate of runoff discharge from the site, the steeper grades were considered beneficial for managing differential settlement and maintaining runoff. Similarly, the 4.5% grades of Option 3 were also considered beneficial for managing differential settlement and runoff over Option 1.

None of the options were considered uncharacteristic within the receiving landscape due to the options being limited to the existing landfill footprint, the relative containment by embankments and trees, and the gradual and intermittent nature of the filling activity. While Options 2 and 3 represented an increased modification to the site and potential natural character values of the estuary, given the presence of the landfill, any additional effects on natural character were likely to be negligible to low. The peaked form of Option 2 however was considered generally more visually prominent than the lower form of Option 3 resulting in greater visual effects.

Overall, the technical assessment concluded there was little discernible difference in effects between the three options. Ultimately the DCC elected to proceed with preparing applications for resource consent Option 3 because:

- It provided for the cost-effective utilisation of an existing Council asset.
- It provided increased capacity and landfill life over Option 1, thereby providing flexibility to fluctuating waste demands and ensure there is a viable option for the continued disposal of waste until which time operations at Smooth Hill commence, including allowing for delays to Smooth Hill development and for a period of transition in operations at the two landfills.
- The landscape and visual effects of Option 3 were similar to Option 1 and reduced compared to the higher Option 2.

5.3. Alternative Discharge Methods

Alternative methods of discharge, and other receiving environments for the discharges to land, groundwater, and surface water have been considered however they are not practicable for an existing landfill in this location. Class 1 landfills by their nature result in the discharge of contaminants to land and the GIL site is hydraulically connected to the Kaikorai Stream and Estuary. No other receiving environments for the discharges to groundwater and surface water exist.

There are no practicable alternative methods of discharge. While the WasteMINZ guidelines prescribe the installation of a base liner for a Class 1 landfill to contain leachate within the landfill, as waste has been placed over the full extent of the landfill footprint, it is not possible to create a new landfill cell where a liner can be constructed on the underlying sediments. Placement of a liner over the existing waste would likely result in differential settlement and liner deformation under the additional load of waste (and which would be exacerbated during a seismic event) resulting in a high risk of liner failure. As described in **section 8.3**, the existing leachate collection trench provides effective containment of leachate from the receiving environment. Proposed extension of the leachate collection trench and internal leachate drains will address any existing apparent leachate migration risks.

The methods of stormwater discharge align with best engineering practice, and the guidance contained in the WasteMINZ guidelines. As described in **section 8.3**, leachate contaminated runoff is directed to the leachate collection system for disposal to the GIWTTP. Sediment laden stormwater from exposed landfill surfaces passes through sediment ponds prior to discharge to the Kaikorai Stream or is discharged to the leachate collection system.

6. Description of the Applications

6.1. Application Framework

The ORC administers the following relevant National Environmental Standards, and Regional Plans which determine the resource consents required:

- The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-FW), which came into force on the 3rd of September 2020. The NES relevantly controls activities affecting natural wetlands. Updated regulations came into force in January 2023 which provide a discretionary activity pathway for "landfills" where they affect natural wetlands.
- The Regional Plan: Waste for Otago (Waste Plan), which was made operative on the 11th of April 1994. The plan controls the discharge of contaminants to land, air, and water associated with landfills and facilities for hazardous wastes.
- The Regional Plan: Water for Otago (Water Plan), which was made operative on the 1st of January 2004. The plan controls the take, use, damming, and diversion of water, other discharges of contaminants to land and water not controlled by the Waste Plan; and drilling of land.

The Kaikorai Stream and its margins that coincide with the northern and western boundaries of the landfill site are defined as "natural inland wetlands" for the purposes of the NES-FW regulations. The *eastern and western sedimentation ponds* and *northern leachate pond* are man-made artificial structures. The *south eastern and eastern constructed wetlands* near Brighton Road are "constructed wetlands" for the purposes of the NES-FW. The NES-FW wetland regulations do not apply to these artificial structures and constructed wetlands.

6.2. The Resource Consents Applied for

DCC seeks replacement resource consents to enable the continued operation, closure and aftercare of the landfill and associated waste diversion facilities at GIL, the ultimate closure of the landfill in approximately December 2029 depending on waste disposal rates, followed by ongoing aftercare of the landfill.

The resource consents that are sought for each of the activities under the relevant rules of the NES-FW and Regional Plans, and their activity status, are outlined in **Table 4** below. The following specific matters are noted regarding the consents outlined in the table:

- The resource consents largely mirror the existing resource consents for the landfill; however, the opportunity has been taken to consolidate the number of consents relating to the discharges of waste and contaminants to land, take of groundwater and leachate, and diversion and take of surface water/stormwater.
- The surface water/stormwater runoff from the working and non-working areas of the landfill are considered diversions of water, and no take of this water is occurring given the diverted water is ultimately discharged to the Kaikorari Stream receiving environment.

As confirmed with ORC, no replacement consents are therefore required for the take of surface water/stormwater under the Regional Plan: Water.

- The diversions of the Kaikorai Stream and Brighton Road Stream that resulted in the formation of the *south eastern constructed wetland* and *eastern constructed wetland* are existing diversions. While the physical works associated with these diversions have been constructed and remain in existence, a replacement consent is required to enable the ongoing diversion of water via these works.
- The raising of the level of the perimeter road berm between the landfill and Kaikorai Stream to minimise inundation of the leachate collection trench would constitute a *defence against water* under the Regional Plan: Water, for which a land use consent is required. The associated diversion of floodwaters is included in the replacement consent for the diversion of surface water and stormwater from working and non-working areas of the landfill.

Table 4 – Resource Consents Applied for from ORC

Resource Consent	Relevant NES-FW/Regional Plan Rule	Commentary
Discharge of waste and hazardous waste, and leachate onto land, that may result in contaminants entering groundwater for the purpose of the operation and closure of a Class 1 landfill (replacement for consent no's 94262-V1 94693-V1, and 3839A-V1).	Regional Plan: Waste: Rule 7.6.1(1) and (2) – New or operating landfills – discretionary activity.	Landfills for the disposal of waste, and associated discharges are discretionary activities, requiring resource consent.
	Regional Plan: Waste: Rule 6.6.1(1) and (2) – Operation of facilities for the treatment or disposal of hazardous wastes – discretionary activity.	Facilities for the disposal of hazardous waste, and associated discharges are discretionary activities, requiring resource consent. Rule 6.6.1(1) and (2) is triggered as compliance with Class 1 waste acceptance criteria will allow some "hazardous wastes" to be accepted – e.g. contaminated soils.
	Regional Plan: Waste Rule 7.6.13 – Composting – discretionary activity.	Permitted activity rule 7.6.12 cannot be met for the composting of greenwaste and associated discharges on site, specifically the composting will not be undertaken on the property from which the majority of the material is sourced. It is therefore a discretionary activity, requiring resource consent.
Take of groundwater from the Kaikorai Stream through a leachate collection trench and take of groundwater and leachate from groundwater bores, LFG wells, and a leachate collection trench for the purpose of the operation and closure of a Class 1 landfill (replacement for	National Environmental Standard for Freshwater: Regulation 45B(4) – Take and use of water within 100m setback from a natural wetland for the purpose of constructing or operating a landfill – discretionary activity.	The taking and use of groundwater will occur within 100m of the natural wetlands along the Kaikorai Stream and is likely to change the water level range or hydrological function of the wetlands. It is therefore a discretionary activity requiring resource consent.

Resource Consent	Relevant NES-FW/Regional Plan Rule	Commentary
consent no's 4139-V1 and 3839B-V1).	Regional Plan: Water Rule 12.2.4.1 – Taking and use of groundwater – discretionary activity.	Permitted activity rule 12.2.2.6 cannot be met, specifically: • The take is likely to change the water level range or hydrogeological function of the Kaikorai Lagoon Swamp regionally significant wetland; and • The take of groundwater will exceed 25,000 litres per day. The taking and use of groundwater is not otherwise provided for in the plan and is therefore a discretionary activity under rule 12.2.4.1, requiring resource consent.
Diversion of surface water and stormwater from working and non-working areas of the landfill for the purpose of the operation and closure of a Class 1 landfill (replacement for consent no's 3839C-V1 and 3840A-V1).	National Environmental Standard for Freshwater: Regulation 45B(4) – Diversion of water within 100m setback from a natural wetland for the purpose of constructing or operating a landfill – discretionary activity.	The diversion of surface water stormwater will occur within 100m of the natural wetlands along the Kaikorai Stream and may potentially change the water level range or hydrological function of the wetlands. It is therefore a discretionary activity requiring resource consent.
	Regional Plan: Water Rule 12.3.4.1 – Damming and diversion of water – discretionary activity.	Permitted activity rule 12.3.2.1 cannot be met, specifically: • In the case of the diversion of floodwaters associated with raising the perimeter road berm, the catchment upstream of that diversion is greater than 50 ha in area. • The diversions may potentially change the water level range or hydrogeological function of the Kaikorai Lagoon Swamp regionally significant wetland. The diversion of surface water and stormwater is not otherwise provided for in the plan and is therefore a discretionary activity under rule 12.3.4.1, requiring resource consent.
Diversion of surface water in the Kaikorai Stream and Brighton Road Stream for the purpose of the operation and closure of a Class 1 landfill	National Environmental Standard for Freshwater: Regulation 45B(4) – Diversion of water within 100m setback from a natural wetland for the	The diversion of surface water will occur within 100m of the natural wetlands along the Kaikorai Stream and is likely to change the water level range or hydrological function of the wetlands.

Resource Consent	Relevant NES-FW/Regional Plan Rule	Commentary
(replacement for consent no 4140 and 4185)	purpose of constructing or operating a landfill – discretionary activity.	It is therefore a discretionary activity requiring resource consent.
	Regional Plan: Water Rule 12.3.4.1 – Damming and diversion of water – discretionary activity.	Permitted activity rule 12.3.2.2 relating to diversions for the purpose of land drainage cannot be met, specifically: • While the diversion was lawfully established prior to 2 July 2011, the diversion is likely to change the water level range or hydrogeological function of the Kaikorai Lagoon Swamp regionally significant wetland. The diversion of surface water is not otherwise provided for in the plan and is therefore a discretionary activity under rule 12.3.4.1, requiring resource consent.
Discharge of surface water and stormwater to the Kaikorai Stream for the purpose of the operation and closure of a Class 1 landfill (replacement for consent no 3840C-V1).	National Environmental Standard for Freshwater: Regulation 45B(5) – Discharge of water within 100m setback from a natural wetland for the purpose of constructing or operating a landfill – discretionary activity.	The discharge of stormwater will occur within 100m of the natural wetlands along the Kaikorai Stream and is likely change the water level range or hydrological function of the wetlands. It is therefore a discretionary activity, requiring resource consent.
	Regional Plan: Water: Rule 12.B.3.1 – Discharge of stormwater to water – restricted discretionary activity.	The discharge of stormwater to water or onto land in circumstances where it may enter water is a restricted discretionary activity, requiring resource consent.
	Regional Plan: Water: Rule 12.B.4.1 – Discharge of water (excluding stormwater) or contaminants to water from an industrial or trade premise – discretionary activity.	The discharge of surface water (excluding stormwater) from the landfill (an industrial or trade premise) to water or land is a discretionary activity, requiring resource consent.
Discharge of landfill gas, combustion emissions from landfill gas flares and engines, dust, and odour into air for the purpose of the operation and closure of a Class 1 landfill	Regional Plan: Waste: Rule 7.6.1(3) – New or operating landfills – discretionary activity.	Landfills for the disposal of waste, and associated discharges are discretionary activities, requiring resource consent.

Resource Consent	Relevant NES-FW/Regional Plan Rule	Commentary
replacement for consent no 94524-V1).[33]	Regional Plan: Waste: Rule 6.6.1(3) – Operation of facilities for the treatment or disposal of hazardous wastes – discretionary activity.	Facilities for the disposal of hazardous waste, and associated discharges are discretionary activities, requiring resource consent. Rule 6.6.1(3) is triggered as compliance with Class 1 waste acceptance criteria will allow some "hazardous wastes" to be accepted – e.g. contaminated soils.
	Regional Plan: Waste Rule 7.6.13 – Composting – discretionary activity.	Permitted activity rule 7.6.12 cannot be met for the composting of greenwaste and associated discharges on site, specifically the composting will not be undertaken on the property from which the majority of the material is sourced. It is therefore a discretionary activity, requiring resource consent.
Placement of a defence against water between the landfill and Kaikorai Stream for the purpose of diverting floodwaters for the operation and closure of a Class1 landfill.	National Environmental Standard for Freshwater: Regulation 45B(1), and (2) – Vegetation clearance and earthworks within, or within 10m setback of a natural inland wetland for the purpose of constructing or operating a landfill – discretionary activity.	Vegetation clearance and earthworks for construction of the defence against water will in some locations be closer than 10m from the natural wetlands along the Kaikorai Stream. Accordingly, they are a discretionary activity.
	Regional Plan: Water: Rule 14.3.2.1 – Erection, placement, extension, alteration, replacement, reconstruction, demolition, or removal, of any defence against water, other than on the bed of a river.	Defences against water, other than on the bed of a river, are a discretionary activity, requiring resource consent.
Disturbance of land at a contaminated site for undertaking capping works and landfill infrastructure for the purpose of the operation and closure of a landfill (replacement for consent no RM21.474.01)	Regional Plan: Waste: Rule 5.6.1 Hazardous wastes at contaminated sites – discretionary activity.	The GIL site is listed in the ORC's HAIL list as a contaminated site. Disturbance of land at contaminated sites is a discretionary activity, requiring resource consent.

Based on the above assessment, the various resource consent applications are to be bundled, and considered as a **discretionary activity** under the RMA.

[33] No resource consent currently exists for the emissions from the landfill gas flare and engine, and accordingly consent is sought for this plant.

Pursuant to section 123(d) of the RMA, a consent duration of **35 years** is sought for all resource consents, except for the taking of groundwater, for which a consent duration of **6 years** is sought as per policy 10A.2.3 of the Regional Plan: Water.

A lapse date of **5 years** is proposed for all resource consents, pursuant to section 125(a) of the RMA.

6.3. Permitted Activities

In addition to the consents required described in **section 6.2**, a number of other activities on the GIL site are permitted activities under the NES-FW and Regional Plans. An assessment of these activities against the relevant rules is outlined in **Table 5**.

Table 5 – Green Island Landfill Permitted Activities

Activity	Relevant NES-FW/Regional Plan Rule	Commentary
Earthworks for undertaking landfill capping, and landfill infrastructure.	National Environmental Standard for Freshwater: Regulation 45B(1), and (2) – Vegetation clearance and earthworks within, or within 10m setback of a natural inland wetland for the purpose of constructing or operating a landfill – discretionary activity.	Vegetation clearance and earthworks for landfill capping and landfill infrastructure will be set back greater than 10m from the natural wetlands along the Kaikorai Stream. Accordingly, they are a permitted activity.
	National Environmental Standard for Freshwater: Regulation 45B(3) – Earthworks or land disturbance outside a 10m, but within a 100m setback of a natural inland wetland for the purpose of constructing or operating a landfill – discretionary activity.	Earthworks for undertaking landfill capping, and landfill infrastructure will occur within 100m of the natural wetlands along the Kaikorai Stream but are unlikely to result in the complete or partial drainage of the wetlands. Accordingly, they are a permitted activity.
Drilling of land for the installation of additional groundwater and landfill gas monitoring wells, and landfill gas wells.	Regional Plan: Water Rule 14.2.1.1 – Drilling of land, other than for the purpose of creating a bore.	Drilling of land for the installation of additional groundwater and LFG monitoring wells, LFG wells will not be for the purposes of creating a bore for groundwater extraction, will not occur over a C series aquifer, and any holes will be sealed so contaminants cannot enter. Accordingly, it is a permitted activity.

6.4. Approvals Required from Dunedin City Council's Consenting Authority

The GIL site is designated for use for *'landfilling and associated refuse processing operations and activities'* (reference D658) in the 2GP. The extent of the designation is shown in **Figure 8** in **section 7.1**. The designation, is subject to the following one condition:

- *Noise generated by any activity on the site shall comply with the following standards as the boundary of the site - 55Dt/40Nt dBA. (NB These levels are subject to an adjustment of minus 5dBA for noise emissions having special audible characteristics).*

The designation of the land means that section 9(3) of the RMA, which prevent persons from using land in a manner that contravenes a District Plan rule, does not apply. Development and use of the underlying land for a landfill and refuse processing is therefore enabled, subject to the requirement under section 176A of the RMA to submit an outline plan of works (or obtain a waiver for minor works) for any works to DCC's consenting authority.

Applications for an outline plan of works will be submitted separately to DCC's consenting authority where any new physical works for the continued operation, closure, and aftercare of the landfill are required. Any such applications will be developed to align with the conditions of any replacement resource consents.

In addition, where such works disturb contaminated land, applications for resource consent will also be submitted to DCC's consenting authority under the requirements of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (**NES-CL**).[34]

DCC will obtain all required approvals prior to any new physical work commencing on the site.

[34] The NESCS is a nationally consistent set of planning controls that ensures land affected by contaminants in soil is appropriately identified and assessed before it is developed, and if necessary the land is remediated or the contaminants managed to protect human health.

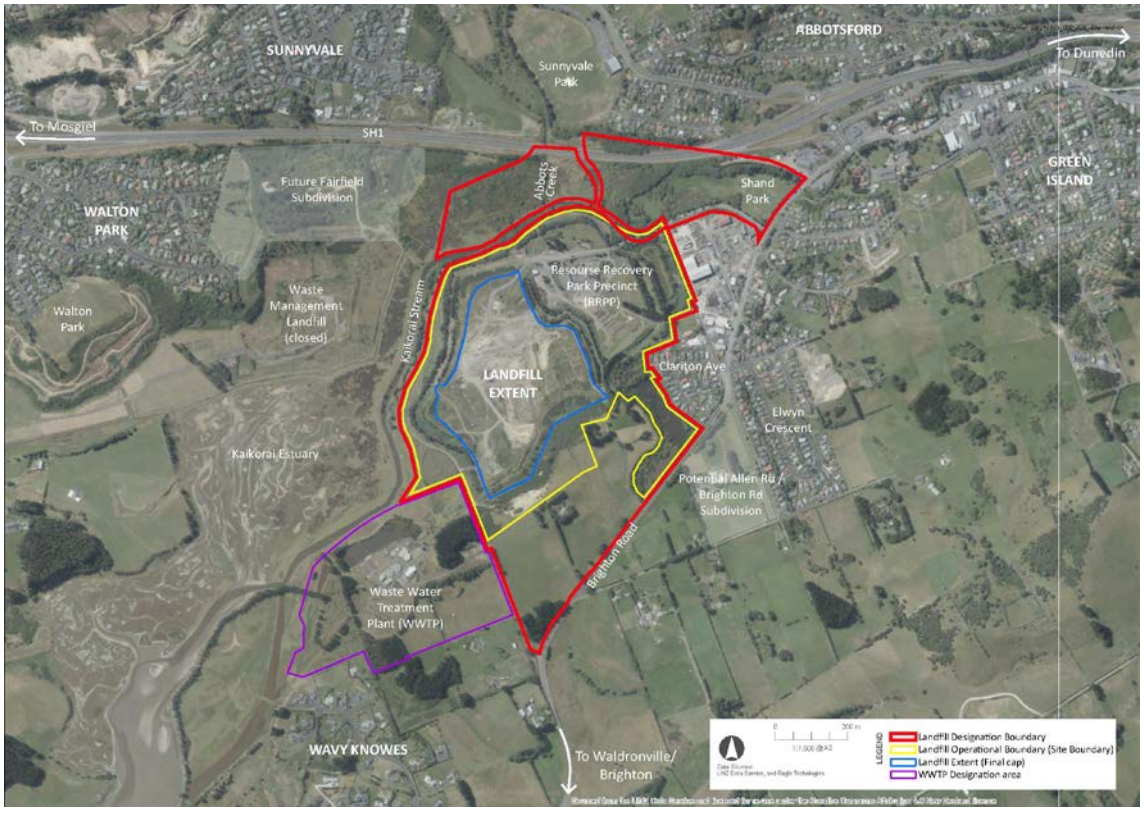
7. Existing Environment

7.1. The Green Island Landfill Site and Surroundings

The GIL site is located approximately 8.8km by road from central Dunedin in the suburb of Green Island. The site comprises a total area of 75.6164 hectares, being the total area of the landholding owned by DCC and designated in the 2GP. **Figure 8** below shows the:

- The **designation boundary**.
- The **landfill operational area**, comprising the area that has been historically used for waste disposal and encompassing the landfill and waste diversion and transfer facilities, being an area of approximately 38 hectares encircled by the existing leachate collection trench and drain.
- The **landfill extent**, comprising the area of the landfill still in operation, and which includes the active landfilling area.
- The **GIWWTP site**, being the location of the landfill gas engine and flare

Figure 8 – Green Island Landfill Site



Primary access to the GIL site is via Brighton Road. The site is generally bound by State Highway 1 to the north, the Kaikorai Stream and Estuary to the west, Brighton Road to the south, and the Clariton Avenue residential area and Brighton Road industrial area to the east. The GIWTTP site is located adjacent to the southwestern boundary of the GIL site.

The Clariton Ave residential area comprises the closest residential properties to the GIL site, being approximately 200m southeast of the existing waste diversion and transfer facilities, and 120m east of the current landfill footprint.[35] Other residential properties are located to the southeast at Elwyn Crescent, and to the north and west within Sunnyvale and Fairfield. Those residential properties are located at greater distances and separated from the landfill site by a combination of the State Highway 1 corridor, the Kaikorai Stream and Estuary, and rural and open space land.

The DCC has recently rezoned a block land between Weir Street and Brighton Road, south of Clariton Avenue, to a General Residential Zone enabling low-medium density residential living.[36] An area of undeveloped land zoned General Residential also exists within Fairfield, accessed from Walton Park Avenue.

The GIWWTP site has semi-rural setting and is bound by the landfill to the northeast, estuary to the north and west, rural lifestyle properties to the south.

7.2. Climate and Meteorology

Climate data for the GIL site has been derived from the Musselburgh climate station operated by NIWA (ref No. 1572) located 7.5 km to the east of GIL and is summarised in **Table 6**. Climate information from the station is indicative of conditions at the landfill site.

The average temperatures range from 13.9ºC in Summer (January) to 5.0ºC in Winter (July), with frequent frost and occasional snow reported. The average yearly precipitation is 806 mm per year. Most precipitation falls in December with an average of 102 mm, whilst July is the driest month on 43 mm.

Table 6 – Climate Data for Dunedin

	Avg. Temp °C	Min. Temp °C	Max. Temp °C	Rainfall (mm)	Humidity	Average Wind Speed (m/s)
January	13.9	10.9	17.7	95	75%	3.2
February	13.8	10.9	17.5	75	67%	3.1
March	12.7	9.8	16.5	62	76%	2.8
April	10.3	7.6	13.8	58	78%	2.9
May	8	5.4	11.3	57	78%	2.6
June	5.7	3.2	8.8	49	81%	2.6
July	5	2.5	8.4	43	79%	2.7
August	6.1	3.2	9.6	48	80%	2.7

[35] The current active landfill area is located at greater distances from Clariton Ave.

[36] Variation 2 to the Proposed Dunedin City District Plan.

September	7.9	4.6	11.8	54	75%	3.1
October	9.3	6	13.3	80	73%	3.3
November	10.8	7.8	14.8	83	72%	3.1
December	12.8	9.9	16.6	102	75%	3.2
Average Annual	9.69	6.82	13.24	67.17	77%	2.94

Wind data collected between February 2022 – January 2023 on the GIL site by an Automatic Weather Station (AWS) have further defined the following wind characteristics at the site:

- The predominant wind direction is from the northeast.
- The average wind speed measured is 2.9 metres per second (m/s).
- Calm conditions (wind speeds less than 0.5 m/s) occur 1.2% of the time.
- High wind speeds (winds greater than 5 m/s) mostly occur from the northeast and southwest.

Given the limited records from the on-site AWS, predicted wind patterns have been modelled for the site, as described in the **Air Quality Report** in **Appendix 7**. This modelling has identified the presence of strong winds from the southwest which are not consistent with the onsite observations. The modelled wind speed is also slightly higher at 3.1m/s (compared with 2.9m/s), and the proportion of calm conditions is slightly higher at 3.3% (compared with 1.2%). Differences in the onsite data and modelling is likely due to the complex terrain around the site, and the modelling is therefore indicative of worst-case on-site conditions.

7.3. Topography and Geology

The GIL has been primarily constructed on the upper parts of the low lying Kaikorai Estuary. The current landfill footprint within which filling has occurred extends up to a maximum height of 25m amsl. Land surrounding the landfill footprint, including the western perimeter access road between the landfill and Kaikorai Stream is low lying, being between 1.5 – 2.0m amsl. Immediately to the south and east of the landfill, the land rises gently to a series of low hills.

The geological setting of the site is described in detail in the Liquefaction and Stability Report in **Appendix 11**, which has been informed by geotechnical investigations described in the Geotechnical Investigation Report in **Appendix 10.** These investigations involved drilling of a series of boreholes, and cone penetration testing (CPTs).

The geology underlying the landfill area comprises sediments of estuarine origin. The estuarine sediments, described as the Kaikorai Estuary Formation (**KEF**), are approximately 11 m thick in the landfill area. The KEF is divided into an upper and lower layer the **UKEM** and **LKEM**), with the upper layer being further divided into two subgroups as shown in **Figure 9** and **Table 7** below.

Figure 9 – Lithological Sequence Mapping

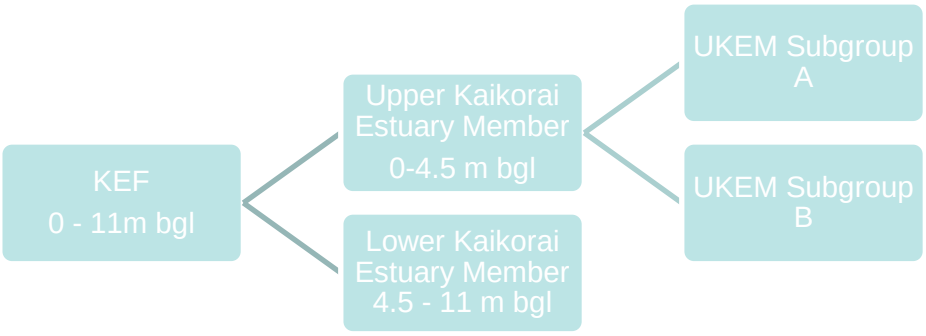


Table 7 – Description of Lithological Units

Member	Description	Subgroup	Thickness
Upper Kaikorai Estuary Member (UKEM)	Variable thin beds of sand, silty sand, sandy silt, silt, clayey silt and silty clay	Subgroup A -mostly homogeneous fine grained	4.5 m
		Subgroup B – heterogeneous, coarser grain size	
Lower Kaikorai Estuary Member (LKEM)	Massive homogeneous beds of clayey silt, silty clay and silt, and minor (possibly localised) beds of clay, very fine sandy silt and silty very fine sand.	-	6.5 m

The estuarine KEF sediments are underlain by Abbottsford mudstone. Investigations at the site have encountered the Abbottsford mudstones beneath the estuarine sediments as a weathered mudstone or siltstone. The elevated land to the south of the site is also comprised of Abbottsford mudstone overlaid by loess soils . These loess materials sourced from the borrow area on the site are used for final capping of the landfill.

The results of the additional site investigations undertaken as part of the Geotechnical Investigation Report are shown in **Table 8** below. No clear geological distinction between the two subgroups of the UKEM were identified. In several of the bore holes there was a coarse-grained layer (sand and/or gravel) at the contact of the LKEM and underlying Abbottsford mudstone. Depending on the location, variable amounts of fill were encountered.

Table 8 – Summary of Geological Profile from GHD Investigations

Geology	Description	Layer thickness
Fill	Variable waste and soil	variable
UKEM	Silty fine to medium sand, sandy silt	1 – 3 m
LKEM	Organic silt, silty clay	6 – 8.5
Coarse sediments	Sands/gravel	0.5 -1.5

Geology	Description	Layer thickness
Abbottsford Mudstone	Grey-brown mudstone, very weak	-

The seismic sources within 200km of the site have been identified in the Probabilistic Seismic Hazard Analysis (PSHA) contained in **Appendix 11**. The Akatore Fault is the closest, most active fault to the site with a preferred reoccurrence interval of 1700 years, with a magnitude estimate of 7.3 Mw. The Green Island Fault lies offshore from the site and strikes northwest from the northern end of the Akatore Fault. The fault has a preferred reoccurrence interval of 22,000 years, with a magnitude estimate of 6.9 Mw. The Kaikorai Fault is the closest fault to the site, however, has a very long estimated reoccurrence interval.

7.4. Groundwater and Leachate

The hydrogeological setting, leachate volumes, and groundwater levels and quality is described in detail in the Design Report in **Appendix 3**, and Groundwater Report in **Appendix 5**.

7.4.1. Hydrogeological Setting

The estuarine sediments of the Kaikorai Estuary Formation (KEF) described in **section 7.3** forms a shallow water bearing strata under the landfill and surrounding area with groundwater levels close to the ground surface. Groundwater investigations undertaken for the 1992 EIA completed by BECA to support the applications for the 1994 resource consents identified that the shallower UKEM deposits exhibited a higher permeability consistent with fine sand and silt (hydraulic conductivity in the order of 4×10^{-6} m/s) than the lower LKEM formation which is more representative of a marine silt deposit (hydraulic conductivity in the order of 6×10^{-7} m/s).

Work undertaken by Barry J Douglass Geotechnical Consultants (**BDGC**) in 2002 characterised the saturated zone of the UKEM unit as exhibiting more varied lithology. There was low to very low permeability associated with the confining beds of silts and clay, and moderate, to at times, high permeability associated with sand deposits. BDGC characterised the LKEM as being present approximately 3.5 – 4.5 m below the original ground surface and comprising clayey silt and silty clay of very low to low permeability. The underlying Abbottsford Formation is an aquitard due to the very low permeability of the mudstone and effectively an impermeable barrier for downward seepage.

Rainfall on the landfill that does not runoff to the landfill stormwater collection system percolates through the landfill material to the base where it accumulates as leachate within the landfill resulting in mounding of leachate levels within the waste of between 16 and 22m amsl. The low permeability of the lower layers of the KEF and the underlying Abbottsford formation along with the sub-artesian/artesian groundwater conditions inhibit downward migration of leachate into the underlying sediments. Mounding of leachate within the landfill and these underlying low permeability layers result in shallow leachate/groundwater flow outwards towards the perimeter of the landfill.

7.4.2. Existing Leachate Volumes, and Quality

Leachate/groundwater from the landfill is intercepted by a leachate collection trench on the eastern, northern, and western perimeter of the landfill as described in **section 4.5**.

Leachate/groundwater levels in the trench are maintained typically at L-0.8m to +0.2m amsl by continuous dewatering. These water levels are lower than the surface water levels, with typical stream and estuary water levels of 2.0 m to 2.5 m amsl. An HDPE liner on the outside face of the trench reduces the volume of groundwater entering the trench from the Kaikorai Stream and Estuary, however, does not completely prevent inflows which contribute to the volume of leachate/groundwater collected. The trench also captures leachate from the surface drain along the southern side of the landfill, gravel drains at the base of the perimeter bund, additional leachate drains in the landfilled waste, and leachate contaminated stormwater and other stormwater runoff from some landfill catchments.

Leachate flow rates are recorded continuously within each of the leachate collection trench pump stations as required by the existing resource consents and reported annually. The total volume of pumped leachate and groundwater over the 2021 – 2022 monitoring year was 50,633 m^3. This is compared with 77,908 m^3 in 2019-2020. This decrease is attributed to there being less rainfall during the 2021 – 2022 monitoring year and an increase in the landfill that has been capped. In the past five years the combined pumping rates from the leachate collection trench have been between 1 – 2 L/s, peaking up to 8 – 9 L/s after periods of rainfall.

Representative samples of leachate are collected from pump station PS3 and analysed for a range of parameters. In the 2021 – 2022 year only one exceedance of the DCC Trade Waste Bylaw 2008 guidelines was reported with the concentration of ammoniacal nitrogen reported at a value of 208 mg/l compared to the Trade Waste Guideline value of 50 mg/l.

7.4.3. Existing Groundwater Levels and Quality

The leachate collection trench and pumping from the trench creates a hydraulic barrier to groundwater and leachate migration to the offsite receiving environment as described in **section 4.5**.

Groundwater levels are monitored monthly in the monitoring well network described in **section 4.5** as required by the existing resource consents and reported annually. The water level monitoring consistently shows that the lowest groundwater levels in monitoring wells occur adjacent to the trench (the C wells in each well line), confirming the presence of the hydraulic barrier, and the effectiveness of the trench in intercepting shallow groundwater flow and leachate. Groundwater levels fluctuate within a range for each well, with no long-term trend in levels evident. Groundwater levels are generally lowest in drier periods (summer-autumn), with highs occurring in winter/spring and after large rainfall events.

Groundwater quality is also monitored monthly as required by the existing resource consents and reported annually. In general, the monitoring wells inside the leachate trench (the A and B wells in each well line) are impacted by leachate. Some wells on the outside of the trench (3C, 4C, 6C, 7C, 8C, and 7D) also show the influence of landfill waste. These wells coincide with areas outside the trench where waste was historically placed. These wells show a more varied water chemistry compared to wells unlikely to be impacted by historical waste materials. These impacts are

managed by the leachate collection trench which pulls groundwater and leachate from both sides of the trench.

Based on historical water quality monitoring data, key groundwater quality trends and patterns for relevant monitoring parameters have been identified. These are summarised in **Table 9** below.

Table 9 – Water Quality Trends in Groundwater

Parameter	Groundwater trends
Electrical Conductivity	• Elevated in all monitoring wells relative to typical background groundwater. • Deep wells – highest in 2D and 4D (also higher chloride in these wells). • Shallow wells – no clear pattern between A/B/C wells.
Dissolved oxygen	• Dissolved oxygen in groundwater is low with many samples <20% oxygen saturation, in contrast most surface samples are > 50%. The *eastern constructed wetland* and *south eastern constructed wetland* exhibit a wide variation in dissolved oxygen content.
Ammoniacal nitrogen	• Generally elevated in groundwater relative to surface water except for the *eastern constructed wetland.* • Deep wells – highest in 2D (range of 14-23 mg/L) and 4D (0.8-10.5 mg/L), compared to 7D (<1.3 mg/L). • C wells – elevated in 5C (14-21 mg/L), 2C (9-13 mg/L) and 4C (5.3-9.8 mg/L), the rest of the C monitoring wells recorded concentrations <5 mg/L.
Chromium	• Most groundwater concentrations < 0.002 mg/L, the exception is MW5C with chromium between 0.0052 – 0.012 mg/L. • Groundwater chromium concentration is generally lower than site surface water (such as *eastern* and *western sedimentation ponds*) but elevated compared to Kaikorai Stream.
Boron	• Boron concentration highest in 1C (~4 mg/L), 5C (~3 mg/L) and 4C (~2 mg/L). • Deep well concentrations is highest in 7D (~1.4 mg/L), 4D and 2D <0.8 mg/l. • Boron elevated in *eastern constructed wetland* (up to 9 mg/L), estuary concentration up to 1.8 mg/L, rest <1 mg/L (note boron analysis not undertaken in GI1, GI2, GI3, GI5).
Arsenic	• Highest groundwater concentrations measured in 2D. Most results < 0.005 mg/L except for 6C and 7D. • Groundwater and site surface water concentrations in similar range.
Iron	• Elevated in groundwater, in particular 4C, 2C, 6C, 5C, and deep monitoring wells. • Highest concentrations recorded in 2D (116 mg/L). • Iron concentration in groundwater an order of magnitude higher than site surface water and two orders of magnitude higher than Abbotts Creek/Kaikorai Stream (GI1-GI5).

Overall, the water chemistry data shows the influence of landfill waste on groundwater quality. In areas where historical waste is known to be present outside of the leachate trench, the groundwater quality shows a mixed major ion signature with elevated contaminants. The major ion chemistry clearly shows mixing of groundwater and landfill leachate in water pumped from the leachate trench.

The depositional environment, and relatively recent (in geological terms) change from estuarine to a freshwater setting influences the groundwater chemistry. Ammoniacal nitrogen and iron are elevated compared to background groundwater in many of the groundwater samples, including monitoring wells unlikely to be influenced by waste. This may reflect the influence of the organic material in the estuarine sediments (KEF) and reducing conditions in the aquifer. Electrical conductivity is elevated in all samples, reflecting the influence of leachate and/or brackish water in the Kaikorai Estuary.

During 2023 additional water sampling from the groundwater monitoring wells and leachate collection system was undertaken for the presence of Persistent Organic Pollutants (POP), specifically PFOS and PFOA (i.e. perfluoroalkyl and polyfluoroalkyl substances[37]). The results showed:

- The concentrations of Total PFOS in the perimeter groundwater wells are at low concentrations and are below the 95% species protection limits of 0.13 ug/L, defined in the PFAS National Environmental Management Plan Version 2.0).
- There was no clear pattern in the concentration and occurrence of PFAS in groundwater and the distribution of waste (particularly in areas where historic waste is present outside the trench). The low level PFAS contamination in areas outside the historic deposition activities or in deep wells may relate to historic activities within the landfill and wider catchment prior to the installation of the leachate collection trench.
- The concentration of Total PFOS and PFOA obtained from PS3, was consistent for all sampling events, with concentrations recorded at least an order of magnitude above the groundwater samples, indicating leachate is not migrating beyond the trench.

7.5. Surface Water

The catchment setting, and surface water quality is described in detail in the Surface Water Report in **Appendix 6**.

7.5.1. Catchment Setting

The landfill is in the low-lying portion of the Kaikorai Catchment. The catchment rises from the coast to a high point of 668 m at Flagstaff hilltop. The Chain Hills form the western and north-western boundary of the catchment, the Kaikorai and Round Hills form the northeast boundary, and Pukemakamaka/Saddle Hill forms the western boundary. The Kaikorai Catchment comprises natural areas of bush, but has been heavily altered by residential, industrial, and agricultural development.

The landfill is located adjacent to the Kaikorai Estuary, which has a total contributing catchment of 49 km^2 above the Brighton Road bridge. The Kaikorai Stream flows from the Chain Hills upstream of the landfill to the northeast, flowing through Green Island, before entering the estuary to the west of GIL. Abbotts Creek enters the Kaikorai Stream to the north of the GIL site.

[37] Synthetic chemicals found in many manufactured products

The mean flow, mean annual low flow, and average number of high flow events per year that exceed three times the median flow (FRE3) from NIWA's only NZ River Map Tool are shown in **Table 10** below for the segments of the Kaikorai Stream directly upstream and downstream of the Abbotts Creek confluence.

Table 10 – Summary of Kaikorai Stream Flow Data

Location	Mean flow (L/s)	Mean annual low flow (L/s)	FRE3 (L/s)
Upstream of Abbotts Creek confluence	227	49	12.8
Downstream of Abbotts Creek confluence	368	81	12.7

The Kaikorai Estuary is shallow (0.5 m – 2 m deep) and water levels are tidally influenced due to its proximity to the ocean. Monitoring in the Kaikorai Stream adjacent to the landfill has indicated the tidal influence has an amplitude of 0.5m between high and low tides, which can be greater when the mouth of the estuary is closed. The mouth of the estuary is managed by ORC to ensure that flooding of the low-lying margins of the estuary and the lower reaches of the Kaikorai Stream and Abbotts Creek is minimised. The current management regime adopted by ORC is to maintain water levels at the Brighton Road bridge below 101.6 mRL.

7.5.2. Existing Surface Water Quality

Surface water in the Kaikorai Stream and Abbotts Creek upstream of the landfill, has been impacted by past and current land uses practices, which include industrial, landfilling, quarrying, and agricultural activities. The development of heavy industrial activities in the early to middle of last century had a significant impact on water and sediment quality in the catchment. In the estuary, the use of the land for waste disposal since the middle of last century has likely resulted in a significant impact on the estuary water quality until the establishment of leachate collection systems at both GIL and the closed Maxwell's/Fairfield landfill in the mid 1990's.

Water quality data for the Kaikorai Stream from a monitoring site approximately 200 m upstream of GI1 is reported by ORC and made available via the LAWA website. Results of this monitoring are shown in **Table 11**. The Kaikorai Stream is characterised as a lowland urban site.

Table 11 – LAWA Kaikorai Stream Monitoring Data

Analyte	Attribute Band	Trend	5-year median concentration
E.coli	E	Very likely degrading	925 n/100ml
Turbidity	-	Likely degrading	3.05 NTU
Total Oxidised Nitrogen	-	Very likely degrading	0.415 mg/L
Ammoniacal-N	C	Very likely degrading	0.011 mg/L

Dissolved Reactive Phosphorus	B	Very likely degrading	0.008 mg/L

Surface water quality is monitored quarterly in the *eastern and western* sediment *ponds* and four sites (ref GI1, GI2, GI2 and GI5) in Abbot's Creek and Kaikorai Stream as required by the existing resource consents as described in **section 4.6**. Stream samples are collected during low tide and not within 72 hours of any measurable rainfall. Stream and sediment pond samples are compared against the ANZG (2018) 80% toxicant default guideline values for freshwater and marine water (commonly used in urban and impact stream catchments) and relevant NPS-FW limits. Samples from the sediment ponds are also compared against historical data sets, and trigger levels established under the current resource consents.

The monitoring of the Kaikorai Stream and Estuary exhibit the influence of an impacted urban to peri-urban catchment, with the upstream sites exhibiting dissolved metal concentrations and nutrient concentrations expected in these types of land use settings. The sites adjacent to and downstream of GIL do not exhibit any significant changes in dissolved metal concentrations that would be a strong indicator of leachate discharge to the environment. The variability in the conductivity readings that are recorded for GI3 and GI5 are reflective of the estuarine environment and the tidal influence that occurs. Nutrient results also indicate a lack of direct and significant water quality impacts from the landfill on water quality.

When compared to Schedule 15 and 16A nutrient limits of the Regional Plan: Water, the results indicate water quality within the catchment is impacted by the surrounding land uses, specifically:

- Ammoniacal-Nitrogen concentrations recorded at the surface monitoring sites have exceeded Schedule 16A PA limits set for 1 April 2026 in the past 12 months at GI2.
- There were no exceedances of the Schedule 16A limit for nitrate – nitrogen at any of the sites in the past 12 months.
- The historical average concentrations of Ammoniacal-Nitrogen are above the Schedule 15 limit (0.1 mg/L) at site GI2 (0.12 mg/L), GI3 (0.21 mg/L) and GI5 (0.19 mg/L).
- The historical average concentrations of Nitrate – Nitrogen at all sites (GI1, GI2, GI3, GI5) does not exceed the limit of 0.444 mg/L.

The monitoring results from the *eastern* and *western sedimentation ponds* exhibit slightly more impacted water quality than the sites outside the landfill boundary, which is not unexpected given the hydraulic nature of the ponds (i.e. to detain water and settle sediments). However historical data set for dissolved metals and nutrients do not indicate persistent and significant levels of contamination of the pond water from landfill activities, with results from 2022 all below the established trigger levels. However, when compared to ANZG (2018) guidelines, some of the analytes exceed the guideline values. This is not unexpected, as the guidelines are not intended to be used for stormwater treatment pond systems.

In January, April, and August 2023, and January 2024 additional water sampling from the surface water monitoring sites and sediment ponds was undertaken for the presence of POP, specifically PFOS and PFOA. The results indicate:

- PFAS concentrations are generally similar to each other in the *eastern and western sedimentation ponds* or least within one order of magnitude. There is no clear increasing or decreasing trends in concentrations apparent at the different monitoring locations.
- PFAS substances are present in the surface water upstream of the landfill at low concentrations.
- The limited data set indicates that concentrations increase slightly at monitoring locations GI3 and/or GI5 but that concentrations have generally decreased to levels similar to those measured at the upstream and estuary monitoring locations.
- All reported analytical PFAS results for the surface water samples from the Kaikorai Stream, Abbots Creek, Estuary and sedimentation ponds, were below the PFAS National Environment Management Plan version 2.0 95% species protection guideline values.

Monitoring at the outlet to the culvert that extends from the *south eastern constructed wetlands* to the *eastern constructed wetland* has detected elevated parameters (namely ammoniacal-Nitrogen, sulphate) indicative of leachate contamination, suggesting leachate is seeping into the culvert. The culvert is closely aligned with the leachate collection trench at this location. CCTV inspection of the culvert indicates the most likely source of leachate seepage is a pipe joint that has deflected due to localised settlement. The sampling and inspection indicate that the volumes of leachate seepage are very small. Given the dilution that occurs in the *eastern constructed wetland* and the Kaikorai Stream any impact on water quality in the Kaikorai Stream is expected to be undiscernible. As of October2024 work is underway to repair this culvert and work is expected to be completed by the end of March 2025 as described in **section 4.6**.

7.6. Flooding and Sea Level Rise

The ORC's Natural Hazard Mapping indicates low lying areas adjacent to the GIL site are at risk of flooding from the Kaikorai Stream. The area at risk of fluvial flooding is shown in **Figure 10** below, which is on the mapped extent of the 19 March 1994 flood of 103.3 mRL.[38] The hazard risk is reflected in the 2GP which identifies low lying areas around the stream and estuary at moderate risk of flooding.

The hatched area showing the location of the existing landfill footprint established since 1994 extends up to 25m above this level and would no longer be subject to flooding. The hazard map indicates that low lying areas around the perimeter of the landfill are prone to flooding due to high flows in the Kaikorai Stream. Most of these areas are outside the main footprint of the landfill but infrastructure including the site access road, leachate collection trench, and the *western sedimentation pond* are within it.

The ORC's Natural Hazard Mapping also indicates those areas of the Kaikorai Stream and Estuary that are at risk of storm surge based on the Otago Regional Council Storm Surge Modelling Strategy, NIWA, June 2008. The area at risk from storm surge is shown in **Figure 11** below. This area indicative of those areas expected to be impacted by long-term sea level rise of up to 0.5 metres, noting current International Climate Change Committee (IPCC) upper range scenarios indicate a sea level rise of approximately 0.25m occurring by 2050. As is the case for the area at risk of fluvial flooding, most of these areas are outside the main footprint of the landfill,

[38] DCC Design Datum where 100m equals 0m above mean sea level.

but small sections of the leachate collection trench and the *western sedimentation pond* are within it.

Figure 10 – ORC Fluvial Flood Risk Area

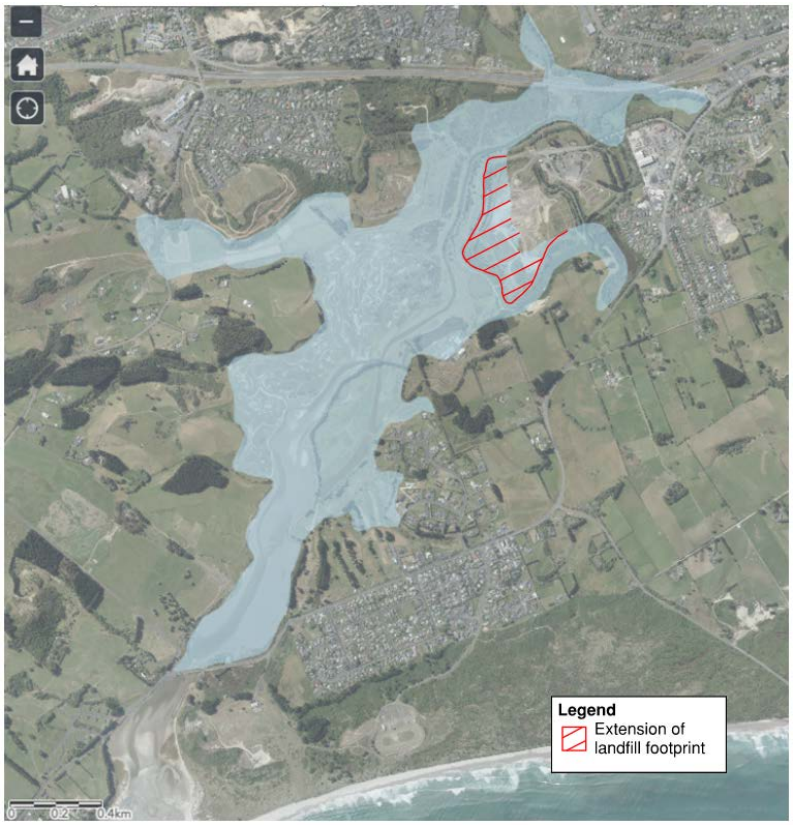


Figure 11 – ORC Storm Surge Risk Area

7.7. Air Quality

The existing air quality surrounding the GIL site is described in the Air Quality Report in **Appendix 7**. Air quality in the area is affected by a range of air pollutants, including:

- Particulate matter, expressed as particles with an aerodynamic diameter less than 10 (PM_{10}) and 2.5 ($PM_{2.5}$) micrometres in size.
- Oxides of nitrogen (NO_x), particularly nitrogen dioxide (NO_2).
- Sulphur dioxide (SO_2).
- Carbon monoxide (CO).
- Nuisance dust and odour.

The primary sources of air pollutants in the area include:

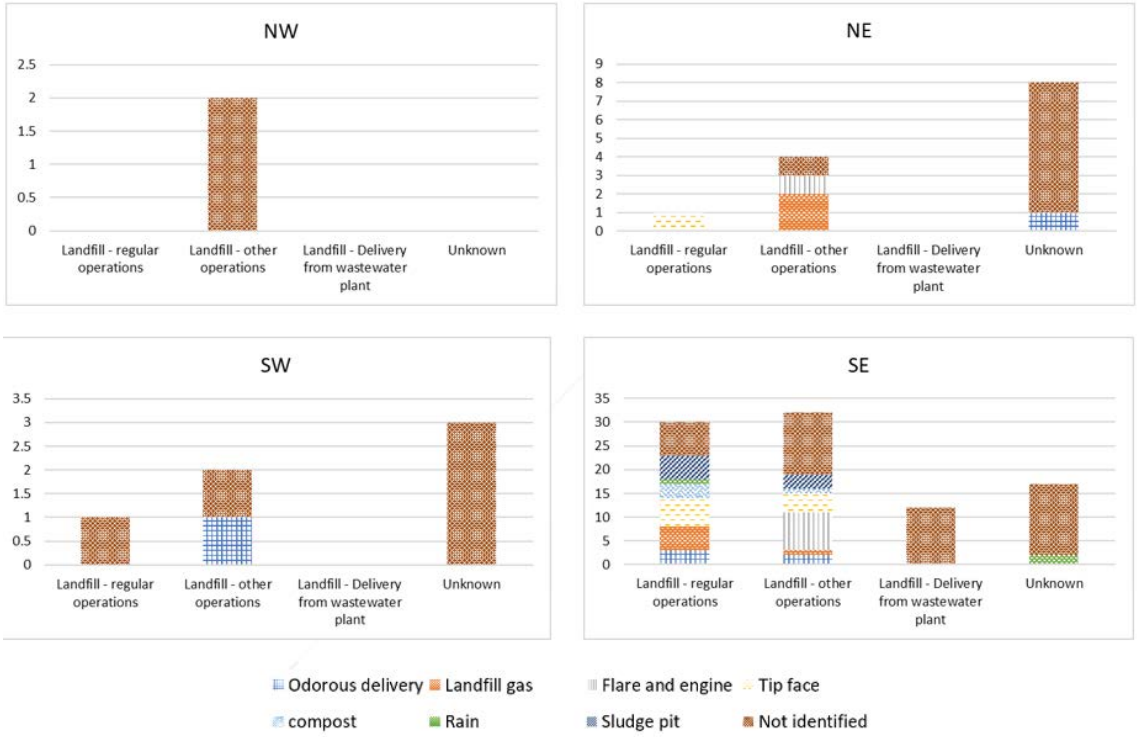
- Odour emissions from the landfill, GIWWTP, and natural sources such as the Kaikorai Stream and Estuary.
- Dust emissions from Blackhead Quarries (2.6km south) and the Fulton Hogan sand quarry (north 1.6km).
- Motor vehicle emissions from local roads and State Highway 1.
- Agricultural emissions, including burning of vegetation, aerial spraying, and ground-based application of fertiliser.
- Possible gas and dust emissions from the adjacent industrial area.
- Possible LFG emissions from the closed Maxwell's landfill on the western side of the Kaikorai Estuary.

7.7.1. Odour

A total of 145 odour complaints were received from July 2017 to August 2022 relating to the GIL site. The number of complaints per year varied from 2 complaints in 2017 to 49 complaints in 2019. In general, most complaints were attributed to regular or other operations, while a maximum of 6 complaints per year (in 2019) were attributed to odorous deliveries from wastewater treatment plants. 41 of the complaints did not have an identified source. For many of the complaints, a possible source was identified by DCC including turning of the compost, activities at the tip face, the sludge pit, particularly odorous deliveries, LFG, or shut down of the flare and engine.

Figure 12 shows the total number of complaints based on the understood source of the odour emission. These are further divided into the direction from the site from which the complaint originated. Most of the complaints (91 of 112 complaints) originated from southeast of the site. 54 of these originated from Clariton Avenue, the nearest residential street to the site. Other complaints from this direction came from Brighton Road (16 complaints), Allen Road (17 complaints), and other streets (4 complaints) within the Green Island suburb.

Figure 12 – Odour Complaint Categories and Sources



Community odour surveys are regularly undertaken around the GIWWTP by an independent party engaged by DCC to assess the impact of odour discharges. The most recent survey in November 2022 received a total of 145 responses. The GIWWTP was not regarded as a significant or noteworthy source of odour. 49%±12% of respondents from the Clariton survey area were 'at least annoyed' by industrial odours, with 43%±11% of the respondents attributing the source to the landfill. The predominant odour description used by respondents in this survey was 'rubbish/rotten/putrid' which is consistent with landfill odours.

7.7.2. Other Air Pollutants

The site is in Air Zone 2 under the Regional Plan: Air, which identifies the site is likely to breach National Environment Standards for Air Quality (NES-AQ) standards for PM_{10}. The main source of PM_{10} in central Dunedin is smoke from solid fuel burners used to heat homes during winter. For the past 5 consecutive years, Dunedin has met the National Environmental Standards for Air Quality (NES-AQ). The city has relatively good air quality year-round, although emissions can accumulate in some of the valley areas. Mosgiel to the southwest of Green Island however can experience poor winter air quality when smoke from domestic and industrial emissions concentrates near the ground surface.

Background concentrations of PM_{10} and $PM_{2.5}$ at the GIL site have been identified from the in the 2022 Waka Kotahi Background Air Quality default values for the Green Island census area. Background concentrations of SO2, CO and NO2 were sourced from the default values in the MfE Good Practice Guide for Assessing Discharge to Air from Industry 2016, as there is no local monitoring of these pollutants. The concentrations are summarised in **Table 12** below.

Table 12 – Background Air Quality Concentrations

Pollutant	Parameter	Assessment criteria (µg/m3)	Concentration (µg/m3)	Source
PM10	Average 24 hour maximum	50	31.5	Waka Kotahi Background Air Quality
	Annual average	20	12.0	
PM2.5	Average 24 hour maximum	25	15.1	
	Annual average	10	6.5	
SO2	1 hour average	350	20	Good Practice Guide for Assessing Discharges to Air from Industry (Table 8)
	24 hour average	120	8	
	Average annual	10	No data (assumed to be < 4)	
CO	1 hour average	30,000	5,000	
	8 hour average	10,000	3,000	
NO2	1 hour average	200	65	
	24 hour average	100	43	
	Annual average	40 (30 ecological)	16	

7.8. Terrestrial and Freshwater Ecology

The existing ecological values of the site and surrounding area, and natural character of rivers and natural wetlands is described in the Ecological Impact Assessment (**EcIA**) Report contained in **Appendix 12**. The report has assessed the ecological values in accordance the Environment Institute of Australia and New Zealand (**EIANZ**) Ecological Impact Assessment (**EcIA**) Guidelines.[39]

7.8.1. Terrestrial Vegetation and Habitats for Fauna

The existing working landfill extent is highly modified and unlikely to support ecologically important indigenous vegetation or habitats for indigenous fauna (except for black-backed gulls and red-billed gulls). Where vegetation occurs on recently worked areas of the landfill, it comprises exotic grassland and weedy exotic herbs and shrubs (e.g., gorse, scotch broom).

Immediately surrounding the landfill footprint to the southeast, areas of indigenous vegetation (e.g., toetoe, pūrei, kōhūhū, and other readily growing indigenous species) have been planted on previously filled and capped areas of the landfill. These planted areas, along with the shelterbelts planted around the landfill site and rank exotic grass and gorse scrub, provide habitat for native and exotic bird species and may also provide poor-quality habitat for indigenous lizards.

[39] Environment Institute of Australia and New Zealand, Ecological Impact Assessment Guidelines, 2018

The areas of planted indigenous vegetation encompasses common readily growing species which are 'not threatened', are not representative of intact forest types in the ED, are small, and have limited species diversity and habitat patten. Terrestrial vegetation is therefore considered to have **negligible** ecological value. None of these areas of vegetation or habitats are identified as comprising significant indigenous vegetation or habitats under the 2GP for the purposes of section 6(c) of the RMA.

7.8.2. Avifauna

Thirty-two species use or may potentially use, the GIL site and immediate surrounds. Fourteen of these species were recorded during surveys conducted at GIL and the Kaikorai Estuary. Of the 32 species:

- Three are classified as nationally Threatened (black-fronted tern, Otago shag and Caspian tern);
- Twelve as At Risk (white-fronted tern, black-billed gull, New Zealand pied oystercatcher, red-billed gull, New Zealand pipit, eastern bar-tailed godwit, banded dotterel, little shag, variable oystercatcher, pied shag, black shag, and royal spoonbill); and
- Seventeen as Not Threatened.

All three Threatened species and the majority of the 12 At-Risk species listed, do not use the GIL site itself, but instead use Kaikorai Estuary downstream, primarily as part of their foraging habitat network in the wider area. The estuary hosts large numbers of birds and is an important feeding and breeding ground for a wide range of coastal, oceanic and wetland bird species, including gulls, terns, swans, ducks, shags, stilts, and oystercatchers.

Excluding the Kaikorai Estuary, At-Risk species recorded at the site itself and surrounds include New Zealand pipit (grassland / shrub areas), royal spoonbill (ponds), shags (waterways) and red-billed gulls (roosting on infrastructure).

The most abundant species recorded on the GIL site are southern backed gulls (**SSGB**) (Not Threatened), followed by red billed gulls, and starlings. Up to 9300 SSGB have been observed using the landfill site itself, primarily as foraging habitat. Up to 450 red billed gulls have been observed on the site. The SSGB commute to and from the landfill site daily from colonies or roosting grounds, and it appears that the active landfill is a main food source for these birds. SSGB have also nested on the site, and they regularly fly between Kaikorai Estuary and the landfill during the day. SSGB are native to New Zealand but are not protected under the Wildlife Act.

The ecological value of these avifauna species is summarised in **Table 13** below:

Table 13 – Ecological Value of Avifauna Species

Species	Threat Status	Ecological Value
Otago shag, black-fronted tern, Caspian tern	Threatened – Nationally Endangered, Vulnerable or Increasing	**Very High**

White-fronted tern, black-billed gull, NZ pied oystercatcher, red-billed gull, NZ pipit, eastern bar-tailed godwit, banded dotterel	At Risk – Declining	**High**
Little shag, variable oystercatcher, pied shag, royal spoonbill, black shag	At Risk – Recovering, Naturally Uncommon or Relict	**Moderate**
Welcome swallow, silvereye, black-backed gull, white-faced heron, South Island fantail, spur-winged plover, kingfisher, pied stilt, paradise shelduck, morepork, grey teal, pukeko, grey warbler, black swan, bellbird, tui, Australian shoveler	Not Threatened	**Low**

7.8.3. Aquatic Habitats and Fauna

As described in **section 7.9**, GIL is located adjacent to the Kaikorai Stream which flows into the Kaikorai Estuary to the west of GIL. Abbotts Creek enters the Kaikorai Stream to the north of the GIL site.

The margins of the Kaikorai Stream and Estuary bordering the landfill to the north and west are identified as a Regionally Significant Wetland in the Regional Plan: Water[40] (known as the Kaikorai Lagoon Swamp), and an Area of Significant Biodiversity Value in the 2GP. They include areas of natural wetlands for the purposes of the NES-FW and comprise areas of significant indigenous vegetation and significant habitats of indigenous fauna for the purposes of s6(c) of the RMA. The landfill operational boundary and landfill extent does not overlap with these areas.

The indigenous vegetation present in the Kaikorai Stream and Estuary comprises largely saltmarsh ribbonwood, pūrei and oioi rush, with much of the former indigenous vegetation having been replaced by weedy exotic species, particularly cocksfoot, gorse and crack willow. Freshwater-influenced swamp areas border the brackish mudflats in some places. Swamps are historically reduced in the wider area, and less than 15% of original swamps remain in the Otago Region making the presence of the swamp more important.

Historic fish records (1989) from Kaikorai Stream indicate the presence of īnanga and longfin eel (both At Risk - Declining species), black flounder, common bully, and redfin bully (Not Threatened species). More recent records (2007) indicate upland bully and shortfin eel (both Not Threatened). Kēkēwai / freshwater crayfish (At Risk – Declining), and kanakana / lamprey (Threatened - Nationally Vulnerable). The introduced species brown trout is also present in Kaikorai Stream. Information about fish communities in the Kaikorai Estuary is limited, however fish diversity is considered low with the main fish species present being common bully, estuarine triplefin, smelt, flounder, eels, whitebait (possibly īnanga) and trout.

Fish surveys have been undertaken 100m upstream and downstream of the surface water monitoring sites at GI1, GI2, and GI3 as part of the preparation of the EcIA report. A total of six species of fish were caught with all three sites comprising similar species, including black flounder, common bully, inanga, longfin eel, shortfin eels, and upland bully. The black flounder was recorded at GI3 only and upland bully were recorded at the hard-bottomed GI1 site only. No eels were caught at the GI2 site. The most abundant species caught were common bully at all

[40] https://www.orc.govt.nz/managing-our-environment/water/wetlands-and-estuaries/dunedin-district/kaikorai-lagoon-swamp.

sites and the size range of this species was similar between sites. No kōura or kākahi were observed at any sites.

Long term monitoring of by the ORC in the Kaikorai Stream just upstream of site GI1, and within the estuary indicates macroinvertebrate health is fair to poor reflective of the degraded water quality in the wider catchment.

Macroinvertebrate surveys undertaken as part of the preparation of the EcIA report identified the most abundant taxa groups comprised mostly tolerant taxa. GI1 was dominated by oligochaetes (worms) and true fly lavae (diptera). GI2 was dominated by oligochaetes (worms) and crustacea (Cladocera water fleas). GI3 and GI5 were dominated by crustacea (mysid shrimp). The percentage of the pollution-sensitive freshwater insects mayflies, stoneflies, and caddisflies was low at GI1 (3%) and GI2 (1%) comprising the caddisflies triplectides and oxyethira only. No pollution sensitive taxa were found at GI3 and GI 5 likely due to the saline influence and silt / sand substrates. No kākahi (freshwater mussels) or kēkēwai (freshwater crayfish) were found. The macroinvertebrate community index (MCI) scores indicate that all sites have probable mild-severe enrichment, having “fair” or “poor” water quality, while the qualitative variant (QMCI) scores showed GI3 and GI5 as having “good” water quality.

The aquatic environment of the Kaikorai Stream is considered to have **moderate** ecological value, and the Kaikorai Estuary is considered to have **high** ecological value The ecological value of key fish species is considered to range from **high** (longfin eel, inanga) to **low** (common bully, upland bully, shortfin eel, black flounder).

7.8.4. Summary of Ecological Values

The ecological values assigned by the EcIA Report to vegetation, habitats, and communities, and indigenous fauna within or surrounding the site are summarised as follows:

- Terrestrial vegetation has **Low** ecological value
- The ecological value for avifauna ranges between **Low – Very High**
- The constructed waterbodies have **Low** ecological value
- Kaikorai Stream has **Moderate** ecological value
- Kaikorai Estuary has **High** ecological value
- The ecological value for aquatic fauna ranged between **Low – High**

7.9. Landscape and Natural Character

The existing landscape character of the site and surrounding area, and natural character of rivers and natural wetlands is described in the Landscape, Natural Character, and Visual Effects Report contained in **Appendix 13**.

7.9.1. Landscape Values and Visibility

The Dunedin Landscape Management Area Review[41] has identified the landscape character areas (LCAs) which make up Dunedin. Within this study, the site is identified within the South Coast LCA. The defining characteristics of this landscape include:

- *Shallow spur and gully seaward slopes with numerous small stream and extensively farmed.*
- *Kaikorai Lagoon is a key estuarine feature and important for Mana whenua.*
- *The orientation of the working rural landscape of the upper slopes has a strong seaward focus and resulting coastal character.*
- *Views inland are often focused on the Saddle Hill landform, which remains prominent in its elevation above Brighton.*
- *Extensive farming on coastal slopes.*

The GIL site comprises a working landfill within the low-lying part of a wider basin-like landscape on the margins of the Kaikorai Estuary. The area surrounding the landfill has a settled, suburban, rural, and coastal character. The suburbs of Green Island, Abbottsford and Fairfield surround the site to the northwest, north and east and comprise a combination of residential, commercial, and industrial development as well as recreational open space. To the south, the landscape has a varied character but is predominantly rural, characterised by open space, stands of large trees, shelterbelts, narrow, gravel roads and farm buildings. There are also larger lot residential properties and the denser, small coastal settlement of Waldronville.

The site and surrounding area are not identified in the 2GP as being in the coastal environment or part of any Outstanding Natural Feature or Landscape (**ONF/ONL**), or a Significant Natural Landscape (**SNL**) highly valued for their contribution to the amenity values or the quality of the environment. The cone of Pukemakamaka/Saddle Hill 3.5km to the west of the site is identified as an ONF, and its upper slopes identified as an SNL in the 2GP. Abbotts Creek, Kaikorai Stream, and the Kaikorai Estuary are considered other key landscape features nearby. All these landscapes are recognised as holding important values including to Te Rūnanga o Ōtākou.

The site is visually well contained from close views, largely screened by the perimeter bunds, and established trees. The hilly character of the surrounding landscape means visibility is obscured by intervening landform from some locations, but elevated views are available from others. Abbotts Creek and Kaikorai Estuary, the motorway and the GIWTTP provide some spatial separation between the site and residential neighbours to the south, west and north. Key viewing audiences include residential and light industrial properties to the east, Island Park Golf Club, and large lot residential properties to the southwest, land recently rezoned General Residential to the southeast, and residential suburbs and recreation spaces on elevated terraces to the west through to the northeast.

[41] Boffa Miskell (2007) Dunedin Landscape Management Area Review: Landscape Assessment.

7.9.2. Natural Character Values

Coastal Environment of Otago Natural Character and Outstanding Natural Features and Landscapes Assessment 2015 rated the natural character of the Kaikorai Estuary as being Medium – Low and recognised "w*hile providing important habitat for wildlife this unit has been significantly modified by human habitation and lacks perceptual naturalness of wild and scenic value."* [42]

The site was once part of the intertidal saltmarsh area of the Kaikorai Estuary but has been progressively drained, filled, and capped since being occupied by the current landfill. The estuary is long, narrow, and shallow, and its margins modified by roads, causeways, drainage channels and buildings as well as reclamation. Vegetation patterns in and around the estuary are extensively modified. Much of the former indigenous vegetation has been replaced by weedy exotic species. The estuary hosts large numbers of birds and is an important feeding and breeding ground for a high diversity of coastal, oceanic and wetland bird species.

7.10. Social Environment

The existing social environment in the area surrounding the GIL site are described in the Social Impact Assessment (**SIA**) in **Appendix 15**. The report describes the demographics, social infrastructure, and community values of the local communities most impacted by the continued operation and closure of the landfill to understand how positive and negative impacts may be perceived or experienced. These includes the communities of Waldronville, Green Island, Abbotsford, and Fairfield, described below:

- **Green Island** is the closest residential suburb to the landfill, located to the east of Brighton Road. Green Island was established prior to 1863, and its predominant economic activity is a mixture of light and heavy industry. Green Island is well-serviced, with medical centres, a supermarket, small-scale retail, and food outlets. It also contains a church, community centre, parks, early childhood education facilities, and two primary schools.
- **Waldronville** is located 1.5 km south of the landfill. Established in the 1950s as a commuter suburb, Waldronville is predominantly residential with a range of recreational facilities including golf club, pistol club, speedway, reserves, and Blackhead Beach. A quarry operated by Blackhead Quarries is located to the east of Blackhead Beach. Residents access local services and facilities located within the suburb of Green Island.
- **Abbotsford** is located to the north of the landfill across from State Highway 1. Abbotsford was established prior to 1953, when the Abbotsford School (primary) was established. The suburb is primarily residential, and contains a church, a kindergarten, and recreational facilities. Abbotsford residents utilise the services and facilities in the adjoining suburb of Green Island. Other social infrastructure in Abbotsford is accessed by the population in Green Island.

[42] Coastal Environment of Otago Natural Character and Outstanding Natural Features and Landscapes Assessment, Dunedin City Section Report, 2015, Mike Moore et al.

- **Fairfield** is located to the northwest of the landfill. A sand quarry operated by Fulton Hogan is located to the northeast, and industrial activities are located along Main Road and Bremner Street. The predominantly residential suburb includes a primary school, Kaupapa Māori immersion school, reserves, and recreation facilities, two churches and small stores.

The demographic profile of these suburbs, Dunedin and Otago Region are summarised in **Table 14**, based on data obtained from the Statistics New Zealand 2018 census.

Table 14 – Demographic Profile

Area of Social Influence		**Area (km2)**	**Population**
Local (SA2)	Waldronville	9.54	1,299
	Green Island	3.64	2,319
	Abbotsford	2.36	2,817
	Fairfield	3.96	2,511
District (Dunedin City)		3,286.27	126,255
Regional (Otago)		31,186.33	225,186

Key demographic indicators for these suburbs indicate:

- The median age ranges from 38 in Waldronville to 44.3 years in Fairfield, compared with 36.8 in Dunedin overall.
- The most common ethnicity is NZ European, which makes up a minimum of 91% of the population, compared with 87% in Dunedin overall.
- Unemployment ranges from 2% in Fairfield to 4% in Green Island. Employment in 'professional' occupations is most prevalent in Waldronville (23%), and Fairfield (22%), and technician and trade occupations are the most prevalent in Green Island (16%) and Abbotsford (18%).
- Median incomes range from $32,300 in Green Island to $40,300 in Waldronville, compared with $25,500 in Dunedin.
- Dwelling ownership is relatively high (e.g. Fairfield at 67.8%), compared to Dunedin City (54.0%).
- The proportion of population that has remained within the suburbs ranges from 80.9% in the same house for a year in Abbotsford to 74.3% in Green Island. 52.7% of the population in Fairfield has remained in the same house for five years, while 45.3% in Waldronville have remained in their house for five years.

Green Island is the primary local centre providing a supermarket, two primary schools a community centre as well as small scale retail and food outlets. Residents in the suburb of Waldronville travel along Brighton Road, near the GIL site to access services and facilities in Green Island. Social infrastructure close to the GIL site includes two primary schools, two early childcare centres, two medical facilities, a supermarket, community garden, and a civic hall. Other social infrastructure includes Shand Park and the Elwyn Crescent Playground.

The Greater Green Island Community Network (**GGICN**) undertook a community survey in 2016 to understand community values in each of the local suburbs. 89% of residents in Green Island considered it a good place to live, compared with 96% in Waldronville, 98% in Abbottsford, and 99% in Fairfield. The most significant problem identified, was vehicles dominating public spaces and streets, except in Waldronville where the difficulty for pedestrians/cyclists getting around was the most significant problem raised.

The DCC Quality of Life Survey 2020, identified that 90% of residents in the Green Island Area rated their overall quality of life positively. 86% of respondents thought Dunedin is a great place to live, but 29% believed that the city was worse compared to 12 months prior to the survey. Community spirit and amenities were believed to have improved, but dissatisfaction with government systems, parking and housing were reasons why Dunedin had worsened. Of the Green Island respondents, 81% believed that traffic congestion was a problem, 57% believed water pollution was a problem, 24% believed noise pollution was an issue, and 25% believed air pollution was a problem.

Air pollution concerns are also highlighted in odour complaints relating to the landfill as described in **section 7.7.1**. Other landfill related issues that have been raised in local news reports include traffic queues in January 2022 after the landfill weighbridge was not functioning, and smoke arising from a landfill fire in 2016, requiring residents to stay inside.

The outcomes of consultation undertaken to date are described in **section 11**.

7.11. Cultural Values

Kāi Tahu whānui, comprise people of Kāi Tahu, Kāti Māmoe and Waitaha descent, who hold mana whenua over an area that includes the entire Otago region. The takiwā or tribal area of Kāi Tahu whānui includes all the lands, islands, and coasts of Te Waipounamu south of Te Parinui o Whiti on the east coast and Te Rae o Kahurangi Point on the west coast as described in the Te Rūnanga o Ngāi Tahu Act 1996.

Kā Papatipu Rūnaka are recognised in the Te Rūnanga o Ngāi Tahu Act 1996 and are principally responsible for managing the collective interests of their members in the areas of cultural, spiritual, economic, moral and social spheres. Membership of Kā Papatipu Rūnaka is based on whakapapa connection to whānau and hapu who hold mana whenua status to an area and resource. Te Rūnanga o Ōtākou have mana over the GIL site and surrounding area. The takiwā (area) of Te Rūnanga o Ōtākou centres on Ōtākou and extends from Purehurehu to Te Matau and inland, sharing an interest in the lakes and mountains to the western coast with Rūnaka to the North and South.

The cultural values which underpin the Kāi Tahu worldview, associations with the area, and how they may be affected by the use and development of resources can only be properly determined through a process of ongoing engagement with mana whenua. Recognising this DCC commenced engagement with Aukaha and Rūnaka on the Waste Futures programme of work, in mid-2019, resulting in a series of briefing meetings, hui, and site visits.

DCC engaged Aukaha on behalf of Te Rūnanga o Ōtākou to prepare a Cultural Impact Assessment (CIA) for the continued operation and closure of GIL to form the basis for ongoing engagement between DCC and mana whenua. The CIA is contained in **Appendix 16**, and describes the cultural values identified by mana whenua relevant to the proposal. It also assesses the proposal against those values and recommends actions and expectations to protect them.

The following values underpin the mana whenua worldview as described in the CIA:

- **Kāi Tahu** are bound to the land, water and all life supported by them by Whakapapa. Wai is a central element in creation traditions and is present very early in the whakapapa of the world. The whakapapa continues down to Rakinui and his wives, Pokoharua-i-te-Pō and Papatūānuku. The children of Rakinui and his wives created the elements of te taiao, including mountains, rivers, forests, and seas, and all living things. Everything in existence is acknowledged and connected through whakapapa. Whakapapa establishes the ancestral rights which give mana whenua the mana and kaitiaki responsibilities over their takiwā.
- **Mauri** is a life-giving force that flows from the living world and down through whakapapa, connecting and binding together all aspects of the world. Mauri is an observable measure of environmental health and well-being. Waterbodies and estuaries with an intact and strong mauri sustain healthy ecosystems and support mahika kai and other cultural values. The primary resource management principle for Kāi Tahu is the protection of mauri.
- **Rakatirataka** refers the exercise of mana to give effect to Kāi Tahu culture and traditions. Rakatirataka is underpinned by obligations placed on mana whenua as kaitiaki. Kaitiakitaka is an expression of rakatirataka. The whakapapa connection with te taiao imposes a kaitiakitaka obligation on mana whenua to protect wai and all the life it supports, in accordance with customs, knowledge, and mātauraka developed over many generations. The focus of kaitiakitaka is to ensure environmental sustainability for future generations, as expressed in the whakataukī mō tātou, ā, mō kā uri a muri ake nei.
- **Tapu** provides an element of safety and direction where there are restrictions. The Māori world is guided by tapu and noa (the opposite of tapu which is ordinary or normal). Mana Whenua should guide discussions and lead the appropriate procedures/protocols regarding wāhi tapu sites, archaeological findings, treatment of taoka and knowledge relating to taoka.
- **Mātauraka** is the body of Māori knowledge and understanding which encompasses (among other things) the Māori world view and perspectives, traditional knowledge, and practices.
- **Tikaka** references behaviour and design outcomes that are culturally appropriate. Mana Whenua engagement allows mana whenua to guide culturally appropriate actions at the correct times.
- **Utu** is an intent to redress historical and current imbalances in ecological and built forms through design.

- **Maumaharataka** emphasises the importance of upholding memories of the past and communicating Kāi Tahu pūrākau (stories) of place, including place names, cultural heritage and narratives. This strengthens intergenerational knowledge, community and place-based identity.
- **Tapatapa** is a manifestation of mana through the naming of landscapes by tūpuna. The placenames. Placenames are important as they are from the earliest migrations and people.
- **Ōraka** represents the act of resting or an area of rest.
- **Taoka** – Indigenous species valued as taoka by Kāi Tahu, as are the habitats through which taoka species survive and thrive. The ecosystems provided by wai māori, in lakes, rivers, wetlands, estuaries, and at the coast, offer lifegiving habitats for indigenous species.

The Kaikārae Estuary is part of an integrated cultural landscape (wāhi tupuna) for mana whenua. Te Rūnanga o Ōtākou's associations with the area are summarised in **Table 15** below:

Table 15 - Mana Whenua Associations with the Kaikārae Estuary

Ikoa Māori	Location/Ikoa Pākehā	Description
Pakaru	Kaikorai Lagoon	Pakaru is the traditional Māori name for the Kaikorai Lagoon, near the mouth of Kaikārae (the Kaikorai Stream). Along with Kaikārae, Pakaru was an important kāinga mahinga kai (food-gathering place) for local Kāi Tahu.
Kaikārae	Kaikorai Lagoon and Stream	Kaikārae is associated with the Waitaha explorer Rākaihautū. Upon arriving at Whakatū (Nelson) in the Uruao waka, Rākaihautū divided his people into two groups. His son, Rakihouia, took one party to explore the coastline, and Rākaihautū led the other party through the interior of Te Waipounamu and down to Murihiku (Southland). While travelling back up the island, Rākaihautū and his party stopped at the mouth of a stream to eat, and their food was a seabird known as karae. This particular location and stream was named Kaikārae.
Pukemakamaka	Saddle Hill	Matamata was the kaitiaki (guardian) of Kāti Māmoe chief Te Rakitauneke and is attributed to carving out the Ōtākou harbour and the Taiari river in search of his lost master when they became separated. The taniwha finally resting where Saddle Hill is now, becoming the peaks Turi Makamaka (Jaffray Hill) and Puke Makamaka (Saddle Hill).

Traditional travel routes through the interior and along the coast connected Kāi Tahu to places of importance for gathering and harvesting mahika kai and connected sites of permanent and seasonal occupation. Old tracks followed "along the western hill-tops, the line of Kaikorai Valley, and the seacoast". Other Kāi Tahu trails proceeded from Kaikārae over Whakaari or Whānau-paki (Flagstaff), to Waikōuaiti.

Mahika kai practices underpin the Kāi Tahu relationship with Otago's rivers, lakes, wetlands, and estuaries. The coastal estuaries, lakes and wetlands of the Otago region once supported rich and healthy mahika kai resources, including a range of shellfish, sea fishing, eeling and harvest of other freshwater fish in lagoons, wetlands and rivers, waterfowl, sea bird egg gathering, forest birds, and a variety of plant resources including harakeke, fern and tī kōuka root.

For mahika kai to be sustained, populations of species must be present across all life stages and must be plentiful enough for long term sustainable harvest. Safe access to mahika kai sites must be available, kai must be safe to gather, safe to harvest and safe to eat and management and harvesting practices must be able to be carried out in accordance with tikaka.

The transmission of mātauraka necessitates whānau being able to access healthy mahika kai to carry out customary practices. The restoration of the mauri of Kaikārae estuary to provide healthy habitat for mahika kai and taoka species is a long-term vision for Ōtākou whānau.

8. Assessment of Environmental Effects

8.1. Assessment Overview

In accordance with Section 104(1)(a) of the RMA, the following sections assesses the actual and potential effects of the continued operation, closure, and aftercare of the landfill and waste diversion and transfer facilities. These effects relate to the physical and natural elements that determine these environments, as well as the economic, social, and cultural environment associated with the area. The assessment has been informed by the assessments made in each of the technical reports contained in the appendices to this AEE and has had regard to any relevant assessment matters contained in the relevant NES's and regional plans.

The focus of the assessment is on the actual and potential effects that fall within the resource consents that have been applied for, which relate to the take, use, and diversion of water; discharges to land, water, and air; placement of defence against water; and disturbance of contaminated land. Matters that relate to the use of land that is authorised under the existing designation in the 2GP have not been considered as these matters fall under the functions of the DCC's consenting authority. For these reasons, no assessment of noise or transport related effects is provided in this AEE, being activities that relate to the use of land covered by the designation.

Key components of this assessment, are the monitoring and management measures proposed to be included in conditions of consent and an updated LDMP to avoid, remedy, and mitigate any adverse effects. Proposed conditions and proposed amendments to the LDMP are described in the following sections and detailed as **Appendix 17 and 18** respectively. They are expected to be the subject of ongoing discussion with ORC, and refined, during the processing of the applications.

8.2. Land Contaminant Effects from Waste Disposal

The continued disposal of waste in the landfill through till closure will result in the further discharge of contaminants to land. The existing resource consent conditions for GIL do not include any specific requirements for waste acceptance, however the WasteMINZ guidelines specify that waste disposed of at landfills should occur in accordance with waste acceptance criteria and procedures to ensure they do not result in unacceptable adverse effects on human health or the wider receiving environment. Detailed waste acceptance criteria and procedures for all waste received at the landfill are contained within the existing LDMP.

The following sections describe:

- The waste types accepted for disposal at the landfill, including any proposed changes.
- Waste acceptance criteria for these waste types.
- Procedures for the verification, acceptance/rejection, and recording of incoming wastes.
- Management of landfill fire risks.

8.2.1. Waste Types Accepted for Disposal

As described in **section 4.2**, GIL is classified as a Class 1 landfill under the WasteMINZ guidelines[43]. The existing resource consents enable the disposal of municipal, domestic, hazardous, industrial, and organic waste to land. The continued operation of the landfill is proposed to accept the same types of waste, subject to them meeting the existing waste acceptance criteria set out in the LDMP and described in **section 8.2.3** below, including:

- General waste, including kerbside collections
- Cleanfill
- Cover soils
- Rubble
- Construction and demolition waste
- Special and hazardous waste
- Asbestos
- Contaminated soil
- Household mattress
- Sludges and liquids (including WWTP biosolids and some used oil)
- Tyres

Some materials listed in the existing LDMP are prohibited from being accepted at the landfill due to the risks they pose to the environment or human health, including radioactive material, liquid paint, refrigerant gases, gas bottles, PCB's and intractable organic chlorine. These materials will remain prohibited. As described in **section 4.3**, household hazardous chemicals, batteries and gas bottles are diverted to the waste diversion drop off area at the site where they are consolidated for transport to specialist disposal facilities off site.

Special wastes accepted include contaminated soil, sludges (including WTTP biosolids) and liquids. These wastes are generally carried by commercial haulage companies and are produced by wastewater facilities and industries. As described in **section 4.2**, a review of DCC's long-term biosolids strategy is being undertaken with a view to reducing (but not necessarily eliminating) WWTP biosolids disposal to landfill long term. In the meantime, lime stabilisation of the majority WWTP biosolids commenced in 2023 and has the effect of reducing pathogen hazard, reducing odour and allow them to be comingled and disposed of with the general waste at the tip face.

GIL has historically received bulk liquid wastes. This includes some loads from ship and vessel bilges that contain quantities of used oil. Historically the disposal of such liquids is not known to have resulted in either safety or environmental issues associated with increased leachate, increased or un-manageable odour issues, or the reduced stability of waste or landfill structure. DCC intends to stop receiving liquid waste in the future once alternative commercial disposal options exist in Dunedin, however in the meantime it is proposed to continue accepting bulk liquids wastes for disposal, subject to meeting the waste acceptance criteria described in **section 8.2.2**.

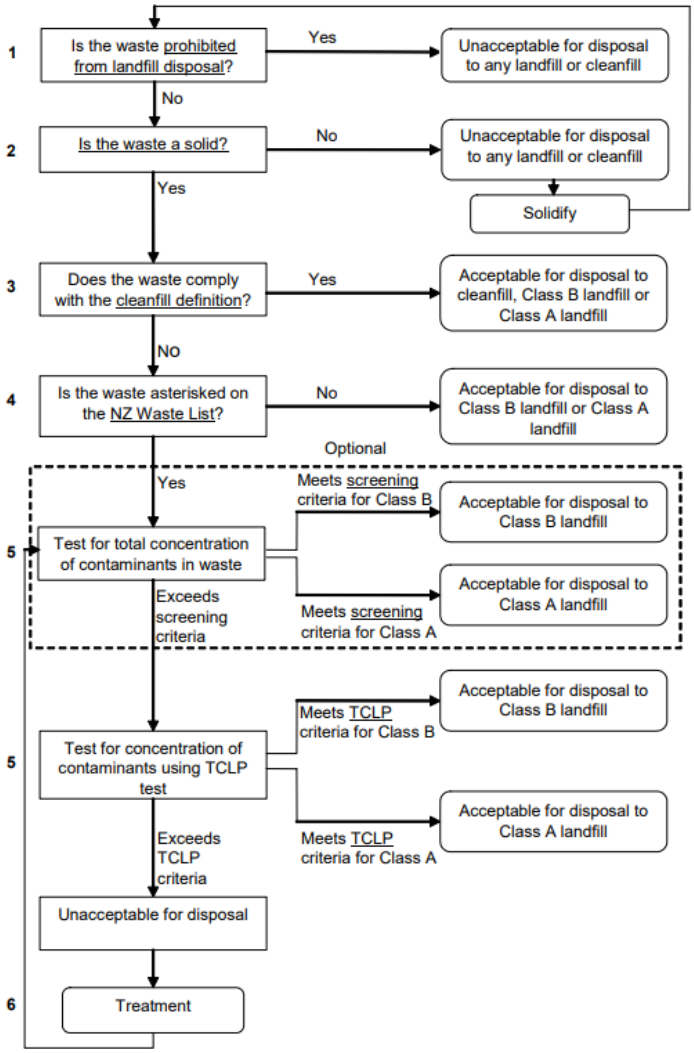
[43] Class 1 landfills were previously known as Class A landfills under the previous CAE Landfill Guidelines (2000)

8.2.2. Waste Acceptance Criteria

All waste types are required to meet waste acceptance criteria to be accepted for disposal at the landfill. The existing landfill waste acceptance criteria in the LDMP have evolved over time and are in-line with the MfE Module 2 Hazardous Waste Guidelines[44] and current best practice and industry standards. As noted in **section 8.2.1**, liquid wastes are however currently accepted, which is not in accordance with the Module 2 guidelines. The criteria were interpedently reviewed in 2017 which affirmed the appropriateness of their use and application.

The continued operation of the landfill is proposed to apply the existing waste acceptance criteria and procedures in the LDMP. The existing waste acceptance decision making process for the landfill as contained in the Module 2 guidelines is set out in **Figure 13** below. The reference to class A landfill in the diagram corresponds with a class 1 landfill.

Figure 13 - Ministry for the Environment Module 2: Hazardous Waste Guidelines – Waste Acceptance Decision Process.



[44] Module 2 – Hazardous Waste Guidelines, Landfill Waste Acceptance Criteria and Landfill Classification, Ministry for the Environment, 2004

Appendix A of the Module 2 guidelines set out leachability limits which represent maximum values that should not be exceeded, to ensure leachable contaminants do not differ from that expected from non-hazardous municipal solid waste being disposed of. The guidelines provide those wastes marked with an asterisk on the Ministry for the Environment NZ Waste List (L-Code) as being hazardous are appropriate for disposal at a class 1 landfill, but only after the landfill operator is confident the waste will not result in leachate from the wastes exceeding the Appendix A limits.

Screening for wastes that generate leachate that exhibits hazardous characteristics occurs in the following way at GIL:

- The Module 2 Class A total concentration (TC) limits as are used as screening acceptance limits. Materials with a TC below the limits are deemed *non-contaminated material* suitable for disposal.
- Material that exceeds the Class A screening limits, are tested against the Module 2 Class B toxic characteristic leaching procedures (TCLP) limits using the USEPA Toxicity Characteristics Leaching Procedure. Material with a TCLP below the limits are deemed *low level contaminated material* suitable for disposal.
- Materials that exceed both the Module 2 Class A and Class B limits are defined as *special waste*, which requires treatment (e.g. stabilisation with cement or lime) to reduce the leachability of the contaminates and meet the Class B TCLP limits before being accepted for disposal.
- If there are no limits set for contaminants in the Module 2 Guidelines or other appropriate guidance[45], then TCLP limits are set using various Trade Waste Bylaw limits, NZ drinking water standards and ANZECC Guidelines for Fresh and Marine Water quality.

From a contaminated-land perspective the key naturally occurring contaminants of concern are Arsenic (As), Cadmium (Cd), Copper (Cu), Chromium (Cr), Nickel (Ni), Lead (Pb), Zinc (Zn), and Mercury (Hg). The Class A and B limits for these contaminants are set out in **Table 16** below.

Table 16 – Green Island Acceptance Criteria for Common Heavy Metals

Metal	Class A (TC)	Class B (TCLP)
Arsenic	100	0.5
Cadmium	20	0.1
Chromium	100	0.5
Copper	100	0.5
Lead	100	0.5
Nickel	200	1
Zinc	200	1

[45] These include the NSWEPA leachability criteria for solid waste landfills, Alberta Hazardous Waste Regulatory Framework 2006, and any other criteria appropriate to the waste type being received.

8.2.3. Waste Acceptance Procedures

Only pre-approved commercial contractors are able to deliver waste directly to the landfill tip face for disposal. The landfill operator will only receive waste from those contractors if an assessment for acceptance has been undertaken by DCC confirming the waste meets the waste acceptance criteria described in **section 8.2.2**, and documentation for that waste has been provided to the landfill operator. This process involves:

- The disposer of waste contacting the DCC Landfill Engineer prior to becoming a user of a landfill, or in the case of regular disposers before there is a change to the nature or mass of the waste being disposed of at the landfill. This allows the DCC to evaluate if the waste meets the waste acceptance criteria and require the disposer to perform any additional tests needed to characterise the waste.
- The disposer undertaking **pre-assessment testing** of waste materials to confirm they meet the waste acceptance criteria for the landfill. Testing is completed by an accredited laboratory and includes samples that represent worst case as well as average waste conditions. Sampling is required for all potentially hazardous wastes, and material from an identified HAIL (Hazardous Activities and Industries List) site.
- The DCC **evaluating information about the waste** and pre-assessment testing to confirm wastes meet the criteria. Wastes that do not meet the criteria may be able to be treated so that they meet the criteria and can be accepted at the landfill.
- Confirmation of **waste acceptance** by the DCC Landfill Engineer is communicated to the disposer and landfill operator. The confirmation to the landfill operator includes any instructions given to the disposer. The Landfill operator has the right to inspect, challenge, sample, test and, if necessary, reject waste brought to the landfill for disposal.

The landfill operator is responsible for implementing procedures at the landfill for the verification, acceptance/rejection, and recording of incoming wastes from commercial contractors and the public. These procedures are described in the LDMP, include:

- **Waste acceptance/rejection** involving all vehicles carrying general waste being directed to the entry kiosk and weighbridge. All customers are required to declare special or hazardous wastes at the kiosk so they can be managed correctly. Vehicles are weighed, and waste is verified that the load does not contain prohibited wastes or wastes that have not been pre-approved for acceptance by DCC. The nature of all waste is recorded, and approved loads are authorised to proceed to either the tip face (commercial loads), or waste transfer station (domestic loads). Unacceptable loads are rejected.
- Performing **random load inspections** of incoming waste to confirm the nature of the waste. Loads are selected on a random basis, with the frequency based on the types and quantity of waste being received, and the findings from previous inspections. If the landfill operator suspects a load might be contaminated, then sampling of this material against the waste acceptance criteria may be required to confirm compliance before the material is accepted for disposal.
- **Supervision of the landfill tipping face and transfer station pit** when wastes are received to ensure the accountability of those depositing wastes and identify inappropriate loads before they incorporated into the waste mass. Where discharge of

unacceptable wastes occurs, site staff will immediately secure the area, take measures to contain the material, and contact the emergency services if required. A plan for treatment or removal of the waste will be actioned as quickly as practicable.

- **Keeping records of waste received** at the landfill and load inspections. Information on waste accepted includes vehicle details, type of waste, and financial transactions. Information on load inspections includes observations made and any violations.
- **Recording landfill disposal locations** for special and hazardous wastes, asbestos, sludges, and liquids. Information recorded includes the type, quantity, location, and depth of waste.

Once received, the following special handling procedures are applied to specific types of *special* or *hazardous* wastes:

- Odorous wastewater treatment plant sludges, and animal products (generally a single large animal) are disposed of using sludge cells which are constructed progressively and move as the landfill tip face moves and progresses. Deposited sludges are mixed with inert soils to stabilise and cover the material as soon as possible.
- Liquid loads (with some solids) from mud-tanks, roads, industrial sites/processes are disposed of into a dewatering pond to allow the settling out of any solids. The dewatering pond is located within a secure fenced compound.
- Asbestos is disposed of in a secure fenced compound. Sprinklers ensure asbestos material remains damp and no dust or fibres become airborne.
- Other wastes with a consistency that is difficult to handle (e.g. are sticky), comprise large items such animal carcasses, or which require immediate burial are disposed of in pre-dug special disposal pits constructed on a case by case basis.

8.2.4. Land Contaminant Conclusions

Recognising the management and mitigation measures for waste acceptance described above, proposed conditions of consent are included in **Appendix 17**, which require:

- The inclusion of waste acceptance criteria in the LDMP which all material accepted into the landfill must meet, and the annual review of the criteria.
- Commercial waste transporters having confirmation from DCC the material meets the waste acceptance criteria prior to disposal.
- Random visual inspections of incoming loads, and supervision of all tipping of waste.
- Implementing procedures for the acceptance of special waste, hazardous waste, and highly odorous waste.
- Maintaining records of wastes received.

Overall, with these measures, the adverse effects of the disposal of waste on the receiving environment, and human health and safety will be appropriately managed in-line with national guidelines and best practice and industry standards to ensure they are low and no more than minor on the environment, and on any persons.

8.3. Effects on Groundwater and Surface Water

Potential effects on groundwater and surface water from the continued operation of the landfill include:

- Abstraction of groundwater from the leachate collection trench affecting water levels in the hydraulically connected Kaikorai Stream.
- Higher water levels in the Kaikorai Stream as a result of climate change induced sea level rise increasing inflows to the leachate collection trench (assessed in **section 8.8**).
- Increased stormwater flows reporting to the site stormwater systems as a consequence of the capping of the landfill.
- Effects on groundwater and surface water quality from leachate, and discharges of stormwater.

Potential effects of the continued operation of the landfill on groundwater and surface water are addressed in the Groundwater Report in **Appendix 5** and Surface Water Report in **Appendix 6**. These reports:

- Describe the catchment and hydrogeological setting and existing and proposed management of groundwater/ leachate, and stormwater.
- Review and interprets groundwater level and quality, and surface water quality monitoring data for the landfill.
- Describe the conceptual understanding of the groundwater system, interaction of groundwater with landfill leachate and the leachate collection system, and interaction with surface water.
- Undertake modelling to estimate the rainfall intrusion through the landfill cap, leachate head and volumes in the landfill, seepage into the leachate collection trench, and groundwater/surface water interaction under both baseline and future conditions at landfill closure.
- Undertake an assessment of effects on groundwater and connected surface water levels and flows, and effects of leachate and stormwater discharges on groundwater and surface water quality.
- Recommend changes to the groundwater and surface water monitoring contained in the existing resource consents.

8.3.1. Existing Groundwater, Leachate, and Stormwater Management Measures

The existing management measures for groundwater, leachate, and stormwater and leachate management will continue to be implemented during the continued operation, closure, and aftercare of the landfill. This includes:

- Measures in the LDMP for minimising the volume of leachate generated to a practicable minimum, including:

    - Stormwater cut-off drains and diversions to minimise storm water run-on to the tip face and daily cover areas.
    - Avoiding excavations that direct stormwater to drain to underlying waste.
    - Placing, maintaining, and repairing intermediate and final cover as soon as possible and at appropriate grades.
    - Maintaining the efficient function of the leachate collection system.
    - Mowing of the landfill cap to increase evapotranspiration.
- Measures in the LDMP to intercept and divert stormwater, separate clean and contaminated runoff, and minimise erosion and sediment transport, including:
    - Separation of clean runoff from contaminated runoff and treating contaminated runoff as leachate, as described below.
    - Provide adequate grades to minimise ponding on the landfill.
    - Keep surface drains free of obstructions including litter.
    - Maintenance of stormwater infrastructure, including desilting of sediment ponds.
    - Lining surface drains with an impermeable material and where necessary to avoid erosion damage.
    - Repair and reinstatement of eroded areas and drains.
- Operation of the existing leachate collection trench, leachate drains, and pump stations, and the discharge of collected leachate to the GIWTTP.
- Operation of stormwater infrastructure including sumps, pipes, drains, and sediment ponds. As described in **section 4.6**, the *northern leachate pond* will revert to a sediment pond at closure and will discharge to the Kaikorai Stream, rather than the leachate collection system.

The continued operation of the leachate collection trench, and gravel drains at the base of the perimeter bund, additional leachate drains in the landfilled waste will continue to be the primary way leachate migration from the site is contained to minimise effects on groundwater and surface water quality.

The leachate collection trench creates a hydraulic barrier which effectively impedes groundwater and leachate migration offsite. Water levels in the trench are typically maintained at -0.8 m to +0.2m amsl by the continuous dewatering of the trench via pump stations PS1 – PS9, which pump leachate and groundwater to the GIWWTP for disposal. These water levels are lower than the surface water levels, with typical stream and estuary water levels of 2.0 m to 2.5 m amsl. In addition, a High-Density Polyethylene (HDPE) liner installed on the estuary/stream site of the trench acts as a further barrier whilst reducing the volume of water/groundwater entering the trench from the Kaikorai Stream. However, it does not completely prevent inflows which contribute to the volume of groundwater/leachate collected.

The collection trench is not embedded into the underlying Abbottsford Formation mudstone. Whilst the trench provides a hydraulic barrier for the migration of shallow leachate from the site, there is a potential for offsite migration of leachate if there is a pathway for leachate to migrate into the LKEM, being contained in a lens of more permeable sediment, and moving under the

trench. However, the underlying artesian groundwater conditions combined with the low permeability of the LKEM, and Abbottsford Mudstone help impede any bypass of the trench.

The effects of leachate and other contaminants on surface water will also be managed by the separation and management of clean and contaminated surface runoff as described in in **section 4.6**, specifically:

- Catchments with **clean** non-contaminated runoff will continue to discharge to the Kaikorai Stream via the *eastern* and *western sedimentation ponds* or directly to the stream.
- Catchments with **stormwater** runoff will discharge to the Kaikorai Stream via the *eastern* and *western sedimentation ponds*, or discharges to the leachate collection system.
- Catchments with **leachate** contaminated stormwater in the active landfilling area or has potential to come into contact with waste or leachate will be left to infiltrate the landfill or discharge to the leachate collection system.

Table 17 below summarises the runoff classification, uses, and discharge point for each of the landfill surface water catchments described in **section 4.6** both currently and at closure.

Table 17 – Proposed Management of Clean and Contaminated Surface Water Runoff

Catchment	Classification	Discharges to 2022	Nature of catchment 2022	Discharges after closure
4 and 4a	CLEAN / STORMWATER	Eastern Sedimentation Pond	All Leachate / Waste touching activities in this area are directed to sewer infrastructure and PS7	Eastern Sedimentation Pond
5b	STORMWATER	Eastern Sedimentation Pond	Vegetated / grassed perimeter bund	Eastern Sedimentation Pond
8	STORMWATER	Eastern Sedimentation Pond	Vast majority is area capped historically.	Eastern Sedimentation Pond
9	CLEAN	Eastern Sedimentation Pond	Vegetated / grassed perimeter bund	Eastern Sedimentation Pond
2	LEACHATE	Northern Leachate Pond	Includes the tip face access road which at times can have waste spilled or dropped on.	Northern Sedimentation Pond
2a	LEACHATE	Northern Leachate Pond	Includes the tip face access road which at times can have waste spilled or dropped on.	Northern Sedimentation Pond
5a North	STORMWATER	Northern Leachate Pond	Area of final capping completed in 2022	Northern Sedimentation Pond
5a South	LEACHATE	Northern Leachate Pond	Area of intermediate cover	Eastern Sedimentation Pond
1	CLEAN	Perimeter swale to Kaikorai Stream	Vegetated / grassed perimeter bund	Perimeter swale to Kaikorai Stream

Catchment	Classification	Discharges to 2022	Nature of catchment 2022	Discharges after closure
3a	CLEAN	Perimeter swale to Kaikorai Stream	Vegetated / grassed perimeter bund	Perimeter swale to Kaikorai Stream
3b	CLEAN	Perimeter swale to Kaikorai Stream	Vegetated / grassed perimeter bund	Perimeter swale to Kaikorai Stream
6b	CLEAN	Perimeter swale to Kaikorai Stream	Vegetated / grassed perimeter bund	Perimeter swale to Kaikorai Stream
6a	LEACHATE	PS1 via open leachate swale and PS3 via leachate drainage in the landfill	Area of active waste Filling	Western & Eastern Sedimentation Ponds
7a	LEACHATE	PS1 via open leachate swale and PS3 via leachate drainage in the landfill	Area of active waste Filling	Western & Eastern Sedimentation Ponds
7b	CLEAN / LEACHATE	PS1 via open leachate swale	Majority is completed perimeter bund above the open leachate swale with some receiving active waste.	Western Sedimentation Pond
10	ALL	PS1 via open leachate swale	Grassed virgin hillside (CLEAN), open borrow area (STORMWATER) and southern edge of landfill only intermediate capped (LEACHATE)	Western Sedimentation Pond
Waste diversion/transfer facilities (future RRPP)	CLEAN / STORMWATER	Direct discharge to the Kaikorai Stream or to ground	Direct discharge to the Kaikorai Stream or to ground	Direct discharge to the Kaikorai Stream or to ground

8.3.2. Proposed Additional Groundwater, Leachate, and Stormwater Management Measures

The leachate collection trench extends around the full perimeter of the landfill except for the southern side of the landfill where the landfill rises to meet the adjacent hillside. Management of leachate in this area is currently via a shallow surface drain which intercepts leachate impacted surface and groundwater runoff and directs conveys it to PS1 from where it discharges to the main sewer line and GIWTTP.

There is the potential that the surface drain does not capture all leachate seepage, and it is less effective in lowering leachate levels in the landfill. Furthermore, there is a potential that leachate could find a pathway from the open drain to the bedding material associated with the main sewer line to the GIWTTP, which runs adjacent to the surface water drain in this area.

Several changes are proposed to address this, and other potential leachate or spill contamination risks associated with the continued operation, closure, and aftercare of the landfill:

- The existing surface drain along the southern side of the landfill is proposed to be replaced with an extension of the leachate collection trench. The extended trench is shown on Drawing 12547621-C301 in **Appendix 3**. The trench will link to the existing trench at MH12 forming an almost continuous system around the perimeter of the landfill, except for the 90m gap on the eastern side of the landfill, and underneath the haul road to the borrow area which impedes construction. Three new pump stations (PS10, PS11 and PS12) will be placed along the trench connecting to a rising main discharging to the main sewer line to the GIWWTP.

  The trench will be constructed in sections to manage odour and slope stability. Any existing underlying waste or other unsuitable material will be removed and disposed of directly to the landfill. The existing surface drain will be shifted downslope and revert to receiving only stormwater runoff from the landfill, borrow area, and hillside to the south, which will be conveyed to the *western sedimentation pond* before discharging to the estuary. These works will be completed within 3 years of replacement consents being granted to allow time to secure funding, complete design and tendering, and undertaking the work.

- Additional internal landfill leachate drains (as shown on Drawing 12547621-C204 in **Appendix 3**) will be progressively over the proposed waste filling area in advance of waste placement to manage leachate levels where the existing underlying intermediate cover soils are likely to impede drainage. The existing cover soils will be graded to direct leachate to the new drains installed in the centre of the landfill. The drains will consist of heavy walled HDPE pipe with rodding points to allow for cleaning by jetting. The pipe will be encased in drainage media and a filter geotextile. As with the existing internal drains, the new drains will discharge by gravity to the leachate collection system.

- Provision for submersible air powered pumps to be deployed in LFG wells if required to extract leachate and thereby reduce leachate mounding in the completed sections of the landfill (especially in the deeper waste). The system will be flexible to allow for pumps to be deployed to any LFG well having a high leachate level. Extracted leachate will be discharged to the leachate collection system.

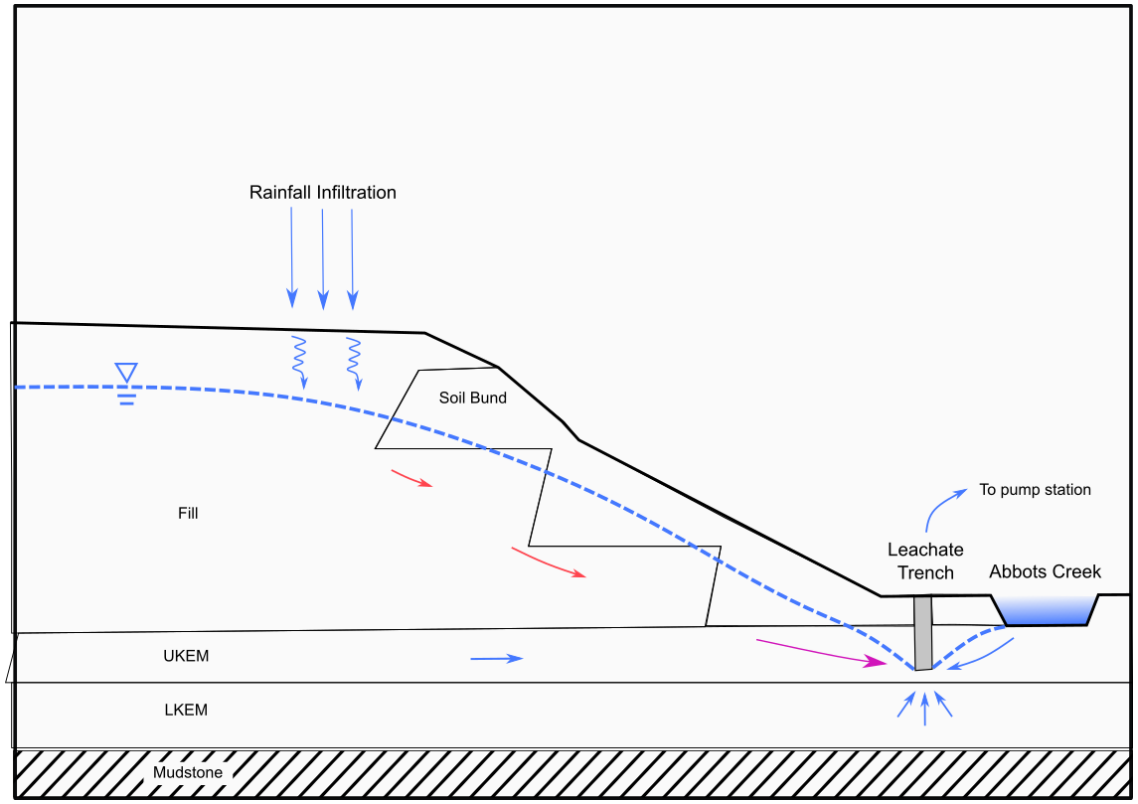
- Repair of the deflected pipe joint in the culvert between the *south eastern* constructed *wetlands* and *eastern constructed wetland* described in **section 4.6** where monitoring has detected elevated parameters indicative of leachate contamination. Repair will involve either sealing the joint with polyurethane foam injection, or fibreglass lining of the pipe section. These works will be completed by March 2025. If ongoing monitoring detects seepage of leachate, further remedial measures will then be considered and implemented within 3 years of the replacement consents being granted, which may include replacement of pipe sections, or fibreglass or PVC lining of the entire culvert.

- Fitting of shut off values at the outlets of the *eastern* and *western sedimentation ponds* to enable the contaminant of spills of fuel, oil, leachate, or other contaminants that flow or have the potential to flow into those ponds. These works will be similarly completed within 3 years of the replacement consents being granted.

8.3.3. Groundwater Conceptual Model

The conceptual understanding of the groundwater system is shown in **Figure 14** below which has been determined based on published information, routine monitoring described in **sections 4.5 and 4.6**, and previous site investigations.

Figure 14 – Conceptual Groundwater Model



In summary:

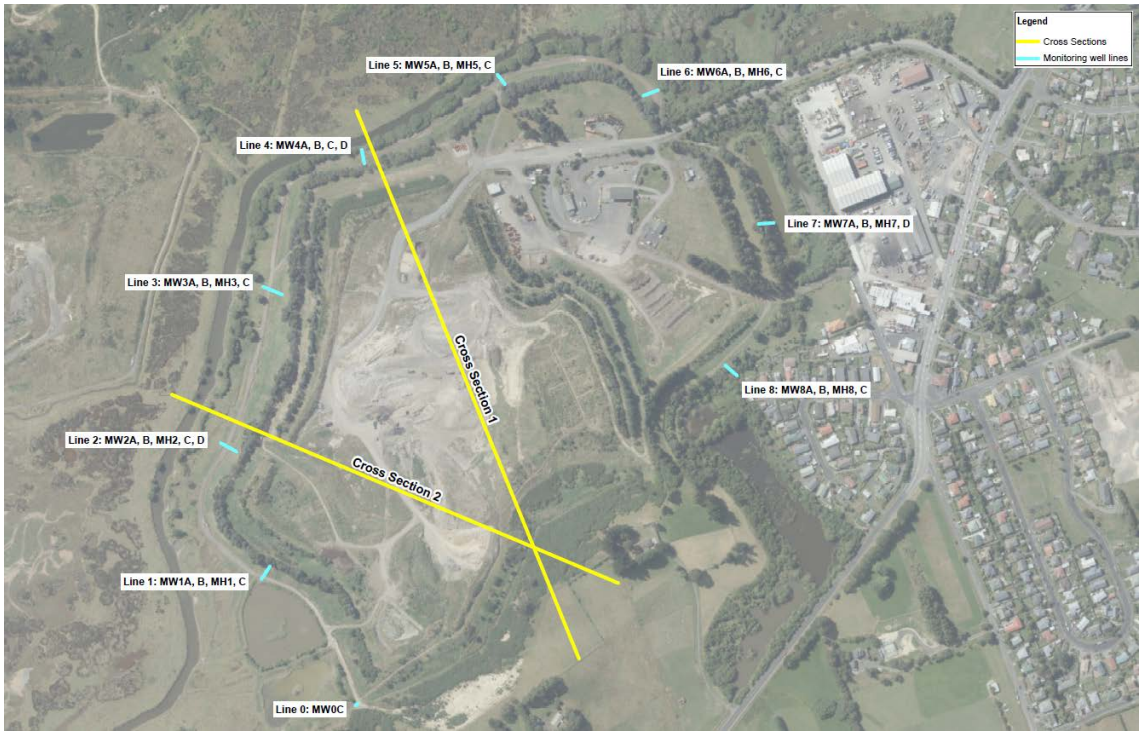
- Rainfall infiltrates the landfill, generating leachate as water encounters waste.
- Leachate migrates down and outwards towards the edge of the landfill.
- Groundwater and leachate is abstracted from the leachate trench, where water chemistry has confirmed the mixing of water types.
- Groundwater quality is influenced by historic waste deposition; this includes areas outside of the trench (e.g well MW4C). However, pumping from the leachate trench maintains the hydraulic gradient and pulls the impacted groundwater towards the trench (and away from surface water).

- Stream depletion effects are limited by presence of the HDPE liner on stream side of trench. However, some abstraction of shallow groundwater from the outer edge of the site (and stream water) is likely to occur.
- An upward hydraulic gradient in the LKEM geological layer restricts migration of leachate into deeper layers under the trench collection system.
- The underlying Abbottsford mudstone layer forms an aquitard limiting deeper flow paths and restricting flow to the southern valley of the landfill where it occurs at/near the surface.

Based on this conceptual understanding, rainfall infiltration through the landfill cap was assessed using Hydrologic Evaluation of Landfill Performance (HELP) software. SEEP/W 2D groundwater modelling was then used to estimate leachate head and volumes in the landfill, seepage into the leachate collection trench, and groundwater/surface water interactions under both baseline and future conditions at landfill closure.

Two SEEP/W cross-sections were modelled (cross section 1 and 2), as shown in **Figure 15** below. Each model was initially run under steady-state conditions to simulate the interpreted baseline groundwater conditions. Steady state model scenarios were then run to simulate future conditions at closure, in particular capping of the landfill and the proposed extension of the leachate collection trench along the southern side of the landfill.

Figure 15 – Location of SEEP/W Cross Sections



The model estimated a flow rate to the leachate trench of approximately 1 L/s which are in line with the current recorded flows described in **section 7.4.2.** The model confirms the trench effective at drawing down leachate levels and intercepting flows to the stream. The modelled leachate head was similar to the current recorded levels described in **section 7.4.1**, although the very high leachate in the centre of the landfill could not be simulated. It is likely that the high

leachate levels reflect the heterogeneity of the landfill materials resulting in pockets/areas of higher leachate.

The modelling results indicates that approximately 70% of the flow to the trench comes from the landfill (and underlying groundwater) and 30% from the direction of the Kaikorai Stream. Stream depletion rates were estimated to be <0.5 L/s for the entire trench length. In the unlikely event that the leachate trench pumps were to fail for an extended period (i.e. several weeks), flow is expected to reverse with flow into the stream at an estimated rate of 0.5 – 0.8 L/s (combined rate), or approximately 0.2% of the mean flow in the Kaikorai Stream.

8.3.4. Effects on Groundwater and Connected Surface Water Flows

The leachate collection trench operates by drawing down water levels in the trench, this intercepts any leachate flowing from the landfill but also draws groundwater from the area outside of the trench. The underlying KEF and Abbottsford mudstone are not used for groundwater supply, therefore the abstraction of groundwater and localised reduction in groundwater levels around the landfill perimeter will not affect any groundwater users.

Groundwater is however hydraulically connected with surface water in the Kaikorai Stream, resulting in abstraction of groundwater from the leachate collection trench having a stream depletion effect. The modelling described in **section 8.3.3** indicates that approximately 30% of the water pumped from the leachate trench is derived from groundwater/connected surface water on the outside of the trench in areas where the trench is close to the stream.

The volume of groundwater/connected surface water extraction is estimated to be less than 0.5 L/s for the entire trench length. As described in **section 7.5.1**, the mean annual flows and mean annual low flows in the Kaikorai Stream are 368 L/s and 81 L/s respectively. The effect of 0.5 L/s of leachate trench abstraction on stream surface flows is expected to be negligible when compared to the stream flows and volumes in the estuary. These losses will have no significant impact on the stream flow regime.

The volume of pumped leachate, groundwater, and stormwater from the leachate collection system over the 2021 – 2022 monitoring year was 1.6 L/s or 5,780 L/hour. In the past five years the combined pumping rates from the leachate collection system have been between 1 – 2 L/s, peaking up to 8 – 9 L/s after periods of rainfall. Several factors will influence future leachate volumes including:

- Capping of the landfill is expected to reduce leachate volumes as infiltration of rainfall into the landfill will reduce.
- Construction of the extension of the leachate trench will increase volumes as the trench will be more effective at collecting both leachate and groundwater seepage from this part of the site than the existing surface drain.
- Stormwater from some catchments which are currently conveyed to the leachate collection system will ultimately be redirected to convey to the stormwater systems on site, as described in **section 8.3.1**.
- In all cases, significant rainfall events will influence leachate volumes.

Given these factors and the historical rates, the rate of take under the current consent is proposed to be reduced to an average of 5 L/s (18,000 L/hour) and a peak of 20 L/s (72,000 L/hour), or 432m^3/day and 1,728m^3/day respectively. These rates accommodate stormwater runoff flows from those catchments which are conveyed to the leachate collection system and contingency for potentially extended periods of rainfall.

As areas of filling are completed and capped, rainfall that previously infiltrated into the landfill and report to the leachate collection system, will instead be stored in surface soils and lost via evapotranspiration or discharge as surface flows to the Kaikorai Stream or sedimentation ponds. Filling and capping in the *eastern sedimentation pond* catchment are complete and there will be no significant change to flows and pond retention times. As filling and capping progresses surface flows to the *western sedimentation pond* will increase. On completion the pond will have a retention time well in excess of 24 hrs for the 2-year 24-hour event, and therefore can accommodate and attenuate the future flows (allowing for climate change) without any increase in pond size required.

8.3.5. Effects on Groundwater and Surface Water Quality

The modelling described in **section 8.3.3** demonstrates that the leachate trench system is effective at creating a hydraulic barrier and intercepting leachate flowing from the landfill. It also is effective in drawing groundwater from outside the trench, thereby preventing the movement of potentially contaminated groundwater arising from historic waste located outside of the trench into surface water.

The modelling indicates leachate flow to the stream at a combined rate between 0.5 – 0.8 L/s if pumping from the leachate trench were to cease for a prolonged period. This scenario is very unlikely as there would be a time lag of several weeks for leachate levels to rise in the trench before the modelled flow rate was achieved. Furthermore, redundancy in the pump system allows leachate to bypass a shutdown pump station and be collected by other pump stations. It is unlikely that all pump stations would be out of action for an extended period given historical performance and the proposed additional mitigation measures described in **section 8.3.2**.

Historical water monitoring described in **section 7.4.3** and **7.5.2** also shows the trench is effective in intercepting leachate, and that there is no discernible adverse effect on water quality resulting from the landfill, including from the surface water discharges. The monitoring shows there is no significant changes in dissolved metal or nutrient concentrations that would be a strong indicator of leachate discharge. In addition, based on the ANZG (2018) for marine and freshwater environments, the adopted 80% guideline values (which represent an impacted catchment) for dissolved metals are typically not exceeded, whilst Ammoniacal-nitrogen concentrations are variable throughout the monitoring sites.

If leachate migration to surface water was occurring a measurable change in water quality between the surface water monitoring points GI2 and GI3 (during low flow conditions) would be expected due to the very high contaminant load in the landfill leachate. Instead, the water quality at the downstream GI3 is generally better than GI2, further supporting the conclusions of modelling. Continued filling of the landfill with progressive capping and the extension of the leachate collection system is expected to maintain or improve the quality of discharges to the stream and estuary over time.

An interim HHERA has been undertaken to assess whether contamination originating from the landfill may represent a risk to the human users or environment of the catchment. A copy of the interim HHERA is included in **Appendix 20**. The overarching purposes of the assessment were to better understand the risk to human health from PFAS which has been measured at low levels in most of the surface water monitoring sites, and to provide additional information to ORC for potential future use in broader catchment monitoring programs addressing contamination in the Kaikorai Stream.

The HHERA provides an interim assessment which can be built upon if additional data is collected. A Tier 1 risk assessment was undertaken, whereby the concentrations of chemicals measured onsite and within the receiving environment were compared with conservative screening levels provided by national or international guidelines and the chemical concentrations measured upstream of the landfill. This assessment identified that the chemical concentrations measured in surface water samples collected downstream of the landfill have generally been consistent with those measured upstream and/or below the relevant Tier 1 screening criteria. On this basis, it was concluded that discharges from the site into the receiving environment of the Kaikorai Stream generally represent a low risk to human users of the waterway and the aquatic environment.

Some chemicals, including nitrate, zinc and PFAS were identified at concentrations above the Tier 1 screening criteria, in samples collected both upstream and downstream from the landfill, suggesting contributions from across the catchment. A broader catchment approach to the ongoing monitoring of these contaminants is recommended to inform the public about the risks associated with recreation and food gathering within the catchment and to support public engagement that ORC may wish to undertake.

Although, the potential sources of PFAS contamination in the environment is a catchment wide issue and not solely attributed to the historical filling of the landfill, the HHERA is proposed be updated after the collection of three years of data and provided to ORC.The critical aspect to address for these applications are the proposed additional improvements for the management of leachate, including the extension of the leachate collection trench, and additional internal landfill leachate drainage. These improvements combined with the progressive closure of the site and ongoing monitoring will ensure the risk of contaminants entering the environment from the landfill is minimised.

8.3.6. Proposed Groundwater and Surface Water Monitoring

The groundwater and surface water monitoring regime under the existing resource consents and described in **sections 4.5 and 4.6** is proposed for the continued operation, closure, and aftercare of the landfill. This includes monitoring to confirm the effective operation of the leachate collection, and stormwater systems and detect any migration of leachate or other contaminants from the site.

Several changes are proposed to the monitoring as recommended in the Groundwater Report in **Appendix 5** and Surface Water Report in **Appendix 6** including:

- Removal of the requirement for isotopic analysis of groundwater from the resource consents. Isotopic analysis does not significantly improve the understanding of the groundwater/surface water system and given the long delay (months) between collection of samples and reporting of results chemical analysis is likely to provide a timelier indication of leachate mobility.

- Removal of the requirement to install a deep groundwater well within the landfill from the resource consent. The installation of a deep well (which has not been implemented) has the potential to create preferential flow paths from fill to the underlying geology.
- Updating the water level and water quality monitoring in the resource consents to align with the requirements in **Table 18** below. Highlighted text denotes additions to the current monitoring.
- Documenting the monitoring results in the annual monitoring report due on 1 October each year, which is to include discussion on any trends that are observable in the data, and any remedial actions that may be required to address any adverse trending water quality.

Table 18 – Proposed Groundwater and Surface Water Monitoring

Frequency	Measurement/Analyte	Locations
Continuous	Leachate flow rate	Leachate collection sumps
3 hourly (using automatic water level pressure transducer)	Kaikorai Stream levels	Surface water GI3
Monthly	Groundwater levels	A / B / C / D wells, BH103, leachate collection system pumpstations and manholes
Quarterly (reduced to 6 monthly two years post closure)	pH Electrical Conductivity Dissolved oxygen Boron Ammoniacal Nitrogen Nitrate Nitrogen Chloride PFAS and PFOA (first three years only)	- C and D wells - BH103 - Representative sample from the leachate trench (PS3) - Surface water (GI1, GI2, GI3, GI 5 and estuary at Brighton Rd bridge) within three hours of low tide - Western sedimentation pond - South western pond - Eastern sedimentation pond - South eastern constructed wetland -Eastern constructed wetland
Annual	Major Ions (Sodium, Potassium, Magnesium, Calcium, Bicarbonate, Sulphate and Chloride) pH Electrical Conductivity Dissolved oxygen Nutrients (Ammoniacal Nitrogen, Nitrate Nitrogen, Dissolved Reactive Phosphorous) Metals (Aluminium Arsenic, Cadmium, Chromium, Iron, Lead, Manganese, Nickel, Zinc) Boron Volatile Organic Compounds (VOC) Semi Volatile Organic Compounds (SVOC)	- C and D wells - BH103 - Representative sample from the leachate trench (PS3) - Representative sample of leachate (from gas well in landfill) - Surface water (GI1, GI2, GI3, GI 5 and estuary at Brighton Rd bridge) within three hours of low tide. - Western sedimentation pond - Southwestern pond - Eastern sedimentation pond - South eastern constructed wetland - Eastern constructed wetland

	PFAS and PFOA Cyanide Chemical Oxygen Demand (COD) Biological Oxygen Demand (BOD)	

8.3.7. Groundwater and Surface Water Conclusions

Recognising the management and mitigation measures, and monitoring of groundwater and surface water above, proposed conditions of consent are included in **Appendix 17**, which require:

- Extension to the leachate collection trench, the continued operation of the leachate collection system, and the disposal of leachate to the GIWWTP.
- Repair of the culvert between the *south eastern* and *eastern constructed wetlands*.
- The fitting of outlets to the *eastern* and *western sedimentation ponds*.
- Stormwater infrastructure being designed to manage storm events, and ongoing operation and maintenance of stormwater systems.
- Review and certification by ORC of the detailed design for improvements to the leachate collection system, changes to the stormwater treatment and discharge systems, and final landfill cap prior to construction, and post construction CQA reporting.
- The separate management of clean runoff, sediment laden stormwater, and leachate contaminated stormwater.
- Implementation of effective measures to minimise stormwater infiltration and runoff into areas of uncovered waste and the leachate collection system.
- Implementation of erosion and sediment controls to minimise sediment generation and runoff from the site.
- Management of spills of fuel, oil, leachate, or other contaminants.
- Visual inspections of the landfill surface monthly and after storm events.
- Comprehensive leachate, groundwater and surface water level and quality monitoring, analysis, and reporting, and the triggering of response measures where the monitoring indicates adverse effects on water quality attributable to the landfill.

Overall, with these mitigation measures and proposed conditions, the effect on connected surface water flows from groundwater abstraction will be negligible and no discernible effect on surface water quality from leachate and other contaminants is expected. Accordingly, adverse effects on the environment and any persons are expected to be low and no more than minor.

8.4. Air Quality Effects

Potential effects on air quality from the continued operation of the landfill include:

- Odour from the disposal of waste to land (including highly malodorous waste), excavation into old waste, LFG, waste transfer station, and ORB.
- Dust from internal roads, earthworks (including placing of cover and capping materials) and placing and compacting dry materials during windy conditions.
- The lateral escape of LFG to air from the landfill.
- Combustion emissions from LFG engines and flares at the GIWWTP.

Potential effects of the continued operation of the landfill on air quality are addressed in the Air Quality Report in **Appendix 7**. This report:

- Identifies sensitive receptors surrounding the landfill.
- Reviews and interprets air quality complaint data, meteorological data, and instantaneous surface monitoring (ISM) data for the landfill.
- Undertakes a detailed assessment of odour impacts from the existing landfill operations.
- Reviews the current odour and dust management measures and recommends additional measures based on the assessment of odour impacts.
- Undertakes an assessment of odour and dust impacts considering the proposed management measures
- Undertakes atmospheric dispersion modelling of LFG flare and engine emissions.

8.4.1. Sensitive Receptors

Sensitive receptors include any person, location, or system that may be susceptible to changes in 'abiotic' factors as a consequence of odours and emissions of dust from landfill operations, and emissions from combustion of LFG by engine or flare. The nearest sensitive receptors in each direction have been reviewed and are identified in **Table 19** and shown on **Figure 16**.

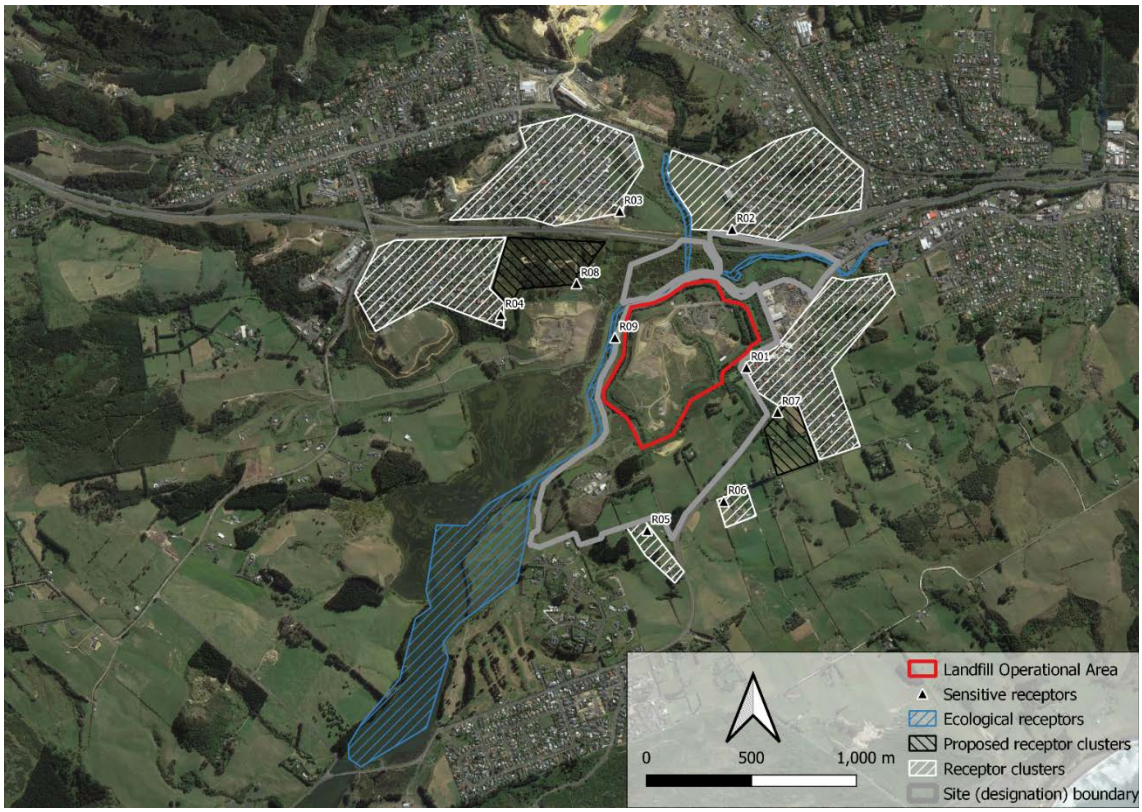
Receptors R01 – R08 indicate residential areas where there are existing clusters of residences, rezoned areas where future residential development is enabled, as well as some recreational and commercial spaces within these areas. The Sunnyvale Sports Complex has been included in the R02 receptor cluster and Te Kura Kaupapa Māori o Ōtepoti primary school has been included in the R03 receptor cluster. R09 indicates the Kaikorai Stream and Estuary ecological receptor, covering a large area around the site.

Table 19 – Sensitive Receptors

ID	Receptor	Receptor type	Distance and direction from landfill footprint
R01	Green Island suburb (southeast) (nearest point along Clariton Ave)	Residential	120 m east
R02	Green Island suburb (northeast) (nearest point along Watson St)	Residential	500 m northeast
R03	Fairfield suburb (north) (nearest point along Holyport Cl)	Residential	530 m north
R04	Fairfield suburb (south) (nearest point along Blanc Ave)	Residential	650 m northwest
R05	172-176 Brighton Rd, Waldronville	Residential	440 m southwest
R06	45-51 Allen Rd South, Waldronville	Residential	420 m south

ID	Receptor	Receptor type	Distance and direction from landfill footprint
R07	Proposed residential area between Weir St and Brighton Rd	Proposed residential	280 m southeast
R08	Proposed residential area in Fairfield	Proposed residential	330 m northwest
R09	Abbotts Creek, Kaikori Stream and Estuary	Ecological	120 m west, northwest and north

Figure 16 – Location of Sensitive Receptors



8.4.2. Odour Effects

Assessment of the effects of odour has involved a review of the existing operations and complaint history followed by a qualitative assessment of the odour impacts from the site using the FIDOL (frequency, intensity, duration, effectiveness, and location) factors provided in the Good Practice Guide for Assessment and Managing Odour (GPG Odour)[46] described in **Table 20** below.

Table 20 – FIDOL Factors

[46] Good Practice Guide for Assessing and Managing Odour, Ministry for the Environment, 2016.

FIDOL Factor	Description
Frequency	The frequency of odour or dust discharges relates to how often an individual is exposed.
Intensity	The intensity relates to the concentration of odour or dust.
Duration	The duration relates to the length of time that an individual is exposed.
Offensiveness	Offensiveness relates to the 'hedonic tone' of the odour, which may be pleasant, neutral or unpleasant. In terms of dust, offensiveness relates to the type of dust.
Location	The sensitivity of locations in the receiving environment, which is characterised by land uses surrounding the site.

Based on a review of the odour complaint history described in **section 7.7.1**, odour from the existing operations is leading to impacts at the nearby sensitive receptors, with receptor clause (RO1) located 120m from the landfill footprint being the source of most complaints. The outcomes of the FIDOL assessment of the odour impacts from the existing landfill operation were:

- *Frequency* – Light winds with speeds < 3 m/s have the greatest potential to cause odour impacts off-site. One of the sensitive receptor clusters (R05) located southwest of the landfill is in an area where low winds occur a moderate (2 – 6%) amount of the time. The nearest receptor cluster R01 and ecological receptor R09 are expected to receive light winds from the site for a low (2%) amount of the year.
- *Intensity* – Based on complaint data odour intensity is causing impacts at the nearby sensitive receptors. Most of the odour complaints are due to impacts at the nearest residential cluster, Green Island suburb (southeast) (R01), which is approximately 120 m east of the site.
- *Duration* – Based on the complaint data the duration of odour impacts ranged from less than an hour to more extended periods, however more than half of the complaints where duration was specified were due to odours which lasted for 1 day or less. Where the specified duration was 1 week or more, this was believed to be due to intermittent odour impacts.
- *Offensiveness* – Generally any odour impact which leads to a complaint is considered offensive, however based on the comments provided with each complaint a range of odour offensiveness was observed.
- *Location* – The most impacted area based on complaint data was the Green Island suburb (southeast) residential cluster likely due to the close proximity of these receptors.

Based on the results of the FIDOL assessment of the existing operations the following existing and proposed management and mitigation measures outlined in **Table 21** and described in the Air Quality Report in **Appendix 7** are proposed to be implemented to reduce and minimise future impacts on sensitive receptors. These mitigation measures are based on the existing operational practices described in the LDMP and amended where necessary to represent best practice adopted at other New Zealand landfills.

Table 21 – Proposed Source Specific Odour Mitigation Measures

Source	Existing mitigation	Additional mitigation measures
LFG flare and engine LFG	• Conducting regular walk-over inspections of the landfill to identify any damage to the cover system and to monitor the effectiveness of the mitigation measures employed. • Mowing and/or maintaining landfill surfaces that are grassed to allow effective surface emission monitoring. • Undertaking instantaneous surface monitoring (ISM) on (at minimum) an annual basis to identify any areas of capping that need to be remediated.	• Establishing 24 hour emergency maintenance agreements with equipment manufacturers (particularly for the flare and engine) to limit the impact of equipment failures. • Replacing the existing candlestick flare with an enclosed flare to handle the total volume of LFG predicted to be collected in the future, so that 'shut downs' at GIWWTP do not lead to interruptions in processing.
Odorous deliveries, including deliveries from wastewater treatment plants.	• A stockpile of suitable cover material shall be located near to the disposal area to allow the waste to be immediately covered. • The bins shall be completely emptied as far as practicable to minimise the amount of residual material retained in the bin which can cause odour nuisance as the truck leaves the site and travels back to its next pick-up point. • A dedicated temporary disposal area shall be developed for biosolids within the active landfill face and this waste shall be placed directly into a prepared hole and immediately covered. • Transportation routes to the landfill can be optimised to minimise the amount of time spent on local roads and waiting at intersections. • Placement areas shall be located as far as practicable from the nearest sensitive receptors. • Implementing protocols to forewarn of the arrival of odorous wastes (examples include non-stabilised biosolids and offal, and deliveries from the wastewater treatment plants) at the landfill so that proper preparations can be made to mitigate odour emissions once the waste is received at the tip face i.e. to cover as soon as the waste is placed. • Training weighbridge staff to identify potentially odorous or unexpected highly odorous deliveries, and to hold such deliveries until such time as tip face operators have measures in place to place and cover the waste quickly and mitigate emissions that occur.	• Refuse will be placed in sealed truck and trailer units or bins while transported to site (no open bin trucks). • Deliveries of highly odorous waste shall be prioritised and allowed to proceed directly to the tiphead. • Majority of wastewater biosolids will be treated (stabilised with lime) prior to arriving at the site. • Investigation of odour complaints shall be undertaken to determine the contributing factors and identification of improvements to odour control procedures. • Where delivery of a particular odorous material remains a consistent driver of complaints despite full employment of the recommended mitigation measures, further investigation should be carried out, including re-assessment of the suitability of receiving this waste at the landfill into the future.

Source	Existing mitigation	Additional mitigation measures
Sludge pit		• Nearly all wastewater biosolids will be treated (stabilised with lime) prior to arriving at the site.
Tip face	• Keeping the size of the tip face to a minimum. • The refuse tip head will be located close to the refuse placement area to avoid pushing the refuse a long distance that would otherwise increase the odour potential. As the refuse placement area changes, the tip head will closely follow that placement area. • Works areas shall be covered at the end of each working day and no refuse shall remain exposed overnight.	• The tip face will be located further away from the nearest receptors (R01). • Significantly reduced putrescible content (from July 2024). • Tip face size will be limited to a width of 30 m
Irregular activities, including daggering through old waste		• An activity specific management plan should be developed which considers the specific construction plan; • Minimise open areas; • Have suitable material to cover excavation if significant odour is observed that could cause complaints; • Use of the odour cannon to minimise odour nuisance while excavating old waste; and • Regular odour scouting.
Unfavourable meteorological conditions	• Scheduling activities such as extensive excavations into old waste (an activity that is only undertaken under exceptional circumstances) that have increased potential to generate odour to days when wind direction is away from sensitive receptors.	• Transport to the landfill shall be arranged so that deliveries arrive between the hours of 10 am and 4 pm, as this time of day generally provide better odour dispersion conditions. • During low wind speed conditions (winds <3 m/s) an odour cannon shall be setup and operated downwind of the disposal area.
General odour emission sources	• Implementing and maintaining good housekeeping standards on the site. • If required the supply of a trailer mounted odour cannon can be deployed upwind of the odour source to provide improved distribution and mixing of odour neutralisers towards receptors. The particular conditions under which odour sprays will be used, will be set out in the LOP	• Deliveries to be arranged so that trucks are not waiting outside the gate prior to the landfill opening for the day.

Source	Existing mitigation	Additional mitigation measures
	• Implementing systems for identifying areas for improvement and recording corrective actions. • Maintaining a log of all odour complaints, including investigations by Site Management to identify the source, actions taken to minimise odour emissions, and feedback to the complainant.	

The FIDOL assessment has been repeated to estimate future impacts on receptors, considering the above management and mitigation measures and proposed changes to the site. The outcomes of the assessment were:

- The *frequency* of low winds will remain unchanged. While sensitive receptors R05 and R09 are at a location where low winds (<3 m/s) occur a moderate amount of time, these wind conditions would have to coincide with significant odour being generated by the landfill for adverse effects to occur.
- Continued site operations are expected to result in a low *intensity* of odour impacts from general operations, by for example maintaining good housekeeping standards onsite, having cover available in case of unexpected odorous deliveries, and minimising activities where possible on days with unfavourable meteorological conditions.
- The *duration* of impacts will be reduced by procedures which identify odour sources as soon as possible and apply mitigation measures such as cover to minimise emissions. For odorous deliveries including those from wastewater treatment plants, planning for receival and prioritising the processing of odorous wastes will reduce the duration of emissions. Establishing maintenance agreements and replacing the existing candlestick flare with an enclosed flare as a backup will minimise the duration of interruption to LFG flare and engine operation which will reduce the duration of impacts.
- *Offensiveness* of impacts from odorous deliveries will be mitigated by requiring loads to be treated prior to delivery (for example by requiring the wastewater biosolids to be stabilised with lime). Where offensive emissions are unavoidable, implementing an odour cannon upwind of the odour source to minimise impacts at receptors will aid in minimising impacts.
- Regarding *location*, the Green Island residential area, particularly Clariton Ave, is expected to be the most likely receptor cluster to encounter odour. A range of contingency measures have been recommended should odour be observed in this area, including minimising truck waiting times outside the site, operation of an odour cannon during low wind speed conditions. In addition, the location of the tip face under the remaining landfill staging will progress further west than previously and will therefore be further from this receptor cluster.

The volume of organic waste accepted at the landfill reduced from July 2024 when kerbside food and organic waste collection commenced. This material collected at the kerbside together with garden greenwaste received at the site is consolidated within the ORB, and then transported for composting off site. The existing garden greenwaste composting operation on the site has

ceased. The odour from the organic waste received at the ORB is largely contained within the ORB which greatly reduces the odour intensity when compared to the composting of green waste in the open previously.

Based on the implementation of the proposed management and mitigation measures and proposed changes to the site, odour discharges are therefore expected to reduce in terms of both intensity, frequency, and duration. While odours may still be detectable on occasions at or near the site boundary, providing the proposed mitigation measures are rigorously implemented, the likelihood of off-site odours being considered offensive and objectionable is low.

8.4.3. Dust Effects

Assessment of the effects of dust has involved a qualitative assessment of dust impacts from the site using the FIDOL factors provided in Good Practice Guide for Assessment and Managing Dust (GPG Dust) considering proposed management and mitigation measures and proposed changes to the site.[47]

The following management and mitigation measures described in the Air Quality Report in **Appendix 7** and based on the existing operating practices described in the LDMP, are proposed to minimise the potential for off-site dust emissions:

- A maximum speed limit of 30 km/hr will apply in all areas of the site.
- Roads within the waste diversion/transfer facilities area will be sealed and well maintained.
- Water-carts will be used on both sealed and unsealed roads as required during dry periods.
- Temporary roads on the landfill will be maintained and graded.
- Dust generating wastes will be treated as a special waste. The customer will be required to dampen down the load prior to delivery to site, and special controls will be implemented at the disposal point, e.g. water sprays, waste pit, etc.

The greatest potential for nuisance dust to occur from the operation of the landfill is from the acceptance of dusty waste and vehicle movements on unpaved roads within the site. Based on wind data from the on-site automatic weather station described in **section 7.2**, winds blowing towards sensitive receptors with a speed >5 m/s are expected to occur at most 2% of the time (westerly winds towards R01). The GPG Dust states that nuisance dust effects are generally only experienced within 300 m of unmitigated dust sources. With implementation of the proposed mitigation measures, dust is expected travel up to 100 m from the source. As the nearest receptor (where sensitivity to dust is increased) is greater than 100 m from the landfill, it is not expected that there will be any significant dust deposited at these locations.

[47] Good Practice Guide for Assessing and Managing Dust, Ministry for the Environment, 2016.

8.4.4. Landfill Gas Effects

LFG is a complex mixture of different gases produced by the degradation of biodegradable waste materials deposited within landfill sites. The emission rate and chemical composition of LFG varies depending on many factors including waste type, time, moisture content, temperature, etc. LFG comprises primarily of methane, carbon dioxide, oxygen, and nitrogen with trace amounts of reduced sulphur compounds and volatile organic compounds. The timescale for the evolution of significant quantities of LFG typically varies from 3 to 12 months following waste deposition and can continue for well over 30 years following the termination of waste landfilling activities.

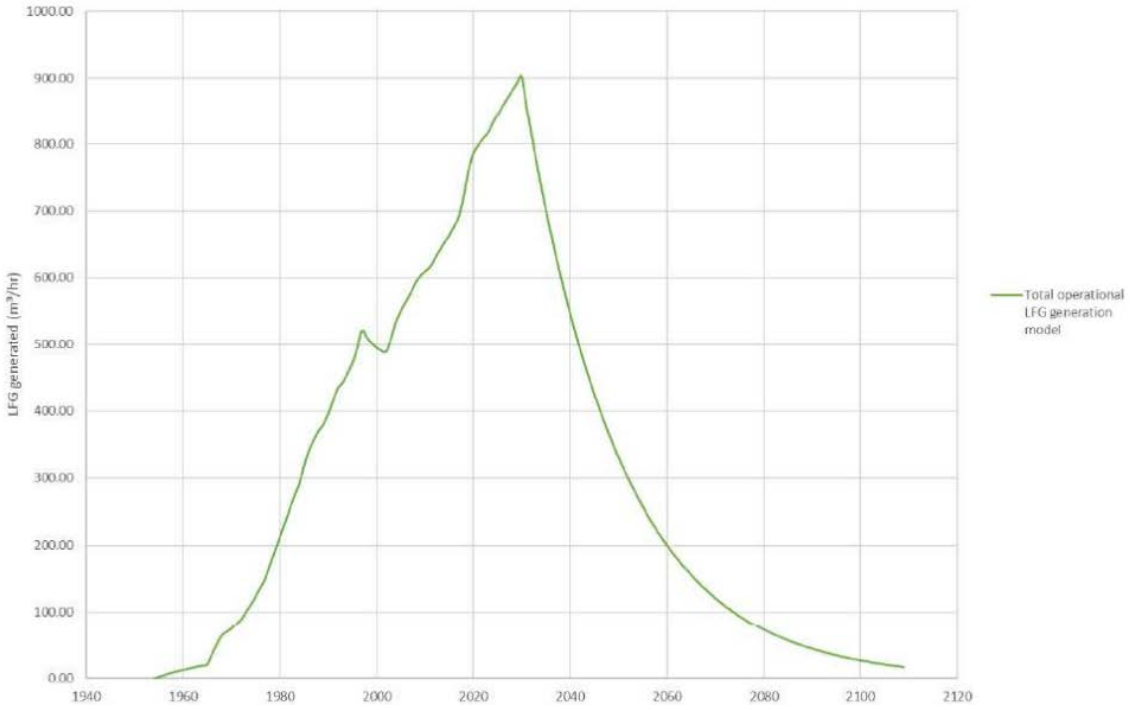
LFG can cause health, safety, amenity, and environmental impacts due to the gases it contains. Under certain conditions, LFG can:

- Be flammable and explosive.
- Present an asphyxiation (suffocation) hazard.
- Be toxic to humans, flora and fauna.
- Be odorous and corrosive.
- Contribute to greenhouse gas emissions.
- Contribute to photochemical smog.

The NESAQ requires landfills that will exceed 1M tonnes of waste to have an LFG collection and destruction system and meet a maximum surface methane concentration of 5,000 ppm. GIL has an existing LFG collection and destruction system which is compliant with the NESAQ requirements. A Landfill Gas Masterplan was prepared by Tonkin+Taylor in 2021 in which a review of the existing LFG system was undertaken and detailed the design work and gas collection wellfield expansion required to maximise gas collection and destruction at the site. The masterplan was updated in September 2023.

The potential magnitude of LFG emissions from the site over time has been taken from the updated Tonkin+Taylor Landfill Gas Masterplan. This data is based on the proposed final landfill surface and a landfill closure date of 2030. The estimated modelled LFG generation rates from the Masterplan are shown in **Figure 17** below.

Figure 17 – Estimated LFG Generation Rates for GIL



The graph shows:

- The total LFG emission rate at the site will peak in 2030 at 903 m^3/LFG/h and will steadily decrease every year post 2030.
- The maximum LFG collection rate at the site will peak in 2030 at 722 m^3/LFG/h based on an assumed collection rate of 80%.

Based on the magnitude and longevity of the estimated emission rates, active LFG management using flares and/or engines will likely be required at the site for many decades to appropriately manage the LFG emitted. The following measures described in the Air Quality Report in **Appendix 7** are proposed to ensure the management of LFG at the site:

- Installation and connection of additional wells to the LFG network as areas of landfilling are completed and permanently capped as shown on Drawing 12547621-C501 in **Appendix 3**.
- Replacement of the existing candlestick flare with an enclosed flare at the GIWWTP to manage the increase in LFG generated, as recommended in the Landfill Gas Masterplan. The flare will be designed to meet the requirements of regulation 27 of the NESAQ.
- Commissioning of a second mobile solar flare to ensure LFG from wells that are not connected to the LFG network is appropriately managed.

Combustion emissions from the existing LFG engine and flare have been estimated using AERMOD atmospheric dispersion modelling to determine the potential air quality effects associated with their operation. The principal air pollutants from combustion include nitrogen dioxide (NO_X), carbon monoxide (CO), particulate matter ($PM_{2.5}$ and PM_{10}) and sulphur dioxide (SO_2) and small amounts of volatile organic compounds (VOCs).

The capacities of the existing flare and engine are 450 m^3/hr and 350 m^3/hr respectively, providing an overall LFG processing rate of 800 m^3/hr which is greater than the maximum estimated LFG collection rate of 722 m^3/hr. Emissions have been modelled for one flare and the engine operating at capacity (a total processing rate of 800 m^3/hr) for all hours of the day. This approach provides for a worst-case assessment of emissions and provides flexibility accommodating both the proposed new enclosed flare, and the existing flares/engine to be upgraded in the future without needing to vary the resource consent.

The outputs of the model were compared with the relevant health-effect based air quality criteria contained in the following documents (in priority order)

- Ministry for the Environment, Resource Management (National Environmental Standards for Air Quality) Regulations, 2004 (NESAQ);
- Ministry for the Environment, Ambient Air Quality Guidelines (2002 update) (NZAAQG);
- Regional Air Quality Targets (RAQT) – Otago Ambient Air Quality Targets (OAQT); and,
- World Health Organisation air quality guideline (WHO AQG) Global Update 2021.

The results of the modelling showed:

- Predicted 1 and 24-hour average NO_2 concentrations, including background, are predicted to be well below the relevant health-effect based assessment criteria at all off-site locations. The maximum off-site annual average NO_2 concentration, including background, was 19 µg/m^3 which is less than the ecological guideline of 30 µg/m^3.
- Predicted 1 and 8-hour average CO concentrations, including background, are predicted to be well below the relevant health-effect based assessment criteria at all off-site locations.
- Predicted 24-hour and annual average PM_{10} concentrations, including background, are predicted to be well below the relevant health-effect based assessment criteria at all off-site locations.
- Predicted 24-hour and annual average $PM_{2.5}$ concentrations, including background, are predicted to be well below the relevant health-effect based assessment criteria at all off-site locations.
- Predicted 1 and 24-hour average SO_2 concentrations, including background, are predicted to be well below the relevant health-effect based assessment criteria at all off-site locations. The maximum off-site annual average SO_2 concentration (including background) was 5.3 µg/m^3 which is less than the most stringent ecological guideline of 10 µg/m^3.

Based on the results of the modelling, the potential for adverse health or ecological effects from the flare and engine emissions are expected to be very low. Additionally, as the site is located within a polluted airshed, PM_{10} impacts must comply with regulation 17 of the NESAQ. This requires that site discharges must not '*increase the concentration of PM_{10} (calculated as a 24-hour mean under Schedule 1) by more than 2.5 µg/m^3 in any part of a polluted airshed other than the site on which the consent would be exercised'*. The modelling of PM_{10} concentrations outside of the site boundary are below 2.5 µg/m^3 and therefore the site complies with Regulation 17.

Regular monitoring of LFG is undertaken at the site to confirm the effectiveness of the collection system and enable detection of any LFG escape that may present a hazard or nuisance to sensitive receptors. This consists of:

- Quarterly walkover visual inspections of the LFG system and landfill surface.
- Annual surface emission (ISM) monitoring using a portable gas detector.
- Monthly monitoring in three monitoring wells (G1 – G4) outside the landfill footprint using a portable gas detector for methane (CH3), carbon dioxide (CO2), and oxygen (O2) percent compositions along with carbon monoxide (CO), and hydrogen sulphide (H_2S) concentrations.

No methane or hydrogen sulphide were detected present in the monitoring wells in the 2021 - 2022 monitoring period or for the years prior to this. However, CO2 was recorded present in the wells on several occasions with values ranging from 0.1% to 10.9%. It is possible that gases including CO2 are present in the adjacent leachate collection trench and the culvert from the *south eastern constructed wetland* to the *eastern constructed wetland* that are migrating into the wells. There is no guidance contained in the WasteMINZ Disposal to land guidelines for trigger values for CO2 concentrations. From the data collected, these concentrations CO2 are not considered to pose a risk.

The potential risks associated with subsurface offsite escape of LFG are addressed in the LFG Risk Assessment Prepared by Tonkin + Taylor, attached as **Appendix 21**. The assessment concludes that there is a negligible to low risk of lateral migration of LFG impacting adjacent site users due mainly to the low permeability of the natural materials underlying and surrounding the landfill, and the shallow groundwater level which limit the ability for LFG to migrate beyond the boundary.

The same monitoring regime is proposed for the continued operation, closure, and aftercare of the landfill, with the exception that walkover visual inspections of the LFG system and landfill surface are proposed to occur monthly rather than quarterly. Surface emission (ISM) monitoring is also proposed to occur quarterly rather than annually.

8.4.5. Air Quality Conclusions

Recognising the management and mitigation measures, and monitoring for odour, dust, and LFG described above, proposed conditions of consent are included in **Appendix 17**, which require:

- Installation of LFG gas wells, destruction of LFG by engines or flares, and ongoing operation and maintenance of the LFG systems.
- Review and certification by ORC of the detailed design for any LFG destruction system, and the landfill cap prior to construction, and post construction CQA reporting.
- No odour or dust beyond the boundary of the site that is noxious, dangerous, offensive, or objectionable.
- Implementation of effective measures to minimise odour and dust.
- Limiting the size of the active landfilling area.
- Implementing procedures for the acceptance of highly odorous waste, including pre-booking, treatment of biosolids, and immediate cover.

- Placement of daily and intermediate cover, and final landfill cap, and maintenance of the cap.
- Visual inspections of the landfill surface monthly and after storm events.
- Maintaining and automatic weather station on site.
- Comprehensive LFG monitoring, analysis, and reporting,
- Complaints procedures.

Overall, with these mitigation measures and proposed conditions, odour impacts will reduce such that the likelihood of off-site odours being considered offensive and objectionable is low. Dust emissions are not expected to cause any adverse effects beyond the site boundary, and combustion emissions from the LFG engine and flares will meet the relevant air quality criteria, and regulation 17 of the NES-AQ. There is a negligible to low risk of subsurface LFG migration beyond the site boundary. Accordingly adverse effects on environment and any persons are expected to be low and no more than minor.

8.5. Landfill Fire Effects

Potential landfill fire effects from the continued operation of the landfill include:

- Fire spread beyond the site into surrounding properties.
- Health effects due to people being exposed to pollutant emissions from burning waste smoke.
- Hazard risks for landfill personnel and users, such as burns, explosions, subsidence, and exposure to hazardous materials.

Potential landfill fire effects of the continued operation of the landfill are addressed in the Fire Report attached to the Design Report in **Appendix 3**. The Fire Report:

- Undertakes an assessment of the risks of a fire occurring on site during operations and following closure.
- Describes fire prevention, detection, and mitigation techniques.
- Describes procedures in the event of a fire emergency and following a fire.

There are two main types of fires that occur at landfills.

- Surface fires at a landfill in recently placed and/or exposed waste.
- Subsurface fires (sometimes referred to as deep-seated fires or ‘hot spots’) caused by exothermic reactions that occur below the surface of the landfill or from a surface fire not being extinguished and extending into the waste. Subsurface fires tend to travel slower than surface fires and are limited to the extent of the landfill.

The source of surface and sub-surface fires can include batteries, hot waste materials, vehicle engines, spontaneous combustion, air ingress, arson, over extraction of LFG, poorly maintained/faulty wiring in equipment, and LFG fuel ignition. Eleven fires have occurred at GIL since April 2016, caused by batteries, hot waste materials, chemical reaction from a hydrated lime delivery, and machinery. All fires were rapidly extinguished by on site staff, except for two fires where FENZ assistance was called.

Historically, no landfill fire has spread off-site via vegetation internal or external to the site, and the highly modified and fragmented nature of vegetation cover within and surrounding the site ensures a relatively low risk of any landfill fire spreading from the site. The existing perimeter access road, accessible to FENZ fire appliances, enables fire responders to contain and extinguish any vegetation fire burning in fragmented patches of vegetation cover at the site.

The following existing and proposed management and mitigation measures outlined in **Table 22** and described in the Fire Report are proposed to be implemented to prevent, detect, report, mitigate, and respond to landfill fires. These measures are based on the existing practices described in the LDMP and amended where necessary to represent best practice and reduce the risk of landfill fires occurring or spreading at the site.

Table 22 – Fire Prevention, Detection, Reporting, Mitigation, and Response Measures

Type	Measures
Prevention	• A review of the sites waste screening procedures will be completed by 1 October 2023 to lower the potential for prohibited and higher risk flammable wastes to be landfilled at the site. • The tip face will be kept under supervision. The tip face will be limited 300m2 where the fire rating is very high or extreme. • Cover materials will comprise insert non-combustible materials. Combustible materials will not be stockpiled in the landfill area. • A 10m wide firebreak free of vegetation will be maintained around the active landfilling area. • Water tanks with a capacity of 60,000 L will be installed close to the active landfilling area, and the site water cart will be retrofitted with a water cannon, or alternative a portable pump maintained on site. • On very high and extreme fire days ensuring that water cart is moved close to the tip face, and water tanks checked to ensure they are full. • Plant and equipment will be inspected, maintained, and cleaned to prevent accumulation of waste. Vehicles will be stored off the active landfill face when not in use. Any fuel spills will be cleaned up immediately. • The LFG collection system will be operated, monitored, and maintained in accordance with best practice guidance, including monitoring of oxygen and carbon monoxide as indicators air ingress and of sub-surface fire. • The ability of FENZ to access the site's hydrants' water tanks, and sediment ponds will be confirmed annually.
Detection. and reporting	• Operational staff will be trained on the detection of surface and sub-surface fires. • A thermal imaging camera will be used to confirm hot loads are not deposited and any surface fires or exposed smouldering waste is extinguished. • Installation of a fixed thermal imaging camera capable of scanning the tip face and vegetated surface of the landfill and triggering an alarm if a surface fire is detected. • Monitoring of carbon monoxide in the LFG collection system will be undertaken to detect sub-surface fires. • Once a fire is detected, regular monitoring of LFG on a daily basis for a period of two weeks.

	• Isolating and turning off the LFG system in the area of any surface or sub-surface fire that is not rapidly extinguished.
Mitigation and readiness	• The site access and internal road network will be maintained to provide access for FENZ appliances and ensure access to site water supplies and borrow area. • Water supplies will continue to be provided on site, including the addition of tanks with a capacity of 60,000 L close to the active landfilling area. • Low flammability tree species will be used in any future planting on the site, as described in **section 4.8**. • On site evacuation plans will be maintained. • On site plant and equipment, including the water cart and compactor, and PPE will be maintained on site. • Operational staff will be trained in first response and fir rescue training, and fire drills undertaken.
Fire response	• Fire response procedures will be maintained which provide for the extinguishment of fires, safety of personal, site evacuation, monitoring to confirm fire extinguishment, incident reporting, and post incident investigation of fire cause and review of fire management measures and procedures.

Recognising the management and mitigation measures for landfill fires described above, proposed conditions of consent are included in **Appendix 17**, which require:

- The inclusion of waste acceptance criteria in the LDMP which all material accepted into the landfill must meet, and the annual review of the criteria.
- Implementation of the outcomes of the review of the waste screening procedures and installation of a thermal imaging camera covering the active landfilling area.
- No burning or stockpiling of combustible materials.
- Limiting the size of the active landfilling area during very high and extreme risk.
- Maintaining fire breaks and providing water tanks near the active landfilling area.
- Fitting of a water cannon to the sites water cart or provision of a portable pump.
- Keeping the active landfilling area under supervision during opening hours.
- Placement of non-combustible daily and intermediate cover, and final landfill cap, and maintenance of the cap.
- Ongoing operation and maintenance of the LFG systems to minimise risk of landfill fires.
- Use of low flammability species in any future landscape planting.
- Visual inspections of the landfill surface monthly.
- Comprehensive LFG monitoring, analysis, and reporting.

Overall, with these mitigation measures and proposed conditions, the risks associated with a fire will be low such any adverse effects on environment and any persons are expected to be low and no more than minor.

8.6. Bird Hazard, Pests, and Litter Effects

8.6.1. Bird Hazards

Putrescible waste is attractive as a food resource for several bird species, as it is generally abundant, easily obtained, and nutritionally adequate. Landfills that provide access to putrescible wastes can significantly influence local bird populations, by increasing breeding activity, population size, and resulting in behaviours that are increasingly urbanised. When this occurs close to airports, it can result in the increase in bird strike risk, compromising aviation safety.

Potential bird hazard effects for aviation safety from the continued operation and closure of the landfill are addressed in the Bird Hazard Report in **Appendix 8** prepared by aviation bird hazard experts Avisure. The Bird Hazard Report:

- Describes the existing bird species and populations present at GIL and Dunedin International Airport.
- Describes the risk that these bird species present for aviation safety.
- Undertakes a risk assessment of bird species present for aviation safety based on the proposed removal of the majority putrescible waste from July 2024 and the ultimate closure of the landfill.
- Describes mitigation measures to mitigate risks to aviation safety, and particularly from SSBG, by way of implementing a SSBG Management Plan.

The New Zealand Aviation Authority (**CAA**) and International Civil Aviation Authority (**ICAO**) guidance recommend that landfills be located no closer than 13km from an airport, such as Dunedin International Airport. Landfills within 13km require careful planning, monitoring, and operation to mitigate potential bird strike risks. GIL is located approximately 16km from Dunedin International Airport, beyond the 13km recommended in the CAA and ICAO guidance. The airport however has an existing bird strike risk that is considered high, and therefore any land use changes should aim to ensure that risk is not exacerbated.

The main bird species attracted to landfills in New Zealand include the SBBG, red-billed gull, rock dove/pigeon, starling, house sparrow, various finch species, and ducks and shags that can be attracted to landfill waterbodies such as retention ponds. By far the most significant hazard to aviation in New Zealand are gulls, particularly the SBBG. They are predators and scavengers and are attracted to food scraps and organic waste. As described in section 7.8, the GIL site supports a variety of bird species, with SBBG present in the thousands, and red-billed gulls regularly in the low hundreds. Other species are in relatively low numbers.

As described in **section 3.4.2**, commencement of the kerbside collection of food and organic waste from Jul 2024 has removed most of the putrescible waste from the general waste stream that currently enters the landfill. This and the ultimate closure of the landfill, will result in this food source no longer being available to birds. In the short-medium term as populations readjust to the reduced availability of food, birds are likely to search for alternative food sources nearby, potentially bringing them into aircraft flight paths and presenting an aviation hazard. In the long-term, bird populations reliant on the landfill are likely to stabilise at lower levels, and any resultant bird strike hazard will reduce.

Review of the species present at GIL, and cross referencing those with bird strike data (obtained from Dunedin International Airport Ltd) and bird surveys was used to complete an aviation industry standard risk assessment of the potential for birds to enter flight paths and present an aircraft collision risk. This assessment considered GIL has a moderate chance of increasing the short-term hazard present within the airport's critical airspace. While the landfill supports a very high proportion of the regional SBBG population, the airport does not current attract large numbers of SBBG. Landfill closure may result in more SBBG being present around the airport while they search for new food sources.

Because of their size and flocking nature, and presence in the bird strike records, SBBG are already a high-risk species for the airport. As a result, it considered necessary to mitigate the potential risk associated with the moderate hazard rating. Although present in the hundred's, red billed gulls are considered a low probability of causing a short-term hazard as they appear not to use the Dunedin aviation airspace in significant numbers, and the GIL population is only a small proportion of the overall population. Starlings are considered to have a very low, and other species a negligible, probability of increasing hazard as their numbers are very low at the landfill.

To address the medium probability of an increased bird strike hazard arising from SBBG dispersing after the removal of most of the putrescible waste, and ultimate closure of the landfill, it is proposed to implement a comprehensive SGGB Management Plan. The development of the plan is already a requirement of condition 52 of the discharge of waste to land resource consent (ref RM20.280.1) for the future Smooth Hill landfill. The purpose of the plan is:

> *"to manage Green Island Landfill food availability and the breeding success of the existing SSGB population at Dunedin breeding sites where access is available, with the objective of reducing the existing level of bird strike risk to aviation prior to closure"*

The plan has been developed in consultation with Te Rūnanga o Ōtākou, the Department of Conservation, and Dunedin International Airport Ltd and provided to ORC as required by the Smooth Hill consents. The plan is attached in **Appendix 9**.

As well as being a requirement of the Smooth Hill consents, the plan is proposed to form part of the replacement consents for the GIL. The plan also includes provision for monitoring of red-billed gulls to ensure no increased risk to aviation hazard from this species.

8.6.2. Pests

Vermin such as rats, mice and feral cats can be brought to the site in loads of waste or are attracted by the food source and migrate from surrounding areas. Vermin can spread disease, cause property destruction, and contaminate food. Flies may become a problem over summer months and are capable of transmitting salmonella and other food-borne diseases.

The existing LDMP includes various measures for controlling pests and flies that will be applied during the continued operation of the landfill to ensure the site is as kept as pest free as possible:

- Implementing good housekeeping practices.
- Thorough compaction of waste in the landfill and application of daily and intermediate cover.
- Regular inspection by pest control contractors and setting of bait stations, or use of insecticide sprays for flies.

In addition, implementation of the kerbside collection of food and garden waste from July 2024 has reduced the amount of such waste entering the landfill and providing a source of food and attraction for pests.

8.6.3. Litter

Uncontrolled litter is unsightly and impacts on the surrounding land, roads and neighbours. It can contribute significantly to loss of amenity experienced at the landfill site and neighbouring properties.

The existing LDMP includes various measures for controlling litter that will be applied during the continued operation of the landfill to ensure the site is as kept as litter free as possible:

- Keeping the landfill securely fenced and gated to avoid indiscriminate dumping outside of the landfill opening hours.
- Minimising the area of the tip face.
- Prompt compaction of waste in the landfill.
- Application of daily cover.
- Use of litter nets and fences, and relocatable fences placed as close as possible immediately adjacent to the tip face. Regular removal of windblown litter on the site and adjacent areas.
- Keeping the waste diversion and transfer facilities tidy.

8.6.4. Conclusions on Bird Hazard, Pests, and Litter

Recognising the management and mitigation measures for birds, pets, and litter described above, proposed conditions of consent are included in **Appendix 17**, which require:

- Separate collection and processing of food and garden organic waste to minimise this material entering the landfill.
- Implementing the SSBG Management Plan to reduce the existing level of bird strike risk to aviation.
- Limiting the size of the active landfilling area.
- Placement of daily and intermediate cover, and final landfill cap, and maintenance of the cap.
- Preventing windblown litter leaving the active landfilling area, and the monitoring and removal of litter.
- Eradication of pest plants, mammalian pests, and feral cats as far as practicable.
- Visual inspections of the landfill surface monthly.
- Comprehensive LFG monitoring, analysis, and reporting,

Overall, with these mitigation measures and proposed conditions, the bird hazard risk to aviation safety, and adverse effects of pets, and litter will be appropriately managed to ensure they are low and no more than minor on the environment, and on any persons.

8.7. Effects on Landfill Stability

Potential land stability effects from the continued operation, closure, and aftercare of the landfill include:

- Earthquakes causing liquefaction, slope deformation, and lateral spreading.
- Elevated leachate/groundwater levels in the landfill leading to a loss of stability.

Potential effects on landfill stability under static, elevated leachate/groundwater, and earthquake seismic loads are addressed in the Liquefaction and Stability Report in **Appendix 11**. This assessment:

- Identifies seismic hazards at the site informed by a Probabilistic Seismic Hazard Assessment (PSHA).
- Assesses the liquification susceptibility of the underlying soils of the site.
- Assesses slope stability and lateral spreading of the landfill closure design along a series of cross sections with a variable landfill structure. Analysis included static, elevated groundwater, servicing limit state (SLS), ultimate limit state (ULS), seismic, and post-earthquake stability.
- Estimates of the size of likely displacements for unstable slopes.
- Considers the influence of areas of sludge within the landfill on stability.

The assessment has been informed by the underlying geology and geotechnical investigations described in the Geotechnical Investigation Report in **Appendix 10**, and groundwater and leachate levels obtained from monitoring wells around and within the landfill. Geotechnical design parameters, different groundwater/leachate design scenarios, and seismic parameters derived from the Probabilistic Seismic Hazard Analysis (PSHA) which considered the nearby known faults described in **section 7.3**, were all utilised as inputs to the stability assessment.

An assessment of the likelihood of liquefaction has been conducted for the site in accordance with the recommendations provided in the Earthquake Geotechnical Engineering Practice Module 3.[48] Results from the assessment indicate that majority of natural soils underlying the landfill are not liquefiable. However, some layers in the UKEM geological unit that exhibit sand-like behaviour are likely to undergo liquefaction under a ULS seismic event, and up to 35 mm of free field settlement is likely. Given that the reported free field settlement is reasonably small, the impact on the landfill and other infrastructure at the site is likely to be minimal.

Slope stability assessments have been undertaken for six cross sections (sections 1 – 6) around the perimeter of the landfill. The six cross sections represent a range of internal landfill structure around the perimeter, having varying fill, final fill height, and thickness of the underlying estuary. Limit equilibrium slope stability analysis was completed for each cross section and assessed against minimum slope stability factors of safety (FoS) criteria which are consistent with current practice adopted in New Zealand, including at other landfill sites. Lateral spreading was assessed in accordance with the NZ Bridge Manual. [49]

[48] Ministry of Business Innovation, Employment, & New Zealand Geotechnical Society, 2021

[49] Waka Kotahi New Zealand Transport Agency, 2022

The following conclusions were reached from the assessment regarding the stability of the landfill under static and seismic loads:

- All six cross sections meet the FoS stability criteria for all static load cases.
- For the seismic SLS load case, only sections 3, 4, and 5 met the FoS requirement. During a SLS seismic event, the landfill is however expected to remain stable with negligible slope deformation (i.e., ≤ 5 mm).
- None of the sections meet the FoS requirement under the design ULS seismic event. During an ULS seismic event, the landfill is likely to variably deform around the landfill perimeter, with the magnitude of slope deformation dependent primarily on the underlying ground conditions (which are variable) and the presence of internal perimeter bunding. The total seismic induced slope displacement is likely to be in an order of 35 to 325 mm in areas where there is no liquefiable layer present and 270 to 930 mm where a liquefiable layer is present.
- In areas where liquefaction is expected to occur under ULS seismic event, up to 200 m from the free face could experience lateral spreading, depending on the continuity of the liquefiable layer and other factors. The northern, western and southwestern perimeter of the landfill are likely to move in the order of 270 to 930 mm towards the nearest free face (i.e. Kaikorai Stream or sediment ponds). Multiple cracks are likely to form near riverbanks, at the toe of landfill and within the landfill and cap. Damage to the existing leachate collection trench is likely, including the buried rising main which collects leachate from the leachate pump stations.
- No *lateral spreading* is likely in areas where liquefaction is not expected to occur under a ULS seismic event. Around the eastern perimeter of the landfill, smaller ground movement, in the order of 75 to 325 mm, is anticipated. Cracks and local slumping of landfill and capping is likely, and the leachate collection trench may experience deformation from the ground movement.
- Slope performance is sensitive to leachate levels in the landfill, and leachate levels should be controlled at, near, or below 12m amsl. Under an extreme event, leachate levels within the immediate vicinity of the landfill shoulder should not be higher than 16 m amsl.

Based on these conclusions, some deformation of the landfill and associated infrastructure will occur under the highest seismic loads contemplated (ULS – a 1 in 2,500-year seismic event). The level of predicted deformation (<1m) falls within the acceptable displacements based on experience at similar sites and current New Zealand design practice. However local damage to landfill infrastructure, such as piping, and capping is expected. Under all other conditions (SLS and static loads) deformation is not anticipated or will be negligible (c.5mm).

The following measures described in the Design Report in **Appendix 3** are proposed to be implemented to ensure release of contaminants to the environment is minimised during, and following, a ULS type seismic event:

- Controlling leachate levels in the landfill to generally near to, or below 12 m amsl and not exceeding 16 m amsl within 40m of the top edge of the landfill. Measures to achieve this are further described further in **section 8.3**.
- Strengthening infrastructure to be more resilient to a seismic event, including:

- Provision of an additional leachate rising main pipe on the ground surface pipe, making it more flexible and resistant to ground movement, and enabling any failure to be quickly identified and repaired.
- Provision of an additional power cable for the leachate pump stations on the ground surface and assessment of the resilience of the electrical controls for the pump stations to identify any required changes.
- Maintaining a diesel standby generator on site to run the leachate pumps in the event of loss of power supply.
- Keeping supplies of rising main pipe, power cable, and spare submersible pumps on site to enable repairs to the leachate collection trench.
- Maintaining a minimum of 5,000m^3 of intermediate cover and capping soils on site to enable emergency repairs of the cover and capping systems to minimise odour/LFG escape, and stormwater ingress to the landfill.

- Initiating emergency response measures following a seismic event. The measures that are described the Design Report will be detailed in the updated LDMP and include procedures for damage assessment; containment of ponded leachate; emergency remediation and permanent repair of the leachate collection system; tanking leachate to another WTTP if the GIWTTP is out of action; and repair of the LFG collection system and landfill cover and capping systems.

Recognising the management and mitigation measures above, proposed conditions of consent are included in **Appendix 17**, which require:

- Installation of an additional leachate rising main and power supply cable for the leachate pump stations on the ground surface.
- Review and certification by ORC of the detailed design for improvements to the leachate collection system prior to construction, and post construction CQA reporting.
- Operation of the leachate collection system to manage leachate levels.
- Maintaining standby electrical supply for the leachate collection system, and supplies of pipe, cable, pumps, and capping soils to enable post-earthquake repairs.
- Emergency response procedures within the LMDP.

Overall, these mitigation measures and proposed conditions will ensure the land stability risks from the continued operation, closure, and aftercare of the landfill will be appropriately managed such that they will be low and any adverse effects on the environment and any persons are no more than minor.

8.8. Flooding and Sea Level Rise Effects

Potential effects from flooding of the Kaikorai Stream and sea level rise on the landfill from the continued operation, closure, and aftercare of the landfill include:

- Surface water flooding in the Kaikorai Stream affecting the operation of the leachate collection trench.
- Higher water levels in the Kaikorai Stream as a result of climate change induced sea level rise increasing inflows to the leachate collection trench.

These effects are addressed in the Design Report in **Appendix 3**, Groundwater Report in **Appendix 5**, and Surface Water Report in **Appendix 6.** These assessments consider:

- Predicted increase in flood levels and sea level rise from climate change surrounding the landfill.
- Potential impacts on the landfill, and proposed mitigations.

As described in **section 7.6**, low lying areas adjacent to the GIL site are at risk of flooding from the Kaikorai Stream from the Kaikorai Estuary. ORC hazard mapping indicates the raised main landfill footprint is outside the areas at risk from flooding, but low-lying areas some around the perimeter of the landfill containing the site access road, leachate collection trench, and the *western sedimentation pond* are within it.

International Panel on Climate Change (**IPCC**) projections indicate that while annual rainfall is likely to remain similar to existing or increase slightly (<5%), there will be an increase in the frequency and intensity of extreme rainfall events. Using the IPCC upper range scenario (RCP 8.5), flood flows are predicted to increase by approximately 9% by 2050, which are expected to increase flood levels by between 60 – 100mm in the area around the landfill. Given the Kaikorai Stream channel in the vicinity of the landfill and the estuary are low energy environments, the risk of channel scour and erosion impacting the landfill are considered very low. There will however be an increased frequency of inundation of the landfill perimeter potentially affecting the operation of the leachate collection trench.

Also described in **section 7.6**, ORC hazard mapping indicates areas of the estuary and Kaikorai Stream are also at risk of storm surge. This is indicative of those areas expected to be affected by long-term sea-level rise of up to 0.5m. Sea levels are predicted to rise up to 0.25m by 2050 under the IPCC upper range scenario. This increase in sea level may result in a general increase in water levels within the estuary and Kaikorai Stream and result in an increase of water entering the leachate collection trench and manholes.

The Groundwater Report in **Appendix 5** has modelled a 0.5m rise in water levels in the Kaikorai Stream and Estuary to reflect the possible impacts of climate change over the foreseeable operational and aftercare period of the landfill. The model predicts slightly higher inflows in the order of 0.6 l/s to the leachate collection trench as a result of future sea level rise of 0.5m, however this increase is well within the operating range of the leachate system, which is designed to accommodate much higher stormwater flows.

Raising the level of the perimeter road berm that extends around the landfill between the adjacent Kaikorai Stream and the leachate collection trench by approximately 1m is proposed to form a defence against water to minimise the risk of inundation of the leachate collection trench by floodwaters. It is also proposed to raise the manholes, chambers, and electrical controls for the leachate pump stations above the predicted future flood level. These works will be completed at least 6 months prior to the final acceptance of waste.

This forming of a defence against water will reduce the width of the floodplain over which floodwaters can spread resulting in an increase in flood levels. Assessment shows that for the 1% (1-100 year) annual exceedance probability (AEP) event, the loss of flood channel capacity will be minor, and the increase in flood level would be approximately 35 mm downstream of the Kaikorai Stream/Abbotts Creek confluence, and approximately 40 mm upstream of the confluence. The estimated increase of 35 – 40 mm in peak flood levels is considered very small

and is within the limits of accuracy for hydraulic modelling. There would be no anticipated increase in flood risk to residential dwellings as a result of these works.

Proposed conditions of consent are included in **Appendix 17**, which require:

- Raising of the berm of the landfill perimeter road and pump station components to minimise the risk of floodwater inundation.
- Review and certification by ORC of the detailed design for improvements to the leachate collection system, and the defence against water prior to construction, and post construction CQA reporting.
- Visual inspections of the landfill surface monthly and after storm events.
- Emergency response procedures within the LMDP.

Overall, these mitigation measures and proposed conditions will ensure the flooding and sea level rise risks for the continued operation, closure, and aftercare of the landfill will be low and any adverse effects on the environment and any persons are no more than minor.

8.9. Terrestrial and Aquatic Ecology

Potential effects on ecological values from the continued operation, closure, and aftercare of the landfill include:

- Clearance of indigenous vegetation providing habitats for indigenous fauna.
- Effects on the aquatic environment and fauna (from toxicity) from leachate migration into groundwater and surface water and discharges of sediment to the receiving environment.
- Effects on avifauna from loss of landfill food supply, disturbance, and impacts on foraging ability.

These effects are addressed in the EcIA Report in **Appendix 12**. This assessment:

- Describes the existing environment, assesses the significance of the vegetation, habitats, and ecosystems, and assesses the ecological values.
- Assesses the ecological effects of the proposal.

The assessment of effects on ecological values has been undertaken in accordance with the EIANZ guidelines, with the magnitude of effects being described on a scale of very high – very low effects, or net gain for positive effects. Terrestrial Vegetation and Habitats for Fauna

No clearance of vegetation is required outside the landfill footprint. Vegetation clearance within the landfill footprint is unlikely to be of ecological concern, as the areas that are proposed to receive landfill have already been cleared of their original vegetation, and any vegetation that may be cleared is comprised largely of exotic species and will result in a **very low** level of ecological effect.

8.9.1. Aquatic Habitats and Fauna

As discussed in **section 8.3**, groundwater is hydraulically connected with surface water in the Kaikorai Stream, with the potential for groundwater abstraction to have a stream depletion effect.

Stream depletion could pose a risk to aquatic habitat within the stream. The groundwater modelling indicates that approximately 30% of the water pumped from the leachate trench is derived from groundwater/connected surface water on the outside of the trench in areas where the trench is close to the stream. The volume of extraction is estimated to be <0.5 L/s for the entire trench length. The mean annual low flow in Kaikorai Stream is 81 L/s and there is a clear tidal flushing influence on water levels in Kaikorai Estuary with an amplitude of generally over half a metre between low and high tides. The volume (0.5 L/s) of stream depletion is very small relative to stream flows even during low flow conditions and will result in a very low level of ecological effects.

Ongoing earthworks and construction of the final landfill cap may result in sediment discharges to Kaikorai Stream and Kaikorai Estuary, which could lead to sedimentation of habitats and an increase in mud content within the estuary. Sampling indicates sand is the predominant substrate type in the estuary and mud content is not high at 26.2%. Ongoing stormwater management will avoid or minimise sediment discharge to and sedimentation of Kaikorai Stream and estuary. including from capping activities. Given this stormwater management, the ongoing operation of the landfill is likely to result in no change, resulting in a very low overall level of effect. The establishment of vegetation cover after installation of the final cap is expected, over the longer-term, to provide effective prevention of sediment runoff.

Although no substantive evidence has been observed from groundwater and surface water monitoring and ecological surveys, ongoing landfilling has the potential for leachate contaminants to enter the Kaikorai Stream and estuary. The Groundwater Report described in **section 8.3**, confirms the leachate collection system is effective at creating a hydraulic barrier and intercepting leachate from the landfill. Given the current functioning of the leachate collection system and its continued operation, the ongoing operation of the landfill is likely to result in no change.

The Groundwater Report indicates the sites adjacent to and downstream of GIL do not exhibit any significant changes in dissolved metals concentrations, which indicates there is not a strong indicator of leachate discharge to the environment. Furthermore, there is no indication of persistent and significant levels of contamination of the sediment pond water from landfill activities, with results from the last year all below the trigger concentrations set by the existing conditions for the GIL. This also applies to the nutrient concentrations, with Ammoniacal-Nitrogen concentrations measured in the past year below the trigger levels.

The ecological data collected as part of the EcIA Report indicates stream health is compromised in sites both upstream and downstream of GIL. An ecotoxicology study completed by Cawthron Institute indicates the potential presence of organic contaminants in the surface water of the Kaikorai Stream. However, no or low toxicity in the ecotoxicology test on blue mussel embryos of the extracts taken from groundwater and surface water were observed. There was also a greater toxicity effect from surface water much further downstream, of the landfill in the Kaikorai Estuary. This suggests that there are likely additional downstream stressors, not directly associated with landfill leachate.

Overall, with the continuing operation of the leachate collection system, and maintenance of the groundwater hydraulic barrier, no discernible effect on surface water quality is expected and there has not been an indication of leachate discharge to the environment in surface water sampling. Accordingly, a **very low** level of ecological effect is expected.

8.9.2. Avifauna

As described in **section 7.8**, GIL currently is an important food source for thousands of SSBG. Implementation of the kerbside collection of food and organic waste from July 2024, has resulted in a significant reduction in putrescible waste entering the landfill resulting in considerably less food being available to SSGB. As described in **section 8.6.1**, it is intended to implement a SBBG Management Plan as required by the resource consent conditions for the Smooth Hill Landfill. This will have the effect of managing the landfill food availability at GIL and the breeding success of the SSGB population at Dunedin breeding sites where access is available.

These actions will result in a high magnitude of effect on black-backed gulls by significantly reducing their food supply and reducing their numbers. While having a negative ecological effect, SSGB are a Not Threatened species that are not protected under the Wildlife Act. They are sometimes considered a nuisance species, and at times DOC conducts colony control at braided river habitats in New Zealand to manage their numbers. A high magnitude of effects on a low value species will therefore result in a **low** overall level of ecological effects. At the time of closure, it is expected that the number of SSGB at GIL will be greatly reduced (relative to current numbers), and therefore closure will have a **very low** overall level of ecological effects.

Disturbance to avifauna foraging and roosting at the GIL (primarily black-backed gulls) will result from ongoing operation of the landfill and construction works associated infrastructure improvements on the site. The level of disturbance from ongoing operation is unlikely to change and birds currently present are habituated to this disturbance. Infrastructure construction work will be of a temporary nature (i.e. short-term) and species that may be disturbed by these works are highly mobile and can disperse to alternative areas. Accordingly, disturbance from operation and construction will have a **very low** level of ecological effects. Disturbance will be greatly reduced following closure of the landfill, and restoration may provide new habitat opportunities.

Impacts on the amount and quality food supply for avifauna could arise during the continued operation of the landfill due to risks of leachate potentially entering the Kaikorai Stream and estuary, when combined with the impacted water quality in the stream and estuary. With the continuing operation of the leachate collection system, and maintenance of the groundwater hydraulic barrier, no additional discernible effect on water quality is expected. Accordingly, it is expected that adverse effects on avifauna food supply will not be discernibly greater than those currently experienced. The continued operational impacts on avifauna food supplies will have a **very low** to **low** overall level of ecological effects. Closure of the landfill is unlikely to result in a discernible change in water quality and as such the quality of the food supply is unlikely to change.

Impacts on the foraging ability of avifauna could occur from the discharge of sediment into the estuary associated with the continued operation of the landfill. With continued on-site stormwater management, there is unlikely to be change in sediment discharge or an increase in potential negative effects on foraging ability relative to the current situation. Accordingly, the continued operational impacts on foraging ability will have a **very low** – **low** level of ecological effects. Closure of the landfill is likely to reduce sediment inputs into the estuary, but as sediment inputs are not that high currently, a discernible reduction is not expected such that the foraging ability of avifauna is unlikely to change.

Red billed gulls currently roost on the roofs of some buildings. As part of closure activities, some of these buildings will be removed and as such there will be a loss of roosting habitat for this species. Given, that some buildings will remain and that there are ample alternative structures,

roofs, and natural habitats for red-billed gulls to roost nearby and in the wider area, that loss of this roosting habitat will resulting in a **very low** overall level of ecological effects on red billed gulls.

8.9.3. Ecological Effects Conclusions

The overall ecological effects are summarised in **Table 23** below

Table 23- Summary of the Overall Levels of Ecological Effects

Ecological effect	Ecosystem Component	Ecological Value	Magnitude of Effect	Level of Effect
Terrestrial environment				
Operation: vegetation clearance	Non-native, weedy exotic herbs and shrubs	Low	Negligible	Very Low
Aquatic environment				
Operation: Groundwater drawdown	Kaikorai Stream and estuary	Moderate – High	Negligible	Very Low
Operation: Sediment discharge	Kaikorai Stream and estuary	Moderate – High	Negligible	Very Low
Closure: Sediment discharge	Kaikorai Stream and estuary	Moderate – High	Negligible	Very Low
Operation/closure: Continued leachate loss	Kaikorai Stream and estuary	Moderate – High	Negligible	Very Low
Avifauna				
Operation: impacts on food supply for black-backed gulls (short-term)	Southern black-backed gulls	Low	N/A	Positive
Operation: impacts on food supply for black-backed gulls (long-term)	Southern black-backed gulls	Low	High	Low
Operation: construction-related disturbance	Avifauna utilising GIL	Low - High	Negligible	Very Low
Operation: operational disturbance	Avifauna utilising GIL	Low - High	Negligible	Very Low
Operation: operational impacts on food supply	Avifauna utilising GIL and Kaikorai Estuary	Low – Very High	Negligible	Very Low – Low
Operation: operational impacts on foraging ability	Avifauna utilising GIL and Kaikorai Estuary	Low – Very High	Negligible	Very Low – Low

Closure: impacts on food supply	Avifauna utilising GIL and Kaikorai Estuary	Low – Very High	Negligible	Very Low – Low
Closure: impacts on foraging ability	Avifauna utilising GIL and Kaikorai Estuary	Low – Very High	Negligible	Very Low – Low
Closure: disturbance impacts	Avifauna utilising GIL	Low - High	N/A	Positive
Closure: avifauna habitat loss	Black-backed gulls Red-billed gulls	Low - High	Negligible	Very low

Overall, the continued operation, closure, and aftercare of the landfill is expected to have a **very low** to **low** (as well as some potential positive) ecological effects. Accordingly, no mitigation or offsetting of effects is considered required. Accordingly, any adverse effects on the environment and any persons are expected to be no more than minor.

8.10. Landscape, Natural Character and Visual Amenity Effects

Potential effects on landscape and natural character values, and visual amenity from the continued operation, closure, and aftercare of the landfill include:

- Modification of the character or quality of the landscape, and visual amenity as viewed from surrounding public and private locations as a result of landform and vegetation modification and built development.
- Changes to the natural elements, patterns, and experiential qualities (or naturalness) of the area arising from modification as a result of landform and vegetation modification, built development, and discharges to the environment.

These effects are addressed in the Landscape, Natural Character, and Visual Effects Report in **Appendix 13**. This assessment considers:

- The existing landscape context of the site, and the potential viewing audience and nature of available views of the site.
- Landscape character, natural character, and visual amenity effects of the proposal informed by visual simulations of the final landfill form from six public viewpoints.

8.10.1. Landscape Character Effects

Landscape character is derived from the distinct and recognisable pattern of elements that occur consistently in a particular landscape. It reflects combinations of geology, landform, soils, vegetation, land use and features of human settlement. It creates the unique sense of place defining different areas of the landscape.

The proposed closure design involves an increase in the height of the final landfill surface to the west within the existing landfill footprint so that at completion the landfill will be shaped like a wedge. The high side of the wedge will lie along the western boundary of the site at approximately 31.5 amsl, with the highest point at the southwest corner. During stages 2 – 3, the volume,

contours and form of those areas will shift and change as refuse is continuously deposited, moved, exposed, and covered, resulting in a worked character. The borrow pit will also extend to the south of the landfill footprint, cutting away the existing hill slope. Following the completion of Stage 3, the landform will be fully capped and re-grassed. The exposed cut slopes of the borrow area will also be re-grassed.

The existing character of the site is as a modified working landfill within the low-lying part of a wider basin-like landscape. The character of the surrounding area is mixed. To the south, the landscape has a predominantly rural and coastal character. To the north and east the character is dominated by built form including SH1, suburban streets and dwellings and an area with light industrial character immediately to the east. Abbotts Creek, Kaikorai Stream, Kaikorai Estuary and Pukemakamaka/Saddle Hill are key landscape features nearby, recognised as holding important values.

The site has formed part of the character of this varied landscape since it opened, so while its appearance will continually change as the landfill progresses, this change is already part of this landscape. The existing perimeter vegetation which will be maintained and replaced will continue to assist with integrating the site into the rural backdrop. Modelling of the landfill form from representative views indicates that the closure design will not compromise the landscape values associated with the Saddle Hill ONF, including views of its iconic shape. This is due to the height of the embankments and existing trees around the landfill.

Overall, the landfill will not appear prominent within views or uncharacteristic within the receiving landscape generating **low – moderate** adverse landscape character effects during operation. Once works are completed, the form and scale of the landform itself and the pattern of proposed vegetation will appear consistent with the existing rural landscape, generating **low** adverse effects.

8.10.2. Natural Character Effects

Natural character is the term used to describe the degree of naturalness in an area, and includes the natural elements, patterns, processes, and experiential qualities attributes of an environment.

The existing level of natural character at the site is highly modified. The long history of reclamation, drainage and waste disposal has considerably altered biotic and abiotic systems. Natural character of the adjacent Kaikorai Stream and Estuary is higher, particularly in regard to the birdlife it supports and scenic qualities present but are also modified. As described in **section 7.9**, the Kaikorai Estuary has been assessed as having Medium – Low natural character in the Coastal Environment of Otago Natural Character and Outstanding Natural Features and Landscapes Assessment 2015.

The proposed increase in volume and height of the landfill will not further reduce the abiotic or biotic aspects of natural character further on site or within the context of adjoining waterbodies. As the additional development remains within the existing landfill footprint, neither the active bed or river margins will be impacted. Experiential aspects of natural character may be adversely changed by a very small degree due to the extension in the operating life and height from that currently anticipated.

Overall, natural character effects are assessed as **very low**.

8.10.3. Visual Effects

Visual amenity effects are influenced by several factors including the nature of the proposal, the landscape absorption capability and the character of the site and the surrounding area. Visual amenity effects are also dependent on distance between the viewer and the proposal, the complexity of the intervening landscape and the nature of the view. A change in view does not, of itself, constitute an adverse visual effect. Landscape is dynamic and is constantly changing over time so that any change in view must be assessed within the context of the landscape which such change occurs.

Visual effects have been assessed from several viewing catchments (Areas A – K) capturing these elevated areas. In addition, the shape of the landfill closure design was modelled, and six visual simulations (VS1 – 6) were prepared to assist with understanding the potential visibility and visual effects of the landfill landform. Photographs representing each of the viewing catchments (A – K) and the simulations (VS1 – 6) are shown in the graphic supplement attached to the Landscape, Natural Character, and Visual Effects Report in **Appendix 13**.

The site is in a basin but is largely screened from close views by earth bunds and established trees around the site perimeter. The hilly character of the surrounding landscape means visibility is obscured by intervening landform from some locations, but elevated views are available from others. Views from elevated areas around the site also include potential views to the sea, the estuary, and surrounding hills and these will not be impacted. There will be no effect on views from the Clariton Ave residential area to Pukemakamaka/Saddle Hill's cone which is identified as an Outstanding Natural Feature (ONF) in the 2GP.

From all viewing catchments, the level of visual effects during operation are assessed as either **very low**, or **low – moderate**. In 'worst case' views, the viewpoint is either elevated so that the landfill is largely without the benefit of intervening vegetation but some distance from the site e.g. Thomson Street (840m away), or views are close but almost entirely screened by the perimeter vegetation so that only glimpses between trees are available e.g. potentially two storey homes on Clariton Ave (350m away). In these close views it is likely to be movement on site (such as moving vehicles) that draws the eye, and the small areas of bare soil or exposed landfill will be less apparent.

Following closure and the completion of capping, where the landfill is visible, it will appear as part of and sympathetic to the surrounding landscape. The level of visual effects at closure from all viewing catchments, are assessed as **very low** or **low**.

The effective ongoing maintenance and management of the existing perimeter trees will be essential in mitigating potential adverse visual effects. As described in **section 4.8**, the VRMP will set out the routine monitoring and maintenance necessary to promote the health and long-term stability of the existing trees, as well as proposed long-term post closure actions for their replacement and transition to native tree species which will enhance amenity values. A framework for the VRMP has been developed and is attached to the Landscape, Natural Character, and Visual Effects Report in **Appendix 13**.

8.10.4. Landscape, Natural Character, and Visual Effects Conclusions

Recognising the management and mitigation measures described above, proposed conditions of consent are included in **Appendix 17**, which require:

- Revegetation of the borrow area upon completion.
- Preparation and implementation of a Vegetation Restoration Management Plan.

Overall, with these mitigation measures and proposed conditions, landscape, natural character, and visual effects will range from low, or low – moderate during operation and reduce to very low or low at closure. Accordingly, any adverse effects on the environment and any persons are expected to be no more than minor.

8.11. Economic Effects

The economic benefits of the continued operation of the landfill are addressed in the Economic Report in **Appendix 14**. This report considers the benefits of disposal at GIL in comparison to out-of-district export and disposal of waste to the AB Lime site at Winton, approximately 200km south of Dunedin as an option to fill the gap until operations at the Smooth Hill landfill commence.

In 2016, the DCC costed out-of-district disposal in excess of $150/tonne including consolidation, transport, and disposal costs (and excluding the waste levy and Emissions Trading Scheme costs). It was estimated the out-of-district option would have to reduce to approximately $100/tonne to be financially competitive with building a new landfill at Smooth Hill. Continued disposal at the GIL site would compare favourably to the new Smooth Hill site given the much lower capital costs and better proximity to Dunedin's main population areas. The GIL site is estimated to be at least 33% more cost-effective than out-of-district disposal.

Out-of-district disposal will also result in higher emissions. Waste would need to be consolidated at a site in Dunedin, then transported in 35-40 tonne loads to the AB Lime landfill using diesel or hybrid vehicles. One truck travelling to and from AB Lime 100 times a year is estimated to generate around 75 tonnes a year in emissions. At an estimated 35,000 tonnes of DCC-managed waste needing to be disposed of each year (excluding commercial waste), this would equate to around 1,000 trucks carrying 35 tonnes making the trip each year, or 750 tonnes of CO2 equivalents a year.

Heavier vehicles also impose higher costs on the road network in terms of wear-and-tear. 1000 or more heavy vehicles (once disposal of commercial waste is included) travelling almost 400 kilometres return to an out-of-district landfill will have an additional impact on the roading network that will impose further costs on ratepayers and taxpayers. These truck movements will also increase congestion impacts.

From a Dunedin perspective, closing GIL in preference to out-of-district disposal will lead to job losses locally as the landfill will no longer be within Dunedin city limits. Approximately eight staff work at the Green Island site.

While Smooth Hill is unlikely to open before 2027 at the earliest, any delay on that project given the current labour market and plant and materials shortfalls could mean that Dunedin is left without a financially responsible landfill option should Smooth Hill not be ready by 2027 and the void at GIL is consumed at the current average of 89,000 m^3/year. The proposed increase of

capacity at GIL will extend the operational life of the site by approximately two more years to provide a buffer for Smooth Hill to be developed, as well as a cost-effective way of dealing with waste in the medium term.

Overall, the continued operation of GIL is considered the most economically cost-effective solution that minimises emissions, road wear-and-tear, congestion, and job losses, also ensuring enough waste disposal capacity is provided to accommodate delays in commissioning the Smooth Hill site.

8.12. Social Effects

The Social Impact Assessment Interim Report (SIA) in **Appendix 15**, provides an assessment of the potential social impacts of the continued operation and closure of the landfill, with reference to the existing community characteristics summarised in **section 7.10**. Potential social effects on the local community from the continued operation, closure, and aftercare of the landfill include:

- **Health and wellbeing** - Changes in the surrounding environment as a result of the proposal could have an impact on the health and wellbeing of the surrounding population.
- **Economy, businesses, and employment** - Impacts on the local and regional economy. Consideration is also given to value of surrounding properties.
- **Amenity and character** - Changes to amenity can impact people's way of life, and what people value about their community including their fears about and aspirations for its future.
- **Fears and aspirations** - The community's perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

The SIA Report considers that there will be some negative impacts associated with the increase in capacity and continued operation of GIL, such as continued odour emissions, noise and vibration and visual amenity impacts. However, as GIL has been operating since 1954 and is part of the community which has grown since the landfill was established, the adverse social impacts during construction and ongoing operation are expected to be minor. The continued operation of GIL will also enable the continuation of waste services for businesses and residents in Dunedin with minimal impact to their operations and at minimal cost, resulting in a moderate positive social benefit.

The ultimate closure of the landfill will have significant positive benefits for the community. When the landfill closes completely, there will be opportunities for environmental enhancements and public recreational use around the edge of the site, including planting and new walking and biking tracks beside the Kaikorai Estuary. Long-term use and public access to the landfill site post-closure will be determined in consultation with Te Rūnanga o Ōtākou, the local community and key stakeholders.

Overall, it is considered that the proposal will have a social benefit to the community, and any negative social impacts will be minor. The SIA Report includes recommendations on mitigation measures to reduce the negative social impacts of the proposal that mirror the recommendations contained in the other technical reports and which form part of the overall mitigations proposed in this AEE and proposed conditions of consent in **Appendix 17**. These conditions include the establishment of a formal Community Liaison Group (CLG) for the purpose of facilitating ongoing

engagement between the consent holder and community on the operation and closure of the landfill. The CLG will provide a forum for the DCC to hear any community issues with or concerns regarding the landfill's operation and to discuss and consider means of addressing those issues or concerns.

8.13. Cultural Effects

The CIA prepared by Aukaha on behalf of Te Rūnanga o Ōtākou contained in **Appendix 16**, assesses the cultural impacts continued operation, closure, and aftercare of the landfill against the cultural values identified by mana whenua, summarised in **section 7.11**. Potential effects on mana whenua values from the CIA are summarised in the following sections.

8.13.1. Wai Māori

The Kaikarae Estuary, Stream and other associated waterways make up an area which has immense traditional significance to mana whenua. Mana whenua seek to restore the estuary and its associated waterways to its traditional state. Embarking on a journey of restoration is embodied by the mana whenua value, utu. This starts with ensuring leachate and contaminants are not able to enter the waterways. The landfill in combination with other industrial discharges, has degraded the mauri of the Kaikarae Stream and surrounding area and has made the area tapu, so that it cannot be used for mahika kai.

Issues raised in the CIA in regard to Wai Māori are:

- The water level of the stream decreases when groundwater is abstracted from the leachate collection trench. Change to the natural hydrology, is one of the many factors that affects mauri and the whakapapa of the waterway. The natural hydrology has also been affected in a significant way by encroachment of the landfill into the wetland.
- Contaminants from leachate or sediment entering groundwater or surface water would further degrade the mauri of the stream and surrounding area, hindering the restoration efforts of both mana whenua and Council. This includes negative impacts on the water quality, ecosystems, avifauna, aquatic fish, invertebrates, vegetation, and riparian vegetation.
- Monitoring and providing for the impacts of climate change are a key focus for mana whenua. It is vital that there are robust mitigation and monitoring measures in place to ensure that the landfill does not become inundated by flooding and storm surge, causing leachate and other contaminants to flow into the Kaikarae stream and surrounding waterways.
- If the potential adverse impacts described above were to occur, this would further degrade waterways which are already currently in poor health. It is the aspiration and duty of mana whenua to enhance the health and wellbeing of all bodies of water as kaitiaki.

The recommendations of both the Groundwater Report, Surface Water Report and EcIA Report, and those set out in this AEE and the LDMP are supported by mana whenua. Recognising the above issues, the CIA makes the following recommendations regarding Wai Māori:

- *That all practicable measures are taken to prevent discharges entering water, including preventing, where possible, leachate from entering groundwater and surface water.*
- *That effects on mauri and whakapapa from alteration of the existing hydrology and contaminants entering water are offset by mitigation measures, including riparian planting and pest management. Proposed offsetting or mitigation management plans need to be provided to mana whenua for review and consultation prior to implementation. While these measures do not directly address the adverse effects on mauri, they will contribute to enhancement of the mauri of the area.*

8.13.2. Mahika Kai and Biodiversity Values

Prior to European settlement, the Kaikarae Stream catchment would have supported large wetland areas surrounding several defined streams, with hillslopes and elevated areas supporting mixed podocarp hardwood forest, with matai, tōtara, rimu, māhoe and narrow-leaved houhere dominant on coastal hills. In the lower catchment, freshwater wetland and forest areas would have graded to intertidal / saltmarsh areas.

Much of the former indigenous vegetation such as the succulent herb swamp has been replaced by weedy exotic species. Six native fish species were observed during sampling across all sites. Mana whenua consider opportunities should be provided for riparian ecological enhancement and a more natural sequence of indigenous vegetation types in the area, enhancing ecological connectivity. A transition to eco-sourced native tree species within the existing screen planting around the perimeter of the landfill and ecological enhancement of the borrow area is recommended following closure of the landfill.

The protection of habitats and the wider needs of mahika kai and taoka species is sought by manawhenua, including:

- Indigenous plant and animal communities and the ecological processes that ensure their survival are recognised and protected to restore and improve indigenous biodiversity.
- Creating networks of linked ecosystems.
- Protecting and enhancing wetlands
- Requiring the management of hazardous operations to avoid impacts on mahika kai values.

The recommendations of both the EcIA Report and the Landscape and Visual Assessment Report are supported by mana whenua. Recognising the above issues, the CIA recommends:

- *a Vegetation Restoration and Management Plan is developed in partnership with mana whenua to restore the ecological values of the Kaikarae Estuary, provide habitat for taoka species and rebalance mauri.*

8.13.3. Wāhi Tūpuna

When the landfill closes there will be opportunities for public recreational use around the perimeter of the site and environmental enhancements, which could include planting restoration projects and new walking and biking tracks beside the Kaikarae Estuary. The aspiration of Te Rūnanga o

Ōtākou is to incorporate mana whenua values and pūrākau associated with the Kaikarae Estuary in a tangible way and to restore the values of this wāhi tūpuna.

The protection of the values of wāhi tūpuna is sought by mana whenua, including:

- Protecting the full range of landscape features of significance.
- Ensuring that the interpretation of Kāi Tahu histories associated with the Kaikarae Estuary and Pukemakamaka is undertaken by Te Rūnanga o Ōtākou.
- Encouraging the use of traditional place names.
- Requiring site rehabilitation plans for land contaminated by landfills.

Recognising these issues, the CIA recommends that a co-design process is undertaken with mana whenua to incorporate mana whenua values and pūrākau associated with the Kaikarae Estuary following closure of the Green Island landfill.

8.13.4. Cultural Effects Conclusions

Overall, the CIA considers that a collaborative process of engagement with DCC has enabled Te Rūnanga o Ōtākou to identify potential impacts on cultural values from the continued operation, closure and aftercare of the GIL. The aspiration of Te Rūnanga o Ōtākou is to incorporate mana whenua values and pūrākau associated with the Kaikarae Estuary in a tangible way through restoration of mahika kai and biodiversity values and through design opportunities following closure of the landfill.

Recognising the CIA recommendations described above, proposed conditions of consent are included in **Appendix 17**, which provide all practicable measures are taken to prevent contaminants entering water, effects on mauri and whakapapa are offset, and to ensure the protection of mahika kai and taoka species, and wāhi tūpuna. These require:

- Ensuring updates to the LDMP, development of the LCMP, and any other management plans are developed in consultation with Te Rūnanga o Ōtākou.
- Extension to the leachate collection trench, the continued operation of the leachate collection system.
- Repair of the culvert between the *south eastern* and *eastern constructed wetlands*, and fitting of outlets to the *eastern* and *western sedimentation ponds*.
- The separate management of clean runoff, sediment laden stormwater, and leachate contaminated stormwater, and ongoing operation and maintenance of stormwater systems.
- Implementation of erosion and sediment controls to minimise sediment generation and runoff from the site.
- Management of spills of fuel, oil, leachate, or other contaminants.
- Comprehensive leachate, groundwater and surface water level and quality monitoring, analysis, and reporting, and the triggering of response measures where the monitoring indicates adverse effects on water quality attributable to the landfill.
- Preparation and implementation of a Vegetation Restoration Management Plan, which provides for restoration of ecological values on the site and, provides habitat for taoka species and rebalance mauri.

In addition, the DCC agrees to a co-design process with mana whenua over the long-term post closure use of the site, including to incorporate mana whenua values and pūrākau associated with the Kaikarae Estuary. The outcomes of this co-design process, including actions for their implementation will be outlined in the LCMP.

Overall, with these mitigation measures and proposed conditions, it is considered that subject to ongoing engagement with mana whenua, the cultural aspirations of mana whenua will be provided for to ensure no more than minor effects on cultural values and on Te Rūnanga o Ōtākou.

8.14. Conclusion of Assessment of Environmental Effects

Based on the assessment in the sections above, it is considered that the ongoing operation, closure, and aftercare of the GIL will have a range of environmental effects which are both positive and adverse in nature. **Table 25** below presents a summary of the environmental effects.

Table 25 – Summary of Environmental Effects

Potential Effects	Assessment Summary
Land contamination	Ongoing acceptance of waste at GIL will occur in accordance with waste acceptance criteria and procedures contained within the existing LDMP. These criteria will be reviewed annually to give effect to any changes in national guidance. Those materials which are currently prohibited from being disposed of at the landfill will remain prohibited. DCC is to commence treating the majority of WWTP biosolids in 2023 and intends to stop accepting liquid wastes one alternative commercial disposal options exist in Dunedin. The existing landfill waste acceptance criteria in the LDMP have evolved over time and are in-line with the MfE Landfill Classification Guidelines: Module 2 and current best practice and industry standards (except for the acceptance of liquid wastes). The landfill operator will only receive waste from commercial contractors if an assessment for acceptance has been undertaken by DCC confirming the waste meets the waste acceptance criteria. Implementation of procedures at the landfill will be implemented for the verification, acceptance/rejection, and recording of incoming wastes from commercial contractors and the public, and handling of special and hazardous wastes. Overall, with these measures, the adverse effects of the disposal of waste on the receiving environment, and human health and safety will be managed to ensure they are low and no more than minor.
Groundwater and surface water flows	Groundwater is hydraulically connected with surface water in the Kaikorai Stream, resulting in abstraction of groundwater from the leachate collection trench having a stream depletion effect. The volume of groundwater/ connected surface water extraction is estimated to be less than 0.5 L/s for

	the entire trench length and any effect is expected to be negligible when compared to the stream flows and volumes in the estuary. As areas of filling are completed and capped, rainfall that previously infiltrated into the landfill and report to the leachate collection system, will instead be stored in surface soils and lost via evapotranspiration or discharge as surface flows to the Kaikorai Stream or sedimentation ponds. The existing ponds able to accommodate and attenuate the future flows (allowing for climate change) without any increase in pond size required. Overall, the effect on surface water flows will be negligible.
Groundwater and surface water quality	Groundwater modelling demonstrates that the leachate trench system is effective at creating a hydraulic barrier and intercepting leachate flowing from the landfill. It also is effective in drawing groundwater from outside the trench, thereby preventing the movement of potentially contaminated groundwater arising from historic waste located outside of the trench into surface water. Historical water monitoring also shows the trench is effective in intercepting leachate, and that there is no discernible adverse effect on water quality resulting from the landfill, including from the surface water discharges. There is no measurable change in water quality between the surface water monitoring points GI2 and GI3 (during low flow conditions). Instead, the water quality at the downstream GI3 is generally better than GI2, further supporting the conclusions of modelling. Continued filling of the landfill with progressive capping and the extension of the leachate collection system is expected to maintain or improve the quality of discharges to the stream and estuary over time. An interim HHERA has been undertaken to better understand the risk to human health from PFAS. This assessment has concluded that discharges from the site into the receiving environment generally represent a low risk to human users of the waterway and the aquatic environment. Groundwater and surface water monitoring will continue to confirm the effective operation of the leachate collection, and stormwater systems and detect any migration of leachate or other contaminants from the site. Overall, the adverse effects on surface water quality from leachate and other contaminants is expected to be low and no more than minor.
Air quality	Existing and additional odour management and mitigation measures based on best practice adopted at other New Zealand landfills are proposed to be implemented to reduce and minimise future impacts on sensitive receptors. The volume of organic waste entering the landfill has reduced following the commencement of kerbside food and organic waste collection in July 2024. The existing greenwaste composting operation on the site has also ceased. The processing of organic waste now occurs within the ORB.

	With these measures, odour discharges are expected to reduce in terms of both intensity, frequency, and duration. While odours may still be detectable on occasions at or near the site boundary, providing the proposed mitigation measures are rigorously implemented, the likelihood of off-site odours being considered offensive and objectionable is expected to be low. Active LFG management using flares and/or engines will likely be required at the site for many decades to appropriately manage the LFG emitted. Based on atmospheric dispersion modelling of the engine and flare emissions, the potential for adverse health or ecological effects from the flare and engine emissions are expected to be very low. PM10 emissions in particular will comply with regulation 17 of the NESAQ. Regular monitoring will continue confirm the effectiveness of the LFG collection system and enable detection of any LFG escape that may present a hazard or nuisance to sensitive receptors. With the implementation of existing and additional dust mitigation measures, it is not expected that there will be any significant dust deposited at the nearest sensitive receptors. Overall, the adverse effects of odour, dust, and LFG are expected to be low and no more than minor.
Landfill fire	Historically, no landfill fire has spread off-site, and the highly modified and fragmented nature of vegetation cover within and surrounding the site will ensure the risk of any landfill fire spreading from the site is low. The existing perimeter access road enables fire responders to contain and extinguish any vegetation fire. Existing and additional fire management and mitigation measures based on best practice are proposed to be implemented to prevent, detect, report, mitigate, and respond to landfill fires. Overall, with these measures, landfill fire risks are expected to be low and no more than minor.
Bird hazards, litter and pest	The removal of most of the putrescible waste entering the landfill from July 2024 and ultimate closure of the landfill, will result in this food source no longer being available to birds. In the short-medium term as populations readjust to the reduced availability of food, birds are likely to search for alternative food sources nearby, potentially bringing them into aircraft flight paths and presenting an aviation hazard. The most significant hazard to aviation are gulls, particularly the SBBG. SBBG are present on the site in the thousands. To address the probability of an increased bird strike hazard arising from SBBG dispersing after the removal of most of the putrescible waste and ultimate closure of the landfill, it is proposed to implement a comprehensive SGGB Management Plan, with the objective of reducing the existing level of bird strike risk to aviation. Existing control measures are proposed to be implemented to address the amenity and potential health effects of pests and litter on the site.

	Overall, with these measures, the bird hazard effects to aviation safety, and adverse effects of pests and litter are expected to be low and no more than minor.
Landfill stability	Slope stability assessments under static and seismic loads have been undertaken around the perimeter of the landfill against minimum slope stability factors of safety (FoS) criteria consistent with current practice adopted in New Zealand, including at other landfill sites. The landfill meets FoS stability criteria for all static load cases. Some deformation of the landfill and associated infrastructure is expected to occur under the highest seismic loads contemplated (a 1 in 2,500-year seismic event). The level of predicted deformation (<1m) falls within the acceptable displacements based on experience at similar sites and current New Zealand design practice. However local damage to landfill infrastructure, such as pipes, and capping is expected. Under all other static and seismic conditions deformation is not anticipated or will be negligible (c.5mm). To ensure release of contaminants to the environment is minimised during, and following, a seismic event, it is proposed to control leachate levels within the landfill, strengthen the leachate collection system infrastructure to be more reliant to a seismic event, and update emergency response procedures. Overall, with these measures land stability effects are expected to be low and no more than minor.
Flooding and sea level rise	Low lying areas adjacent to the site are at risk of flooding and storm surge from the Kaikorai Stream from the Kaikorai Estuary, which are expected to be exacerbated by climate change and sea level rise. The groundwater modelling predicts inflows in the order of 0.6 l/s to the leachate collection trench as a result of future sea level rise which is well within the operating range of the leachate system, which is designed to accommodate much higher stormwater flows. To mitigate the effects of floodwater inundation of the leachate collection trench, it is proposed raise of the berm of the landfill perimeter road to act as a defence against water and raise pump station components. The resulting loss of flood channel capacity is expected to be minor, and the estimated increase in flood levels is expected to be small and not increase the flood risk to any residential dwellings. Overall, with these measures flooding and sea level rise effects are expected to be low and no more than minor.
Terrestrial and aquatic ecology	Vegetation within the landfill footprint is comprised largely of exotic species, and therefore any clearance is expected to result in a very low level of ecological effects. The volume (0.5 L/s) of stream depletion from the continued operation of the leachate collection trench is very small relative to stream flows even during

	low flow conditions and is expected to result in a very low level of ecological effects to aquatic habitats. Implementation of existing stormwater management measures will avoid or minimise sediment discharge to and sedimentation of Kaikorai Stream and estuary resulting in no change. The leachate collection system is effective at creating a hydraulic barrier and intercepting leachate from the landfill, and monitoring shows there is not a strong indicator of leachate discharge to the Kaikorai Stream and estuary, or persistent and significant levels of contamination of the sediment pond water. The ecological data collected indicates stream health is compromised in sites both upstream and downstream of the site suggesting that there are likely additional downstream stressors, not directly associated with the landfill. The continued operation of the leachate collection system and stormwater management measures is likely to result in no change and is expected to result in a very low level of ecological effect. The removal of most of the putrescible waste entering the landfill from July 2024 and the implementation of the SBBG Management Plan will reduce the food supply for, and numbers of SSBG. SSGB are not threatened or protected, and therefore any loss will have a low level of ecological effect. The level of disturbance, amount, and quality of food supply, foraging ability, and roosting habitats of avifauna is not expected to change and is expected to result in a very low – low level of ecological effect. Disturbance is expected to be greatly reduced, and water quality is not expected to change discernibly post closure. Overall, ecological effects are expected to be very low to low (and some potentially positive) and no mitigation or offsetting is required. Any adverse effects will be no more than minor.
Landscape, natural character, and visual amenity	The existing landscape character of the site is a modified working landfill within the low-lying part of a wider basin-like landscape. The existing perimeter vegetation will be maintained and replaced in accordance with the VRMP Plan and will continue to assist with integrating the site into the rural backdrop. Modelling of the landfill form from representative views indicates that the landfill will not compromise the landscape values associated with the Saddle Hill ONF, including views of its iconic shape. The existing level of natural character at the site is highly modified. The landfill will not further reduce the abiotic or biotic aspects of natural character further on site or within the context of adjoining waterbodies. Experiential aspects of natural character may be adversely changed by a very small degree due to the extension in the operating life and height from that currently anticipated. The site is largely screened from close views by earth bunds and established trees around the site perimeter. In ‘worst case’ locations, views are either some distance from the site, or almost entirely screened by the perimeter vegetation so that only glimpses between trees are available. Following

	closure, the landfill will appear as part of and sympathetic to the surrounding landscape. Overall, landscape, natural character and visual effects are expected to range from low, or low – moderate during operation and reduce to very low or low at closure. Accordingly, any adverse effects are expected to be no more than minor.
Economic	When compared to out-of-district disposal at the AB Lime landfill in Winton, the continued disposal of waste at the site is estimated to be at least 33% more cost-effective, and will result in less transport emissions, wear and tear on the road network, and reduced congestion. It will also avoid the loss of jobs locally at the landfill. The increase of capacity at the site will extend the operational life of the site to provide a buffer for Smooth Hill to be developed, as well as a cost-effective way of dealing with waste in the medium term.
Social	There will be some negative social impacts associated with the continued operation of the landfill. However, as the landfill has been operating since 1954 and is part of the community which has grown since the landfill was established, the adverse social impacts are expected to be minor. The continued operation of the landfill will also enable the continuation of waste services for businesses and residents in Dunedin, resulting in a moderate positive social benefit. The ultimate closure of the landfill will have significant positive benefits for the community, including opportunities for environmental enhancements and public recreational use around the edge of the site. Overall, it is considered that the proposal will have a social benefit to the community, and any negative social impacts will be minor.
Cultural	Mana whenua seek to restore the Kaikorai estuary and its associated waterways to its traditional state, that all practicable measures are taken to prevent discharges entering water, and effects on mauri and whakapapa from alteration of the existing hydrology and contaminants entering water are offset by mitigation measures, including riparian planting and pest management. Mana whenua consider opportunities should be provided for riparian ecological enhancement and a more natural sequence of indigenous vegetation types, enhancing ecological connectivity, and providing for the protection of habitats and the wider needs of mahika kai and taoka species. The aspiration of Te Rūnanga o Ōtākou is to incorporate mana whenua values and pūrākau associated with the Kaikarae Estuary in a tangible way and to restore the values of this wāhi tupuna when the landfill closes, and which provides for the protection of the values of the wāhi tupuna. Recognising the CIA recommendations all practicable measures will be taken to prevent contaminants entering water, effects on mauri and whakapapa are offset, and ensure the protection of mahika kai and taoka

	species, and wāhi tūpuna. This includes preparation and implementation of a Vegetation Restoration Management Plan and undertaking a co-design process with mana whenua over the long-term post closure use of the site. Overall, it is considered that subject to ongoing engagement with mana whenua, the cultural aspirations of mana whenua will be provided for to ensure no more than minor effects on cultural values and on Te Rūnanga o Ōtākou.

9. Statutory Assessment

9.1. Statutory Planning Documents

In accordance with Section 104(1) of the Resource Management Act 1991 (**RMA**), the following sections provide an assessment of the applications for resource consent against the provisions of the following statutory planning documents which are relevant to the assessment of this proposal:

- National Environmental Standards for Air Quality 2004 (**NES-AQ**)
- National Environmental Standard for Freshwater 2020 (**NES-FW**)
- National Policy Statement for Freshwater Management 2020 (**NPS-FW**)
- The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (**NRMP**), which sets out Otago Papatipu Rūnaka aspirations in relation to natural resource management in their takiwā (area).
- Partially Operative Regional Policy Statement (**ORPS**)
- The Proposed Otago Regional Policy Statement (**P-ORPS**)
- Regional Plan for Otago: Waste (**Waste Plan**)
- Regional Plan for Otago: Water (**Water Plan**)

The above planning documents present a hierarchy whereby the provisions of regional and district plans are required by the RMA to give effect to the higher order policy direction within the regional policy statement, which in turn are required give effect to any relevant national policy statement. However, in the Otago region, the current regional plans in particular pre-date and do not yet fully give effect to the higher order policy contained in the NPS-FW, ORPS, and emerging P-ORPS. The P-ORPS is also subject to appeals which are still to be resolved. This overall results in a highly fragmented policy framework resulting in conflicts and uncertainty in the policy direction for managing the use and development of resources, including this proposal.

As for the assessment of effects in **section 8**, the focus of this statutory assessment is on the provisions of the above planning documents that fall within the scope of the resource consents that have been applied for. Rather than assessing the provisions of each document in turn, the assessment groups and assesses the relevant provisions from all documents holistically under policy themes. This enables policy differences and conflicts between the documents and any resulting uncertainty in the resulting policy direction to be identified and analysed for each theme.

The assessment in particular focuses on the higher order, contemporary and settled provisions of the NPS-FW and ORPS, and the Waste Plan recognising that while it is outdated, it remains principal document for managing waste and landfills in the region. Assessment of the proposal against the provisions of the Kāi Tahu ki Otago NRMP has been addressed in the CIA prepared by Aukaha on behalf of Te Rūnaka o Ōtākou and contained in **Appendix 16**. Relevant NRMP provisions are captured in the following assessment.

The Regional Plan for Otago: Air (**Air Plan**) has not been considered in the assessment. This is due to discharges to air from landfills instead being captured by the provisions of the Otago Regional Plan: Waste.

9.1.1. Social, and Cultural Wellbeing Provisions

The relevant provisions addressing economic, social, and cultural wellbeing are set out in **Table 26**.

Table 26 – Economic, Social, and Cultural Wellbeing – Policy Framework

Planning Document	Relevant Provisions
Partially Operative Otago Regional Policy Statement (ORPS)	Objectives 1.1 and Policies 1.1.1, 1.1.2 Objective 2.2 and Policies 2.2.1, 2.2.2
Proposed Otago Regional Policy Statement (P-ORPS)	Objective MW-O1, and Policies MW-P2, P3
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.2, objectives (i), (ii), (iii), and (iv)

ORPS objective 1.1, and policies 1.1.1, 1.1.2 require that economic, social, and cultural wellbeing, and the health and safety of people and the community is *"provided for"* when undertaking the use and development of natural and physical resources. Social and cultural wellbeing is to be provided for by: *"recognising and providing"* for Kāi Tahu cultural values; *"avoiding significant"* adverse effects on human health; *"promoting"* community resilience and the need to secure resources for the reasonable needs for human wellbeing, and *"promoting"* good quality and accessible infrastructure and public services.

ORPS objective 2.2, and policy 2.2.1 requires the cultural values in Schedule 1 of the ORPS are to be *"recognised and provided for"*, and the life supporting capacity of natural resources be safeguarded to support Kāi Tahu wellbeing. Policy 2.2.2 requires the "protection" of wahi tupuna is to be *"recognised and provided for"*. P-ORPS objective MW-O1, and policies MW-P2, and P3 seek similar outcomes. The NRMP at section 5.2 seeks to establish the rakātirataka and kaitiakitaka of Kāi Tahu in the Otago Region and ensures that this is recognised and supported throughout all natural, physical, and historic resource management issues in the region.

The continued operation of GIL and ultimate closure of the landfill will provide for, economic, social, and cultural wellbeing, and health and safety. Specifically, the project will provide for Dunedin's immediate waste disposal needs until Smooth Hill is operational thereby providing for community resilience and avoiding adverse effects on human health from inadequate waste management. This is while ensuring adverse effects on the local community are minimised. Continued operation of the landfill is projected to have economic benefits over and above the alternative out-of-district export of waste.

Infrastructure improvements for the containment of leachate, together with updated monitoring and management measures will also ensure there are no significant adverse effects on human health in the surrounding environment, and that Kāi Tahu cultural values (including mauri, whakapapa, and mahika kai) are recognised and provided for. Ongoing engagement with Te

Rūnanga o Ōtākou, including input into management measures in the LDMP, LCMP, and VMRP that support cultural values will ensure recognition of mana whenua, and exercise of rakātirataka and kaitiakitaka.

9.1.2. Integrated Management Provisions

The relevant provisions addressing the integrated management of resources are set out in **Table 27**.

Table 27 – Integrated Management – Policy Framework

Planning Document	Relevant Provisions
National Policy Statement for Freshwater Management 2020 (NPS-FW)	Policies 3 and 4
Partially Operative Otago Regional Policy Statement (ORPS)	Objectives 1.2 and Policy 1.2.1
Proposed Otago Regional Policy Statement (P-ORPS)	Objective LF-WAI-O1 and Policy LF-WAI-P3

NPS-FW objective 2.1 and policies 3 and 4 require freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole of catchment basis, and as part of New Zealand's integrated response to climate change.

ORPS objective 1.2, and policy 1.2.1 requires the integrated management of natural and physical resources are to be *"achieved"* by: taking into account the impacts of management of different resources on each other; recognising the value and function of a resource may extend beyond the area of interest; ensuring the effects of activities on the whole of a resource are considered; and promoting healthy ecosystem services. P-ORPS objective LF-WAI-O1 and policy LF-WAI-P3 seek similar outcomes.

The continued operation of GIL and ultimate closure of the landfill will provide for the integrated management of natural and physical resources to the extent practicable, recognising it forms part of the existing environment. The proposal for operation and closure been designed cognisant of the interactions between land, freshwater, and ecosystems. In particular, infrastructure improvements for the containment of leachate, and continued operation of stormwater treatment and discharge methods will avoid or mitigate adverse contaminant effects on groundwater and connected surface water quality in the receiving environment, and its ecosystems. Similarly, the proposed takes and diversions of water will ensure the continuance of downstream flows that promotes healthy freshwater ecosystems.

9.1.3. Waste Management Provisions

The relevant provisions addressing waste management are set out in **Table 28**.

Table 28 – Waste Management – Policy Framework

Planning Document	Relevant Provisions
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 4.6 and Policies 4.6.2, 4.6.3, 4.6.6, 4.6.7, 4.6.8 Objective 5.3 and Policy 5.3.1
Proposed Otago Regional Policy Statement (P-ORPS)	Objective HAZ-CL-O3, Policies HAZ-CL-P14, P16, P17, and P18
Otago Regional Plan: Waste (Waste Plan)	Objectives 3.3.1, 3.3.2, 3.3.3, 3.3.4 Objectives 4.3.1, 4.3.2 and Policies 4.4.1, 4.4.2, 4.4.3, and 4.4.4. Objectives 6.3.1, 6.3.2 and Policy 6.4.1, 6.4.12 Objective 7.3.1, 7.3.3, and Policies 7.4.1, 7.4.3, 7.4.4, 7.4.5, 7.4.6, and 7.4.11
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.6, Objectives (i), (ii), and (iii), and Policies 22 and 23

ORPS objective 4.6, and policies 4.6.6 and 4.6.7 *"promotes"* an integrated approach for the use, storage, and disposal of waste, and *"encourages"* waste minimisation responses. Policies 4.6.2, 4.6.3, 4.6.8 requires that the disposal of waste *"ensures"* the health and safety of people; *"minimises"* adverse effects on the environment; and risk associated with natural hazards. The establishment of hazardous substances collection, disposal, recycling facilities is *"promoted"*, while *"ensuring"* disposal occurs in accordance with relevant regulatory requirements. P-ORPS objective HAZ-CL-O3, and policies HAZ-CL-P14, P16, P17, and P18 seek similar outcomes.

Waste Plan objectives 4.3.1, 4.3.2, and policies 4.4.2, 4.4.3, and 4.4.4 prioritises waste minimisation, encouragement of the compositing of organic material, with the disposal of residual waste to occur in an environmentally safe manner. Further, policy 7.4.8 *"promotes"* the use of alternatives to landfills for waste disposal. Objective 6.3.1, 6.3.2, and policy 6.4.1 requires the adverse effects from the disposal of hazardous wastes are to be *"avoided"*.

The continued operation of GIL and ultimate closure of the landfill will ensure that waste materials and hazardous substances will not harm human health or the quality of the environment. The continued operation of GIL forms part of Dunedin's wider Waste Futures programme which aims to deliver an integrated waste solution encompassing waste reduction, recycling, and recovery to achieve the goals in the WWMP2020 to minimise the amount of residual waste being disposed of to the landfill. This will include the removal of most of the food and organic waste from the general waste stream entering the landfill. Notwithstanding minimisation efforts, there remains an immediate need to operate the landfill for the disposal of waste until Smooth Hill is operational.

Waste will continue to be disposed of in the landfill in an environmentally safe manner. The waste acceptance criteria align with MfE Module 2 guidelines and current best practice and industry standards (with the exception for liquid waste), and infrastructure improvements are proposed for the containment of leachate. No other hazardous wastes or hazardous substances will be accepted, with these continuing to be collected, recycled or disposed of in accordance with regulatory requirements so as to avoid adverse effects.

Waste Plan objective 7.3.1, and policies 7.4.3, 7.4.4, 7.4.5, 7.4.6, and 7.4.11 requires landfills are to be sited and operated in accordance with WasteMINZ guidelines so adverse effects are *"avoided, remedied, or mitigated"*, and *"minimised"*, and managed in compliance with approved management and post closure procedures. Waste inputs are to be identified and quantified, and discharges from landfills are to be monitored.

GIL has been in operation since 1953 and is not sited in a location that aligns with the current best practice WasteMINIZ guidance. However, the continued operation and improvements to the leachate collection system, existing stormwater treatment and discharge methods, operating and post closure monitoring and management measures contained in an updated LDMP and LCMP will ensure the health and safety of the community, and avoid, remedy, and mitigate adverse effects on the environment, to ensure they are minimised. Monitoring and management measures will include: applying the existing waste acceptance criteria and procedures; recording of waste received; and a comprehensive monitoring programme encompassing discharges to groundwater, surface water, and air.

Waste Plan objectives 6.3.2, 7.3.1, 7.3.3 and policies 4.4.1, 6.4.12, 7.4.1 require the management and disposal of waste *"takes into account"* Kāi Tahu cultural values; *"avoids, remedies, or mitigates"* adverse effects on the mauri of natural and physical resources; *"protects"* wahi tapu, and wahi taoka; and *"maintains"* consultation with Kāi Tahu on landfill management. The NRMP policies address the potential for activities such as landfill structures to adversely affect the values that Kāi Tahu hold for their ancestral landscapes which they whakapapa to. Kāi Tahu cultural values have been taken into account by infrastructure improvements to contain leachate together with updated monitoring and management measures avoiding, remedying, and mitigating adverse effects on mauri of resources, and ensuring protection of toaka species. Ongoing engagement with Te Rūnanga o Ōtākou will be maintained and will provide further opportunities for taking into account Kāi Tahu cultural values including through the development of the VRMP and LCMP.

9.1.4. Water Quantity Provisions

The relevant provisions addressing water quantity are set out in **Table 29**.

Table 29 – Water Quantity – Policy Framework

Planning Document	Relevant Provisions
National Policy Statement for Freshwater Management 2020 (NPS-FW)	Objective 2.1 and Policies 1, 2, 5,11, 13 15.
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 3.1 and Policies 3.1.1, 3.1.3.
Proposed Otago Regional Policy Statement (P-ORPS)	Objectives LF-WAI-O1, Policies LF-WAI-P1, P2, P4 Objectives LF-FW-O1A, LF-VM-O5, Policies LF-VM-P5 Objectives LF-FW-O1A, O10, and Policies LF-FW-P7, P7A, P13 Objective LF-LS-O12, and Policy LF-LS-P21

Otago Regional Plan: Water (Water Plan)	Objective 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.6, and Policies 5.4.2, 5.4.3, 5.4.8, 5.4.9 Objectives 6.3.1, and Policies 6.4.0A, 6.4.16 Policy 10A.2.3
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.3, Objectives (i), (ii), (iv), (v), and Policies 1, 2, 4, and 5.

NPS-FW objective 2.1 and policies 1 and 15 requires that natural and physical resources are managed to give effect to Te Mana o te Wai and prioritises the health and wellbeing of water bodies and freshwater ecosystems over the ability of people to provide for social, economic, and cultural wellbeing. Policy 5 requires freshwater is managed through a National Objectives Framework (NOF) to ensure degraded water bodies and freshwater ecosystems are *"improved"*, and other waterbodies and freshwater ecosystems *"maintained"*.

ORPS objective 3.1, policy 3.1.1 requires freshwater to be managed to *"maintain or enhance as far as practicable"*; aquatic ecosystem health, indigenous habitats, indigenous species and their migratory patterns; the natural functioning of rivers, wetlands, and aquifers; and amenity and landscape values of rivers and wetlands. Adverse effects of flooding and erosion, and effects on existing infrastructure reliant on freshwater are to be *"avoided, remedied, or mitigated."* P-ORPS objectives LF-FW-O1A, O10, and policies LF-FW-P7, and P13 require healthy water that *"supports"* healthy populations of indigenous species and mahika kai that are safe for human consumption, and health of people, and natural character is *"preserved and protected"* from inappropriate development.

Water Plan objectives 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.6, and policies 5.4.2, 5.4.3 require activities involving freshwater are to give priority to *"avoiding"* in preference to *"remedying or mitigating"* adverse effects on: the natural, water supply, historic, and cultural values listed in Schedule 1 of the Water Plan for the affected water body; natural character; amenity values; flooding; erosion; sedimentation; and existing lawful uses.

The continued operation and closure of GIL will extract groundwater, leachate and connected surface water in the Kaikorai Stream through the leachate collection trench. The volume of groundwater/connected surface water extraction derived from outside of the trench is estimated to be <0.5 L/s for the entire trench length, which is expected to have a negligible effect on stream surface flows when compared to the stream flows and volumes in the estuary. The underlying KEF and Abbottsford Formation are not used for groundwater supply, therefore the abstraction of groundwater and localised reduction in groundwater levels around the landfill perimeter will not affect any groundwater users.

Consequently, surface water flows will continue to be provided that ensures the health and wellbeing of waterbodies and freshwater ecosystems downstream the landfill are maintained. Groundwater and surface water flows will be provided to maintain as far as practicable: aquatic ecosystem health, indigenous habitats, indigenous species and their migratory patterns; the natural functioning of downstream rivers, wetlands, and aquifers, and their amenity and landscape value. Adverse effects on the natural and human use values listed in schedule 1 of the Water Plan, natural character, amenity values, and downstream users will also be avoided, that there are no existing downstream infrastructure or users reliant on freshwater.

NPSFW objective 2.1 and policy 11 requires freshwater is allocated and used efficiently and future over-allocation *'avoided'*. P-ORPS policies LF-FW-P7 and P7A seek similar outcomes. ORPS objective 3.1, policy 3.1.3 requires the allocation and use of freshwater to be managed by *"recognising and providing for"* social and economic benefits of sustainable water use, *"avoiding"* over allocation, and *"ensuring"* that water allocated does not exceed what is necessary for its efficient use. Water Plan objectives 6.3.1, 6.3.2, policies 6.4.0A similarly requires *"ensuring"* that the taking of water is to be no more than that required for the use. Water Plan policy 6.4.16 requires the taking of water is to be measured. Policy 10.A.2.3 limits the duration of new consents to take and use water to no more than six years.

The take and use of groundwater/and leachate is required to enable the effective containment of leachate from the landfill and therefore will not exceed what is necessary for the efficient use of the activity, noting also there are no downgradient users of groundwater who will be affected. The take of groundwater (and leachate) will continue to be measured. A consent duration for the take and use of groundwater/leachate of 6 years is sought, which is consistent with policy 10A.2.3.

NPSFW objective 2.1 and policies 1 and 2 requires freshwater is managed to give effect to Te Mana o te Wai, and tangata whenua are actively involved in freshwater management, and Māori freshwater values are identified and "provided for". P-ORPS objectives LF-WAI-O1, and Policies LF-WAI-P2, and P4 seek similar outcomes. The NRMP Wai Māori policies express the cultural importance of water to Kāi Tahu and the importance of protecting and restoring the mauri of all water. Infrastructure improvements to contain leachate, updated monitoring and management measures, and development of the VRMP and LCMP will ensure that Te Mana o te Wai and Kāi Tahu cultural values are provided for, and mauri is protected and restored to the extent possible. Ongoing engagement with Te Rūnanga o Ōtākou will ensure the continued involvement of tangata whenua.

9.1.5. Water Quality Provisions

The relevant provisions addressing water quality are set out in **Table 30**.

Table 30 – Water Quality – Policy Framework

Planning Document	Relevant Provisions
National Policy Statement for Freshwater Management 2020 (NPS-FW)	Objective 2.1 and Policies 1, 2, 5, 12, 13 15.
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 3.1 and Policies 3.1.1 Objective 5.4 and Policy 5.4.1
Proposed Otago Regional Policy Statement (P-ORPS)	Objectives LF-WAI-O1, Policies LF-WAI-P1, P2, P3, P4 Objectives LF-FW-O1A, LF-VM-O5, Policies LF-VM-P5 Objectives LF-FW-O1A, O10, and Policies LF-FW-P7, P13, P15, P16 Objective LF-O12, and Policy LF-LS-P21

Otago Regional Plan: Water (Water Plan)	Objective 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.6, and Policies 5.4.2, 5.4.3, 5.4.8, 5.4.9 Objective 7.A.1, 7.A.2, 7.A.3 and Policies 7.B.1, 7.B.2, 7.B.4, 7.B.6, 7.B.7, 7.B.8, 7.C.1, 7.C.2, 7.C.3, 7.C.5, 7.C.8, 7.C.9
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.3, Objectives (i), (ii), (iv), (v), and Policies 1, 2, 4, 5, 10, 11, 12, 13, 14, 15, 16, 17, 18.

NPS-FW objective 2.1 and policies 1 and 15 requires that natural and physical resources are managed to give effect to Te Mana o te Wai and prioritises the health and wellbeing of water bodies and freshwater ecosystems over the ability of people to provide for social, economic, and cultural wellbeing. Policy 5 requires freshwater is managed through a National Objectives Framework (NOF) to ensure degraded water bodies and freshwater ecosystems are *"improved"*, and other waterbodies and freshwater ecosystems *"maintained"*. Policy 12 requires the national target for water quality improvement is achieved.

ORPS objective 3.1, policy 3.1.1 requires *"maintenance"* of good water quality, and *"enhancement"* where it is degraded, including for: important recreation values, and existing drinking and stock water supplies. Freshwater is also to be managed to *"maintain or enhance as far as practicable"*; aquatic ecosystem health, indigenous habitats, indigenous species and their migratory patterns. In specific reference to discharges of contaminants, ORPS objective 5.4, and policy 5.4.1 requires the *"significant"* adverse effects of offensive or objectionable discharges are to be *"avoided"*, and other effects *"avoided, remedied, or mitigated"*. P-ORPS objectives LF-FW-O1A, O10, and policies LF-FW-P7, P13, P15, and P16 requires health water that *"supports"* healthy populations of indigenous species and mahika kai that are safe for human consumption, and health of people, and natural character is *"preserved and protected"* from inappropriate development.

Water Plan objectives 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.6, and policies 5.4.2 and 5.4.3 require activities involving freshwater are to give priority to *"avoiding"* in preference to *"remedying or mitigating"* adverse effects on: the natural, water supply, historic, and cultural values listed in Schedule 1 of the Water Plan for the affected water body; sedimentation; and existing lawful uses. Objectives 7.A.1, 7.A.2, 7.A.3, and policies and 7.B.2, require objectionable discharges of contaminants are to be *"avoided",* including to maintain Kāi Tahu values. Policy 7.B.1 require water quality is to be *"maintained or enhanced"* where it does not meet the numerical limits for achieving good water quality in Schedule 15 of the Plan. Policy 7.C.5 requires measures are adopted to prevent contamination of the receiving environment from stormwater discharges; and to trap debris, sediment, and nutrients present in runoff. Policy 7.C.8 requires the use of contingency plans to prevent, contain, and recover accidental spills of any hazardous substance is promoted.

Overall, the health and wellbeing of waterbodies and freshwater ecosystems beyond the immediate vicinity of the landfill will be maintained. The continued operation and infrastructure improvements to the leachate collection system, and stormwater and erosion and sediment control methods will maintain good downstream water quality, maintain as far as practicable aquatic ecosystem health, indigenous habitats, indigenous species and their migratory patterns, and avoid the significant adverse effects of offensive or objectionable discharges. Contingency

measures in the updated LDMP and LCMP will prevent, contain, and recover accidental spills. Adverse effects on the natural and human use values listed in schedule 1 of the Water Plan, sedimentation, and downstream users will also be avoided, noting there are no existing downstream infrastructure or users reliant on freshwater.

Groundwater modelling shows that the leachate trench is effective at creating a hydraulic barrier and intercepting leachate from the landfill and drawing in waste impacted groundwater from outside the trench, preventing the migration of potentially contaminated groundwater into the Kaikorai Stream and Estuary. Historical water monitoring show there is no discernible adverse effect on water quality resulting from the landfill, including from the surface water discharges. While the results indicate some exceedances of the Schedule 15 limits, this is considered reflective of water quality being impacted by surrounding land uses in the wider catchment. Overall, water quality is expected to be maintained. Progressive capping of the landfill and infrastructure the improvements to the leachate collection system are expected to maintain or enhance the quality of discharges to the stream and estuary over time.

NPSFW objective 2.1 and policies 1 and 2 requires freshwater is managed to give effect to Te Mana o te Wai, and tangata whenua are actively involved in freshwater management, and Māori freshwater values are identified and *"provided for"*. P-ORPS objectives LF-WAI-O1, and Policies LF-WAI-P2, and P4 seek similar outcomes. The NRMP Wai Māori policies express the cultural importance of water to Kāi Tahu and the importance of protecting and restoring the mauri of all water. The policies address the effects of discharges and land use on water and require the regular monitoring of all discharges. Infrastructure improvements to contain leachate and contaminant spills, updated monitoring and management measures, and development of the VRMP and LCMP will ensure that Te Mana o te Wai and Kāi Tahu cultural values are provided for, and mauri protected and restored to the extent possible. All discharges will continue to be regularly monitored. Ongoing engagement with Te Rūnanga o Ōtākou will ensure the continued involvement of tangata whenua.

9.1.6. Air Quality Provisions

The relevant provisions addressing air quality are set out in **Table 31**

Table 31 – Air Quality – Policy Framework

Planning Document	Relevant Provisions
National Environmental Standard for Air Quality (NES-AQ)	Regulations 17, 26, and 27
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 3.1 and Policy 3.1.6 Objective 5.4 and Policies 5.4.1
Proposed Otago Regional Policy Statement (P-ORPS)	Objective AIR-O2, and Policies AIR-P3, P4, P6
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.7, Objectives (i), (ii), (iii), and Policies 1, 2, 3, 4, 5.

Regulations 26 and 27 of the NES-AQ requires landfills to operate a system for the collection of LFG that ensures the discharge of gas from the surface of the landfill does not exceed 5000 parts of methane per million parts of air and the gas is flared or used as a fuel for generating electricity. The landfill will continue to provide an LFG collection and destruction system that meets the NES-AQ requirement that the discharge of gas from the surface of the landfill does not exceed 5000 parts of methane per million parts of air.

Regulation 17 of the NES-AQ limits increases in the discharge of PM_{10} from combustion emissions. ORPS objective 3.1, and policy 3.1.6 require good ambient air quality that supports human health, and amenity values are to be *"maintained". O*bjective 5.4, and policy 5.4.1 require the ***"****significant"* adverse effects of offensive of objectionable discharges are to be *"avoided"*, and other effects *"avoided, remedied, or mitigated."* P-ORPS objective AIR-O2, and policies AIR-P3, P4, P6 require human health, amenity, mana whenua values, and ecosystems are *"not compromised"* by localised discharges to air.

The NRMP policies for Air and Atmosphere address the impacts of dust and other air-borne contaminants on health, mahika kai, cultural landscapes, indigenous flora and fauna, wāhi tapu and taoka. The policies encourage reduced vehicle emissions and the planting of indigenous plants to offset carbon emissions.

Continued operation of the landfill in accordance with management measures in an updated LDMP will ensure the likelihood of detection of 'offensive or objectionable' odours or dust at nearby receptors will be low. Concentrations of pollutant emissions from the LFG flare in combination with existing background concentrations will be well below the relevant air quality criteria and comply with the NES-AQ regulation 17 requirement for the discharge of PM_{10}. The significant adverse effects of objectionable discharges will therefore be avoided, and good ambient air quality that supports human health and cultural values will be maintained. Native planting is proposed as part of future landscape management under the VRMP which will assist in offsetting carbon emissions.

9.1.7. Beds of Rivers Provisions

The relevant provisions addressing the beds of rivers and wetlands are set out in **Table 32**.

Table 32 – Beds of Rivers – Policy Framework

Planning Document	Relevant Provisions
National Policy Statement for Freshwater Management 2020 (NPS-FW)	Objective 2.1 and Policies 1, 2, 5, 7, 13, 15, clause 3.24(1)
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 3.1 and Policy 3.1.2
Proposed Otago Regional Policy Statement (P-ORPS)	Objectives LF-WAI-O1, Policies LF-WAI-P1, P2, P3, P4 Objectives LF-FW-O1A, LF-VM-O5, Policies LF-VM-P5 Objectives LF-FW-O1A, O10, and Policies LF-FM-P7, P13

Otago Regional Plan: Water	Objective 5.3.1, 5.3.3, 5.3.4, 5.3.6, and Policies 5.4.2, 5.4.2A, 5.4.3, 5.4.8, 5.4.9 Objective 8.3.1, and Policies 8.4.1, 8.5.5,
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.3, Objectives (i), (ii), (iv), (v), and Policies 1, 2, 4, and 5.

NPS-FW objective 2.1 and policies 1 and 15 requires that natural and physical resources are managed to give effect to Te Mana o te Wai and prioritises the health and wellbeing of water bodies and freshwater ecosystems over the ability of people to provide for social, economic, and cultural wellbeing. NPS-FW Policy 7 and policy 5.4.2.A of the Water Plan requires the loss of *"river extent and values is avoided to the extent practicable".*

ORPS objective 3.1, policy 3.1.2 requires beds of rivers, wetlands, and their margins to be managed to *"maintain or enhance"*: life supporting capacity; good water quality; bank stability; ecosystem health and indigenous biological diversity; natural functioning and character; and amenity values. The adverse effects of flooding and erosion are to be *"avoided, remedied, or mitigated."* P-ORPS objectives LF-FW-O1A, O10, and policies LF-FW-P7, and P13 are require the form, function, and character of water bodies reflects their natural characteristics and behaviours to the extent reasonably practicable, and natural character is *"preserved and protected"* from inappropriate development.

Water Plan Objective 8.3.1 and policy 8.5.5 requires consideration of the effectiveness and need for any defence against water, and any effect on existing defences. Policy 8.4.1 requires when managing activities in, on, under or over the margin of any river, to give priority to *"avoiding"* changes in flow; where it would affect existing structures or arises from any reduction in flood carrying capacity. Policy 8.6.1 requires in managing the disturbance of the margin of a river, to have regard to any adverse effect on: spawning requirements of indigenous fauna, bed and bank stability; water quality; amenity values caused by any reduction in water clarity; and downstream users.

These provisions are relevant to the proposed establishment of a defence against water between the landfill and Kaikorai Stream by raising the berm of the existing landfill perimeter road by approximately 1m. The intent of these works is to prevent floodwater inflows into the leachate collection trench, thereby improving its operational resilience to flood events. The works will not result in the loss of stream extent or values, noting that it will be constructed on the alignment of the existing road which is setback from and located in an area highly modified, and which exhibits low levels of natural character. There are no practical alternatives and there is a functional need for the defence against water in this location.

Good water quality; bank stability; ecosystem health and indigenous biological diversity; natural functioning and character; and amenity values downstream will be maintained. Adverse effects of flooding and erosion downstream of the site will be avoided with the defence against water maintaining flood channel capacity resulting only in a minor increase in flood levels. Changes in the nature of downstream flows and sediment that would affect existing structures; or arises from any reduction in flood carrying capacity will also be avoided.

Disturbance of the margin of the Kaikorai Stream is not expected to have any adverse effect on downstream spawning requirements of indigenous fauna; water quality; and downstream users. In particular, construction management measures will capture any sediment laden water and ensure that sediment is not discharged downstream.

NPSFW objective 2.1 and policies 1 and 2 requires freshwater is managed to give effect to Te Mana o te Wai, and tangata whenua are actively involved in freshwater management, and Māori freshwater values are identified and *"provided for"*. P-ORPS objectives LF-WAI-O1, and Policies LF-WAI-P2, and P4 seek similar outcomes. The NRMP Wai Māori policies express the cultural importance of water to Kāi Tahu and the importance of protecting and restoring the mauri of all water. Proposed construction management measures for the defence against water, together with development of the VRMP and LCMP will ensure that Te Mana o te Wai and Kāi Tahu cultural values are provided for, and mauri protected and restored to the extent possible. Ongoing engagement with Te Rūnanga o Ōtākou will ensure the continued involvement of tangata whenua.

9.1.8. Indigenous Biodiversity and Wetland Provisions

The relevant provisions addressing biodiversity are set out in **Table 33**.

Table 33 – Biodiversity – Policy Framework

Planning Document	Relevant Provisions
National Policy Statement for Freshwater Management 2020 (NPSFW)	Objective 2.1 and Policies 1, 2, 5, 6, 9, 13, 15, clause 3.22(1).
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 3.1 and Policies 3.1.2, 3.1.9 Objective 3.2 and Policies 3.2.2, 3.2.16 Objective 5.4 and Policies 5.4.2, 5.4.6, and 5.6.4A
Proposed Otago Regional Policy Statement (P-ORPS)	Objectives LF-WAI-O1, Policies LF-WAI-P1, P2, P3, P4 Objectives LF-FW-O1A, LF-VM-O5, Policies LF-VM-P5 Objectives LF-FW-O9, O10, and Policies LF-FW-P10A, , P13 Objectives ECO-O1, O3, and Policies ECO-P1, and P5A, P10
Otago Regional Plan: Water (Water Plan)	Objectives 10.3.1, 10.3.2 and Policies 10.4.1, 10.4.2, 10.4.8
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.7, Objectives (i), (ii), (iii), and Policies 1, 2, 3, 4, 5. Section 5.5, Objectives (i), (ii), (iii), (iv), (v), (vi), (ix) and Policies 1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 15, 16.

NPSFW objective 2.1 and policies 1 and 15 requires that natural and physical resources are managed to give effect to Te Mana o te Wai and prioritises the health and wellbeing of water bodies and freshwater ecosystems over the ability of people to provide for social, economic, and cultural wellbeing. Policy 9 requires the habitats of indigenous freshwater species are *"protected"*.

ORPS objective 3.1, and policy 3.1.9 requires ecosystem and indigenous biodiversity be managed to *"maintain or enhance"* ecosystem health and indigenous biological diversity; and *"maintain or enhance as far as practicable"* areas of predominately indigenous vegetation. P-ORPS objectives ECO-O1 and policy ECO-P5A require indigenous biodiversity is healthy and thriving and any decline is halted, including by ensuring the effects of existing activities are no greater in intensity, scale or character.

The continued operation of the landfill will maintain ecosystem health, indigenous biological diversity, and areas of predominately indigenous vegetation. No clearance of indigenous vegetation will occur, and implementation of native plantings in riparian areas associated with the VRMP will improve habitat values. Disturbance effects to avifauna will be unlikely to change, and while there will be loss of food supply and habitat for SSBG, they are not threatened or protected, and effects on SSGB are authorised by the existing consents for the Smooth Hill landfill. The continued operation and infrastructure improvements to the leachate collection system, and stormwater and erosion and sediment control methods will maintain downstream water quality and ensure a very low or low level of ecological effect on downstream freshwater fish fauna, and the food availability/foraging ability of avifauna, and ensure the habitats of indigenous freshwater species are protected.

NPSFW policy 6 and policy 10.4.8 of the Water Plan requires that *"there is no further loss of the extent of natural inland wetlands, their values are protected, and their restoration is promoted"*. P-ORPS objective LF-FW-O9, and policy LF-FW-10A, seek similar outcomes. ORPS objective 3.1, and policy 3.1.9 requires important hydrological services and resources and processes that support indigenous biological diversity are to be *"recognised and provided for".* Objective 2.2, and policy 3.2.16 requires the function and values of wetlands are to be *"protected"* by *"maintaining"* their significant values; and *"avoiding, remedying or mitigating"* other adverse effects. Water Plan objectives 10.3.1, 10.3.2, and policies 10.4.1, and 10.4.2, require adverse effects are to be *"avoided"* on any regionally significant wetland.

The margins of the Kaikorai Stream and Estuary bordering the landfill to the north and west are identified as a Regionally Significant Wetland in the Regional Plan: Water and comprises areas of significant indigenous vegetation and significant habitats of indigenous fauna for the purposes of s6(c) of the RMA. Corresponding ORPS objective 3.2, and policies 3.2.1 and 3.2.2 require areas of significant indigenous vegetation and habitats are to be "protected and enhanced" by: "maintaining" those values that contribute to the area being significant; "avoiding significant" effects on other values; and "remedying or mitigating" other adverse effects. ORPS objective 5.4, and policy 5.4.6 require offsetting of indigenous biological diversity is to be considered where the residual adverse effects of activities cannot be "avoided, remedied, or mitigated." P-ORPS objectives ECO-O1 and policy ECO-P5A require indigenous biodiversity if healthy and thriving and any decline is halted, including by ensuring the effects of existing activities are no greater in intensity, scale, or character and do not result in the loss of extent or degradation of the ecological integrity of significant natural areas.

The continued operation of the landfill, including the proposed infrastructure upgrades will occur outside of any natural wetlands. Indirect stream depletion effects from the leachate collection trench are estimated to be <0.5 L/s, which is expected to have a negligible effect on stream surface flows and very low effect on natural wetlands. The continued operation and infrastructure improvements to the leachate collection system, and stormwater and erosion and sediment control methods will maintain downstream water quality and ensure a very low or low level of ecological effect on wetland values. Accordingly, important hydrological processes will be provided for, and there will be no loss of natural wetlands or their values, and effects on the regionally significant Kaikorai Lagoon Swamp will be avoided. Similarly, areas of significant vegetation and habitats will be protected by maintaining values that contribute to the area being significant. No residual adverse effects exist that require offsetting.

NPSFW objective 2.1 and policies 1 and 2 requires freshwater is managed to give effect to Te Mana o te Wai, and tangata whenua are actively involved in freshwater management, and Māori freshwater values are identified and *"provided for"*. P-ORPS objectives LF-WAI-O1, and Policies LF-WAI-P2, and P4 seek similar outcomes. The NRRP Wai Māori policies express the cultural importance of water to Kāi Tahu and the importance of protecting and restoring the mauri of all water. The policies oppose the draining of wetlands and stipulate that all wetlands are to be protected and seek revegetation with locally sourced indigenous plants for all disturbed areas.

The NRMP Mahika Kai and Biodiversity policies advocate for the involvement of Kāi Tahu in the management of mahika kai and express the importance of protecting and enhancing mahika kai values and the physical access of Kāi Tahu to important sites. The policies have a particular focus on the protection of indigenous fish and their habitats, particularly from hazardous operations and the use, transportation and storage of hazardous substances. The policies also cover the protection and enhancement of existing wetlands as well as the reinstatement of wetlands that have been neglected.

Infrastructure improvements to contain leachate, updated monitoring and management measures, and development of the VRMP and LCMP will ensure the protection of indigenous fish from hazardous operations and ensure that Te Mana o te Wai and Kāi Tahu cultural values are provided for, and mauri protected. Ongoing engagement with Te Rūnanga o Ōtākou will ensure the continued involvement of tangata whenua, including to ensure physical access to sites.

9.1.9. Natural Hazard Provisions

The relevant provisions addressing natural hazards are set out in **Table 34**.

Table 34 – Natural Hazard – Policy Framework

Planning Document	Relevant Provisions
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 4.1, Policies 4.1.4, 4.1.6, 4.1.7 Objective 4.6, Policy 4.6.8
Proposed Otago Regional Policy Statement (P-ORPS)	Objective HAZ-NH-O1, Policy HAZ-NH-P4, P7

ORPS objective 4.1 and policies 4.1.4, 4.1.6, and 4.17 require the natural hazard risk to people, communities, and property to be minimised and reduced, including through avoiding activities that result in significant risk from natural hazards, and encouraging design that facilitates recovery from natural hazard events. ORPS objective 4.6 and policy 4.6.8 require the risk of natural hazard events associated with the disposal of waste to be minimised. P-ORPS objective HAZ-NH-O1, and Policies HAZ-NH-P4, and P7 similarly require levels of risk to people, communities, and properties from natural hazards do not exceed a tolerable level.

The GIL is at risk of land deformation caused by seismic events. Stability assessments have confirmed that the predicted displacement under the highest predicted seismic loads falls within acceptable levels. Controlling of leachate levels in the landfill, proposed strengthening of infrastructure to be more resilient to seismic events, and emergency response measures included in an updated LDMP will ensure significant risks are minimised and reduced, and recovery from seismic events is facilitated.

The GIL is in area at moderate risk of fluvial flooding from the Kaikorai Stream and at risk from sea level rise, which has the potential to affect the operation of the leachate collection trench. As an existing activity, complete avoidance of these hazard risks is not practicable. The establishment of a defence against water between the landfill and Kaikorai Stream and raising of components of the leachate collection system above the flood level will ensure significant risks are minimised and reduced, and recovery from flood and storm surge events is facilitated. Flood channel capacity as a result of the defence against water will be maintained, resulting only in a minor increase in flood levels, thereby ensuring natural hazard risks from potential floodwater displacement are minimised.

9.1.10. Nationally and Regionally Significant Infrastructure Provisions

The relevant provisions addressing nationally and regionally significant infrastructure are set out in **Table 35**.

Table 35 – Nationally and Regionally Significant Infrastructure – Policy Framework

Planning Document	Relevant Provisions
Partially Operative Otago Regional Policy Statement (ORPS)	Objective 4.3 and Policies 4.3.1, 4.3.2, 4.3.3, and 4.3.5
Proposed Otago Regional Policy Statement (P-ORPS)	EIT-INF-O4, Policy INF-P15 EIT-TRAN-O7, Policy EIT-TRAN-P21

ORPS objective 4.3, and policies 4.3.1, 4.3.2, and 4.3.5 requires infrastructure of national or regional significance (which includes roads of national significance, and airports) be *"protected"* by *"avoiding significant"* adverse effects, and *"avoiding, remedying or mitigating"* other adverse effects on the functional needs of such infrastructure.

The P-ORPS, includes landfills in the definition of *"regionally significant infrastructure"*, however that status is affected by a currently unresolved appeal. P-ORPS objectives EIT-INF-O4 and EIT-TRAN-O7 and policies INF-P15 and EIT-TRAN-P21 require the provision of effective and resilient infrastructure, and an air transport network that is safe.

Dunedin International Airport DIAL is defined in the ORPS and P-ORPS as being infrastructure of national or regional significance. While GIL is located more than 13km from DIAL, any risk of aircraft bird strike caused by dispersal of SBBG from GIL as a consequence of a reduction in food and organic waste entering the landfill, and the ultimate closure of the landfill will be managed through the implementation of a SSBG Management Plan, so as to ensure adverse effects of the functional needs of Dunedin airport are avoided.

9.2. Other Matters (s104(1)(c) RMA)

9.2.1. Dunedin City Council Waste Minimisation and Management Plan 2020

As described in **section 3.1.1**, the Waste Minimisation Act requires DCC to adopt a Waste Management and Minimisation Plan (WMMP). The current WWMP was adopted in June 2020 as part of the Waste Futures Project. The vision of the plan is:

> *We have a duty to protect and enhance Dunedin's natural environment and resources for those generations who come after us (mō tatou, ā, mō kā uri ā, muri ake nei).*
>
> *Dunedin is actively committed to zero waste, inclusive of a circular economy, to enhance the health of our environment and people by 2030.*

Targets of the plan include:

- *Reduce the municipal solid waste generation per capita by at least 15% by 2030 compared to 2015.*
- *Reduce the amount of municipal solid waste disposed to landfill and incineration by at least 50% by 2030 compared to 2015.*
- *Increase the diversion rate away from landfill and incineration to at least 70% by 2030.*

The plan includes a number of objectives, policies and methods (implementation pathways) supporting this vision, outlines how the plan will be funded, and sets performance indicators against which to measure implementation progress. Also included in the plan is a summary forecast of future waste demands.

Relevant objectives and methods relevant to waste disposal are as follows:

> ***OBJECTIVE 5:*** *The community has access to well managed waste disposal facilities.*
>
> ***Method:*** *The DCC will investigate landfill disposal options in readiness for the closure of Dunedin landfills.*
>
> ***OBJECTIVE 6:*** *Hazardous waste is managed in accordance with best practice*
>
> ***Method:*** *The DCC will work collaboratively with the Otago Regional Council to ensure standards for the safe treatment and disposal of hazardous waste are managed and monitored in accordance with the current legislation, regulation and best practice guidelines*
>
> ***Method:*** *The DCC will investigate options for the collection of hazardous household waste chemicals*

Method: *The DCC will use provisions of a Solid Waste Bylaw to ban prohibited waste from landfill disposal*

OBJECTIVE 7: *All open and closed landfills in Dunedin District have been identified and are operating in accordance with industry best practice*

The summary of forecast future demands in the WWMP notes that DCC is preparing for GIL's closure sometime between 2023 and 2028, that there is demand for the future provision of a landfill for waste disposal, and that export of waste out of the district is both undesirable and cost prohibitive. Development of Smooth Hill landfill is proposed to meet this future demand for landfill provision.

The continued provision of a landfill within Dunedin is consistent with the vision, objectives, and methods of the WMMP. Whilst the DCC is actively committed to realising 'zero waste' and enabling appropriate diverted material solutions, there is still a need for a landfill. The continued operation of GIL will meet the community demand for waste disposal facilities until Smooth Hill commences operation.

The GIL has been in operation since 1953 and is not sited in a location or designed in accordance with the best practice WasteMINZ guidelines. It will however continue to operate in accordance with those guidelines to the extent practicable. The waste acceptance criteria align with MfE Module 2 guidelines and current best practice and industry standards (with the exception for liquid waste). Hazardous wastes that exceed the waste acceptance criteria of the criteria will not be accepted at the landfill in accordance with best practice, thereby supporting the intent of the WWMP to implement the collection of hazardous household waste chemicals, and a Solid Waste Bylaw.

9.2.2. WasteMINZ Technical Guidelines for Disposal to Land

The Waste Minimisation Institute of New Zealand (WasteMINZ) *Technical Guidelines for Disposal to Land (August 2018)* provides technical guidance relating to the siting, design, operation, and monitoring of landfills in New Zealand, based on local and international experience. The guidelines replaced earlier publications relating to landfills in New Zealand, including the Centre for Advanced Engineering Landfill Guidelines (2000). The guidelines:

- Define clean fill material, controlled fill, managed fill material and waste types intended for disposal to land.
- Define classes of landfills based on the types of material to be accepted for disposal, and associated waste acceptance criteria.
- Provide a consistent approach to siting, design, operations and monitoring to reduce the actual and potential effects of landfills on the environment and communities.
- Make current best practice recommendations on key technical requirements for siting, design, operations and monitoring of landfills.

The guidelines are not intended to be a detailed technical manual, but rather a source of information from which facility operators and regulatory authorities can seek comprehensive technical, planning and legal advice from appropriately qualified experts.

Waste Plan policy 7.4.11 requires the siting, design, construction, construction, operation, and management of new landfills be in accordance with the guidelines, and a site-specific management plan.

The guidelines outline that class 1 landfills require:

- A rigorous assessment of siting constraints, considering all factors, but with achieving a high level of containment as a key aim.
- Engineered environmental protection by way of a liner and leachate collection system, and an appropriate cap, all with appropriate redundancy.
- LFG management.
- A rigorous monitoring and reporting regime, along with stringent operational controls. Monitoring of accepted waste materials is required, as is monitoring of sediment runoff, surface water and groundwater quality, leachate quality and quantity, and LFG.

GIL in its current form proceeded the modern landfill design standards described in the CAE Landfill Guidelines (2000), and the more recent WasteMINZ guidelines. These guidelines recommend the installation of a low permeability liner and leachate collection system for class 1 municipal solid waste landfills. GIL does not meet these requirements, instead providing for leachate containment and management by way of the combination of the underlying low permeability estuarine sediments, and lateral flow of leachate within the landfill towards the perimeter leachate collection trench, from where it is intercepted and directed to the GIWTTP. As described in **section 8.3**, these measures are effective at intercepting leachate and preventing migration into the Kaikorai Stream and estuary, and further improvements to this system are proposed to address potential migration risks.

The landfill otherwise aligns with WasteMINZ guidelines, including the progressive installation of a landfill cap that aligns with the minimum requirements for depth and permeability, ongoing installation and operation of an LFG collection and destruction system (and which also meets the requirements of the NES-AQ), and stormwater controls and treatment to ensure sediment is captured prior to discharge into the receiving environment.

The landfill will be subject to an extensive monitoring regime and operational controls in an updated LDMP and LCMP. These include waste acceptance criteria and procedures, including ensuring hazardous wastes that do not meet the leachability criteria are not accepted. Monitoring of groundwater and surface water, leachate quantity/quality, air quality, and LFG are proposed to continue with some improvements, including to capture additional contaminants (e.g. PFAS and PFOA), monitor leachate levels in the landfill, and more frequent LFG surface (ISM) monitoring. This monitoring will ensure containment and treatment methods remain effective, or corrective actions are undertaken.

9.3. Section 107 RMA

Section 107 of the Act provides that a consent authority shall not grant a discharge permit, that would allow the discharge of contaminant or water into water, or the discharge of a contaminants onto or into land in circumstances which may result in that contaminant entering water, if after reasonable mixing, the contaminant or discharge is likely to give rise to the following effects in the receiving waters:

- *the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials:*
- *any conspicuous change in the colour or visual clarity:*
- *any emission of objectionable odour:*
- *the rendering of fresh water unsuitable for consumption by farm animals:*
- *any significant adverse effects on aquatic life.*

As described in this AEE, the landfill the existing leachate collection trench provides effective containment of leachate from the receiving environment, and proposed improvements will address any potential migration risks. The methods of stormwater discharge align with best engineering practice, and the guidance contained in the WasteMINZ guidelines. As described in **section 8.3**, leachate contaminated runoff is directed to the leachate collection system for disposal to the GIWTTP. Sediment laden stormwater from exposed landfill surfaces passes through sediment ponds prior to discharge to the Kaikorai Stream or is discharged to the leachate collection system.

On the basis of the historical monitoring described in **sections 7.4** and **7.5**, it is considered unlikely that the continued discharges of contaminants to land and water associated with the landfill will give rise to any of the effects listed in section 107 of the RMA in the receiving waters, after reasonable mixing.

10. Purpose and Principles of the RMA

Part II of the RMA sets out the purpose (Section 5) and principles (Sections 6-8) of the RMA. The overall section 5 purpose of the RMA is to 'promote the sustainable management of natural and physical resources'. This is to be achieved by managing resources in a way which provides for the social, economic, and cultural wellbeing, and health and safety of people and communities. This is while sustaining the potential of natural and physical resources to meet the needs of future generations; and avoiding, remedying, and mitigating adverse effects of activities on the environment.

Section 6 of the RMA sets out a number of relevant matters of national importance that are to be *"recognised and provided for"* in the use, development, and protection of natural and physical resources. Specifically:

- Section 6(a) – the preservation of the natural character of wetlands, rivers, and their margins, and their protection from inappropriate use and development.
- Section 6(c) – the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.
- Section 6(e) – the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.
- Section 6(h) – the management of significant risks of natural hazards.

Section 7 of the RMA lists a number of other matters that are to be given *"particular regard to"*, relevantly:

- Section 7(a) – Kāitiakitanga.
- Section 7(aa) – the ethic of stewardship.
- Section 7(b) – the efficient use and development of natural and physical resources.
- Section 7(c) – the maintenance and enhancement of amenity values.
- Section 7(d) – intrinsic values of ecosystems.
- Section 7(f) – maintenance and enhancement of the quality of the environment.
- Section 7g) – the finite characteristics of natural and physical resources.
- Section 7(i) – the effects of climate change.

Section 8 of the RMA requires the principles of the Treaty of Waitanga (Te Tiriti o Waitangi) to be taken into account.

The continued operation of GIL until closure will provide for Dunedin's social, economic, and cultural wellbeing. Specifically, it will provide its ongoing waste disposal needs until operations at Smooth Hill commence, and which will have economic benefits over and above the alternative option involving the out-of-district export of waste. The continued operation and improvements to the leachate containment infrastructure, earthquake, and flood reliance improvements, together with proposed ongoing monitoring and management measures in an updated LDMP and LCMP will also ensure there are no significant adverse effects on the health and safety of people and communities, and Kāi Tau cultural values.

Social, economic, and cultural wellbeing will be realised while sustaining the potential of resources for future generations, and avoiding, remedying, or mitigating adverse effects. In particular:

- Natural character values of the Kaikorai Stream and estuary adjacent to the site are modified. The continued operation of the landfill will not further reduce the abiotic or biotic aspects of natural character within the context of adjoining waterbodies. Experiential aspects may be adversely changed by a very small degree. Natural character effects have been assessed as very low, and opportunities exist to restore natural character post closure through implementation of the VRMP. The natural character of wetlands, rivers, and their margins will therefore be preserved.
- The Kaikorai Stream and estuary comprise areas of significant indigenous vegetation and habitats of significant indigenous fauna under the Regional Plan: Water, and 2GP. No clearance of indigenous vegetation of habitats in these areas will occur. Stream depletion effects on these habitats from the leachate collection trench will be very small. Continued operation of the leachate collection system and stormwater management will result in no changes to these habitats from contaminant discharges. There will be no increased disturbance, or changes to the food supply, foraging ability, and roosting habitat of indigenous avifauna, except for SBBG which have low ecological value. Effects on avifauna are expected to reduce post closure. Areas of significant indigenous vegetation and significant habitats of indigenous fauna will therefore be protected.
- Predicted levels of landfill deformation from the highest seismic loads contemplated fall within acceptable displacements, and measures are proposed to improve the earthquake and flood resilience of the landfill leachate collection systems. The significant risks of natural hazards will therefore be managed.
- The increase of capacity at the site will extend the operational life of the site to provide a buffer for Smooth Hill to be developed, as well as a cost-effective way of dealing with waste in the medium term. It will be an efficient use and development of natural and physical resources.
- Adverse effects from odour and dust, litter, and pests will be managed by best practice measures to ensure that they are reduced or remain low. Perimeter vegetation will be maintained and replaced and will integrate the site into the rural backdrop and screen views. Following closure, the landfill will appear part of and sympathetic to the surrounding landscape. Amenity values and the quality of the environment will therefore be maintained and enhanced.
- Landfill gas will be contained, collected, and destroyed in a way consistent with national standards to manage its contribution to the effects of climate change.

The relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga have recognised and provided for and the principles of Te Tiriti o Waitangi have been taken into account. In its engagement and consultation to date and proposed ongoing collaboration with Te Rūnanga o Ōtākou in the update and preparation of management plans, the DCC is recognising mana whenua and actively protecting Māori interests.

Overall, it is considered that the proposal will achieve the purpose and principles of the RMA 1991.

11. Consultation

11.1. Engagement Approach

The following section sets out the engagement process undertaken to date by DCC, as part of the consent application process for the ongoing operation and closure of Green Island landfill. Following consultation and engagement on the plans for the new kerbside collection in 2020, key stakeholder engagement started in late 2022 following development of the preferred option for the staged capping and closure of the landfill. Wider community engagement commenced in February 2023 and is ongoing, as part of the future development of Resource Recovery Park Precinct (RRPP) facilities at the landfill and ideas for the future use and enhancement of the site post-closure of the landfill.

DCC are leading the engagement with support from the wider project team. Engagement has been undertaken in accordance with DCC's *Significance and Engagement Policy (August 2017)*. In line with this policy, the consultation approach has been based on the International Association of Public Participation (IAP2) spectrum of engagement.

An Engagement Strategy (**the Strategy**) has been prepared by Boffa Miskell to guide the engagement process for the Waste Futures Programme. The strategy focuses on the interrelationship between the roll out of the new kerbside collection service in July 2024, the proposed changes to GIL in coming years to support the new collection service including the improved RRPP and the proposed closure of the landfill itself, and the new Class 1 landfill currently planned at Smooth Hill. The engagement strategy is continually reviewed and refined as the engagement progresses.

A range of engagement groups have been identified in the Strategy, including:

- Aukaha and Te Rūnaka o Ōtākou
- Key stakeholders, organisations, and interest groups
- Immediate neighbours; and Greater Green Island community including users of the Green Island Landfill facilities.

Engagement with Aukaha and Te Rūnaka o Ōtākou is as a Treaty partner and is ongoing with regular huis held throughout the project. Community engagement is focused on the local Green Island community and immediate neighbours.

Engagement has continued post-lodgement of the consent application with several activities undertaken to keep people informed about the plans for the closure of the landfill, the future development of the RRPP, and the future use and enhancement of the site post closure of the landfill. Engagement between DCC and the neighbours in Clariton Avenue is also ongoing, with a focus on plans to enhance the existing screening planting and ideas for the future use and enhancement of the site following final stage of capping and post closure of the landfill.

11.2. Engagement Summary to date

Below is a summary of the engagement undertaken to date by DCC since October 2022. As outlined above engagement is ongoing and will continue post-lodgement of the Green Island landfill closure consent application process, to inform the future development of RRPP facilities and ideas for the future use and enhancement of the site post closure. Additional stakeholder groups may be identified and engaged with as this process continues.

Aukaha and Te Rūnaka o Ōtākou

DCC initially engaged with Aukaha and Te Rūnaka o Ōtākou, on the Waste Futures programme, in mid-2019.

A series of briefing meetings were held by the DCC, prior to a hui with members of the rūnaka in August 2019. The hui focused on future waste management options and opportunities and explored options to achieve waste futures outcomes sought by mana whenua.

After this hui there was ongoing engagement throughout 2020 and 2021, as part of the consent application process for the proposed new Class 1 landfill facility at Smooth Hill.

In relation to the plans for the future of Green Island landfill, a hui and site visit of the landfill was undertaken with Aukaha and representatives of the rūnaka in April 2022. The purpose of the hui was to collectively discuss the future for the landfill site, including the proposed RRPP facilities and eventual landfill closure and hear the key priorities for whānau. Acknowledging that the site has been used as a landfill since the 1950s, several areas of interest were highlighted, including:

- The need to protect and restore the Kaikorai Stream and Estuary.
- Ensure the finish of the capped landfill complemented the surrounding landscape and maintained natural character.
- Use of native planting to enhance the existing screening vegetation around the landfill site and increase local biodiversity.
- Maintain/enhance views to Pukemakamaka Saddle Hill.

As technical work continued to help inform the plans for the future of Green Island landfill, a further hui was held with Aukaha in September 2022 to provide an overview of the preferred landfill closure option and ensure whānau concerns and aspirations continued to be considered as part of the plans for the landfill site.

Since then, there has been ongoing engagement with Aukaha via regular huis to:

- Assist Aukaha with the development of the cultural impact assessment for the Green Island landfill ongoing operation and closure consent.
- Inform the design, and the scopes and outcomes of the technical assessments required for the landfill closure AEE, including the assessments in relation to ground, water quality, air quality, ecology and landscape and visual effects; and
- Seek Te Rūnaka o Ōtākou input into the Organics Receival Building (ORB) consent application.

The DCC and project team provided a further briefing presentation to Te Rūnaka o Ōtākou (and Aukaha) on 22 February 2024.

Engagement will continue with Te Rūnaka o Ōtākou via Aukaha throughout 2024 and beyond to ensure that their concerns and aspirations are consistently understood and considered as part of the landfill closure consent process, future plans for the RRPP site and for the long-term use and enhancement of the site post closure. In addition, consultation is also currently underway in relation to the wider Waste Futures Programme, including requirements for engagement under the conditions of the Smooth Hill consent granted in May 2023. This includes engagement in relation to the development of the draft SSBG Management Plan (Avisure 2023).

Otago Regional Council (ORC)

DCC initially engaged with ORC in Oct 2022 to obtain feedback/input into the consent process for the closure of GIL, the scopes of the technical assessments, and the requirements for the applications for resource consent. Regular engagement continued through to lodgement as part of the pre-application process. Areas of interest included the proposed landfill closure design and assessment of effects as it relates to the Waste Plan, Water Plan and Regional Policy Statement, including potential effects on air quality, water quality and ecology.

Engagement with ORC is ongoing, as part of the GIL closure consent application process and the future consent application process as required for the new RRPP facilities.

Dunedin City Councillors

Regular briefings on the Waste Futures programme, including the GIL capping and closure project have been given to Dunedin City Councillors throughout the project. The updates provide an overview of the project and proposed consenting process. Areas of interest identified by the Councillors included how the Waste Futures Programme will contribute to DCC zero-waste and carbon reduction objectives, the potential ongoing effects of the Green Island landfill operation and closure on the local community and environment, the future development of the RRPP and use of the site post closure as well as funding options for the project. Engagement with Councillors is ongoing.

Community Boards

DCC have provided updates on the project to both the Chairs of the Mosgiel – Taieri Community Board and the Saddle Hill Community Board. The purpose of the updates was to provide information to assist the Community Boards understanding of the future plans for the GIL site, its ongoing operation and closure and future development of the RRPP and plans for post-closure use and enhancements. Areas of interest included potential ongoing effects of the Green Island landfill operation and closure on the local community and environment, the ability of people to continue to visit Rummage store and use the future RRPP, and opportunities to improve public access to the site and the Kaikorai Stream and Estuary post closure. Engagement with the Community Boards is ongoing.

Dunedin International Airport Ltd and New Zealand Airline Pilots Association

DCC commenced discussions with representatives from Dunedin International Airport Ltd (**DIAL**) regarding the Waste Futures programme in late-2019 as part of the Smooth Hill landfill consent

application process. Initial meetings provided an opportunity to discuss the project, including the proposed approach to bird management and to exchange relevant information. Key areas of interest included the risks associated with increased bird activity in the vicinity of the airport. Liaison with DIAL in respect to bird strike risk and management are ongoing as part of the development of the working draft of the SBBG Management Plan that has been submitted as part of this consent application process and the establishment of a DIAL/DCC Liaison Group. This group also includes the New Zealand Airline Pilots Association (**NZAPA**).

Department of Conservation (DOC)

To date DCC have also engaged with DOC as part of the development of the draft SBBG management plan which has been developed to support the Green Island landfill closure consent application. DOC have acknowledged that, as black-backed gulls/karoro are not protected wildlife, they have no direct statutory role in their management and as such their main area of interest is in supporting the interests of Te Rūnanga O Ōtākou and their aspirations regarding karoro. DCC intend to continue to engage with DOC throughout the consent process and post lodgement, on the plans for the landfill closure, the new RRPP facilities and the public use and environmental enhancement of the site post closure.

11.3. Community Engagement

The local Green Island community

With support from Boffa Miskell, DCC began community engagement on the future operation and closure of the Green Island Landfill in February 2023. Engagement is ongoing. The purpose of the community engagement is to inform neighbours and the wider Green Island community and residents about the plans for the future of the Green Island landfill, including:

- The wider Waste Futures programme and Dunedin's wider commitment to reducing carbon emissions and reducing waste going to landfill
- The roll-out of an enhanced kerbside recycling and waste collection service for the city from July 2024
- The staged closure of the landfill itself and the consent application process
- plans for the new RRPP facilities and opportunities for future public access to the site and surrounding environment, including Kaikorai Stream and Estuary post closure.

A range of engagement activities have been undertaken and are ongoing. All activities are promoted and supported by engagement collateral including flyers, public drop-in sessions banners, and handouts (**Appendix 19)**.

Specific community engagement activities undertaken from February 2023 to date are listed under the headings below.

Development of the DCC Waste Futures website

The dedicated Waste Futures website was established in 2018. It has been regularly updated with Waste Futures information, including plans for the staged capping and closure of the landfill and it will continue to be updated post lodgement of the consent application and as work continues plans for the future of the landfill, the RRPP facilities and the ideas for the use of the site post

closure. A video has been developed and uploaded onto the website that further explains the project.

https://www.dunedin.govt.nz/council/council-projects/waste-futures/green-island-landfill-site

Pop-up information sessions around Green Island community

A series of pop-up information sessions were held at different locations around the Green Island community throughout 2023, including at Fresh Choice Supermarket, at the Rummage Store, at the Sunnyvale Sports Centre and café and at the Greater Green Island Community Get-Together. DCC staff and project team members were at the drop-in sessions and available to talk to people more about the plans for GIL. A series of banners were prepared specifically to assist with the drop-in sessions and show people the proposed changes for GIL at closure and post closure and to present ideas for how the site could be used in the future.

***Figure 18 and 19** - Pop-up information sessions were held in throughout 2023 at public locations around Green Island community, including at the local supermarket and the Greater Green Island Community Get-together*

It is estimated that over the course of the pop-up sessions the team have engaged with over 400 people.

The key messages that came from speaking to people at these sessions were:

- They appreciate being informed about what's happened and responded positively to being kept informed about what was happening at GIL, including plans for closure around 2029, based on current waste disposal rates.
- A high level of interest in the new kerbside collection bin system, including the new bin to collect green and food waste and efforts made by DCC to reduce waste and process recycling.
- They liked the idea that the area around Green Island site could provide recreation opportunities in the future, such as tracks and trails, when the landfill closed.
- Some concern for the health of the Kaikorai Stream and Estuary and whether there were plans to improve the health of the waterway, including action needed to stop illegal dumping of waste.
- Keen to get updates on the plans for the proposed landfill at Smooth Hill and what was happening with that process.
- Interested to know that they would be able to continue to use the existing RRPP facilities and go to the landfill, even once the landfill itself is closed.

Information flyers/handouts

Handouts were also designed and handed out at the sessions to provide further information and direct people to the DCC Waste Future website page if they wanted to know more and be kept informed. There were also opportunities for people to register their interest to be kept informed via email about the above activities as they progress, via providing their contact details to DCC.

11.3.1. Greater Green Island Community Network

Engagement with the Greater Green Island Community Network (GGICN) as a key stakeholder in the project began in 2022 and has continued throughout 2023 and 2024, with DCC staff attending GGICN Committee meetings and talking to other groups in the Green Island community as opportunities arise, this includes the Green Island Business Association. Also, and with support from the GGICN regular articles have been included in the local newsletter (The Informer) since March 2023 advising people about what is happening and the opportunity to find out more and keep up to date.

Both the Green Island Business Association and the GGICN expressed support for the eventual closure of the landfill and plans for improvements to the site, both through the development of the RRPP and the post-closure ideas. This was because it was felt that having people coming to the site, particularly at weekends, resulted in people spending time at Green Island shops/centre.

Engagement with the GGICN and regular articles in the 'Informer' will continue throughout 2024/2025, with plans for DCC to attend local events as opportunities arise, to continue to talk to people about the project.

11.3.2. Residential neighbours

Flyer drops to neighbours

Over 100 flyers were delivered to neighbour's houses in Clariton Avenue, Taylor Street, Wavy Knowes and parts of Walton Park on 18 and 19 February 2023. The purpose of the flyers was to invite neighbours to attend a series of information sessions to find out more about the plans for the future of Green Island landfill, meet the DCC team and ask questions.

Online information sessions with neighbours

Online information sessions, via Zoom, were held in February and March 2023. The meetings were attended by DCC Group Manager Waste and Environmental Solutions and key members of the project team who presented imagery that explained what was planned for the future of Green Island landfill, including the staged closure of the site and that based on Dunedin's current waste disposal rates closure was expected to be around 2029. Seven people took the opportunity attend the sessions. Areas of interest included ongoing management of the landfill up to closure, including odour, noise, and potential for increased views if the landfill as it continued to fill up. All attendees were appreciative of the chance to meet the team and find out more about what was planned and asked to be kept informed as the plans progressed.

On-on-one meetings with interested residential neighbours (Clariton Avenue)

Following the online information sessions, several of the neighbours who attended the sessions expressed interest in being kept informed about the plans for the closure of the landfill and the development of the RRPP. Regular one-on-one meetings (six over the course of 2023) were subsequently held with these neighbours to discuss the plans for the site in detail, hear their concerns and provide opportunities to ask questions.

The neighbours involved in the one-on-one meeting were appreciative of the ability to meet regularly with the Council team and ensure a 'no surprises' approach about the consent. These one-on-one meetings will continue post lodgement and into 2025.

Key issues raised by the neighbours at these meetings included:

- plans for enhancing the existing screening planting around the site, to help mitigate the visual effects of the landfill, whilst maintaining long-distance views, including to Pukemakamaka Saddle Hill, and avoiding shading of their gardens and outdoor areas.
- Ongoing concerns about pest management and SBBG management whilst the landfill remains in operation and post-closure.
- how they can continue to work in collaboration with DCC, and how they will be kept informed about the plans for the landfill closure and any potential access to the site post-closure
- ability for them to be able to easily raise concerns/complaints about the ongoing day-to day operations of the landfill with DCC prior to closure and be assured of a response (clear complaints resolution process)

These concerns are being addressed through the technical reports, updates to management plans, and several of the draft consent conditions. This includes a draft consent condition outlining the establishment of a Green Island Landfill community liaison group (CLG).

Information days and site tours for neighbours

The DCC have also held information evening and afternoons, in March and August 2024, for Clariton Ave neighbours on site at Green Island landfill. These site tours were led by DCC staff and provided more information about the Staged capping and closure of the landfill itself over the coming years, the RRPP project and the resource consent process. There was also an opportunity to ask questions and meet the team.

11.4. Ongoing Engagement

Stakeholder and community engagement will continue post -lodgement of the consent application for the proposed closure of the GIL. Additional stakeholder groups will be identified and engaged with as this process continues.

Engagement with the Greater Green Island Community network as a key stakeholder in the project will continue throughout 2023, with plans for DCC to attend local events to continue to talk to people about the project.

Green Island Landfill Community Liaison Group (CLG).

It is also intended to invite the community to establish and maintain a Community Liaison Group (CLG) for the purpose of facilitating ongoing engagement between the Dunedin City Council and the community on the operation and closure of the landfill. Membership of the CLG will be confirmed following issuing of resource consents, but it is likely to include Dunedin City Council reps, Otago Regional Council as consent authority, key stakeholders, and interested community members and neighbours. Before the CLG is set up, the DCC will continue to meet and engage with neighbours.

12. Conclusion

The DCC has embarked on the Waste Futures Programme to develop an improved comprehensive waste management and diverted material system for Dunedin, including future kerbside collection and waste disposal options.

The GIL is the city's current landfill for the disposal of municipal solid waste and hazardous waste. Based on current waste disposal projections, the landfill is expected to reach full capacity in approximately April 2027. DCC has been planning for this eventuality, and as part of the Waste Future's Programme has confirmed the need to replace the landfill at GIL with a new landfill located at Smooth Hill.

In the interim, DCC needs to be able to continue to be able to dispose of waste at GIL to meet the city's waste disposal needs. The GIL operates under 14 existing resource consents which all expire on the 1st of October 2023. DCC is therefore applying for replacement resource consents which provide for the continued operation of the landfill until approximately December 2029 depending on waste disposal rates, followed by closure and ongoing aftercare of the landfill. The applications overall have a discretionary status under the RMA.

Technical assessments have been completed assessing the actual and potential effects of the continued operation and closure of the landfill. Those assessments and this AEE conclude:

- Continued waste disposal at GIL will be more cost effective than out of district disposal, and result in lower emissions, road network wear and tear, and congestion. It will provide flexibility to fluctuating waste demands and ensure there is a viable option for the continued disposal of waste until which time operations at Smooth Hill commence, including allowing for delays and for a period of transition in operations at the two landfills.
- Ongoing acceptance of waste at GIL will occur in accordance with waste acceptance criteria and procedures contained within the existing LDMP to ensure effects on the receiving environment and human health and safety will remain low.
- Continued operation, and improvements to the leachate collection system, and operation of stormwater management measures will ensure the provision of flows in the Kaikorai Steam, and the effective interception of leachate and stormwater contaminants to ensure effects on groundwater and surface water quality will remain low.
- Implementation of best practice mitigation measures will ensure odour, dust, pest, and litter effects are reduced or will be low. Health and ecological effects from LFG combustion emissions will remain very low and will comply with the NES-AQ.
- Implementation of best practice measures to prevent, detect, and response to landfill fires will ensure any fire risks remain low.
- Implementation of a SSGB Management Plan will ensure the probability of an increased bird strike hazard arising from SBBG dispersing following the removal of the majority of putrescible waste and ultimate closure of the landfill will be low.
- Earthquake and flood/sea level rise resilience infrastructure improvements, and emergency response measures will ensure effects on the operation of landfill leachate collection systems are mitigated, and effects from these hazards, including from flood displacement, will be low.

- Continued operation of the landfill within its existing footprint, and operation of the leachate collection system and stormwater management measures, will result in no change to surrounding terrestrial or aquatic habitats or fauna in the ecologically significant Kaikorai Steam and estuary from stream depletion, discharges of contaminants or habitat disturbance. Ecological effects will remain very low – low.
- Continued operation of the landfill, and an increase in its finished height will not compromise the existing levels of landscape character or natural character, which are highly modified. Views will remain screened by perimeter vegetation. Landscape, natural character, and visual effects will be low, or low-moderate during operation, and reduce to low at closure.
- Significant positive social impacts will result from the continued disposal of waste for residents in Dunedin at minimal cost, and the certainty for the community from closure of the landfill in approximately 2029. Implementation of best practice mitigation measures will ensure adverse social impacts are low.
- Recognising the CIA recommendations all practicable measures will be taken to prevent contaminants entering water, effects on mauri and whakapapa are offset, and ensure the protection of mahika kai and taoka species, and wāhi tūpuna. This includes preparation and implementation of a VRMP and undertaking a co-design process with mana whenua over the long-term post closure use of the site.

A suite of draft resource consent conditions has been developed, which together with proposed updates to the LDMP and the future development of a VRMP and LCMP will ensure any adverse effects will be avoided, remedied, mitigated, or offset.

The continued operation and closure of the landfill has been assessed against the relevant statutory documents, and purpose and principles of the RMA. The current regional policy framework is fragmented, and subject to ongoing review, with resulting uncertainty in policy direction as it relates to these applications. Notwithstanding, the proposal is considered in an overall sense to be consistent with the direction of these documents in their current form and in particular the more contemporary and settled directions of the NPS-FW and ORPS, as well as those of the Waste Plan. It will achieve the purpose and principles of the RMA.

Appendix 1: Records of Title

Appendix 2: General Arrangement Plan

Appendix 3: Design Report

Appendix 4: Landfill Development Management Plan (LDMP)

Appendix 5: Groundwater Report

Appendix 6: Surface Water Report

Appendix 7: Air Quality Report

Appendix 8: Bird Risk Assessment Report

Appendix 9: Draft Southern Black Backed Gull Management Plan

Appendix 10: Geotechnical Investigation Report

Appendix 11: Liquefaction and Stability Report

Appendix 12: Ecological Impact Assessment Report

Appendix 13: Landscape, Natural Character, and Visual Effects Report

Appendix 14: Economic Report

Appendix 15: Social Impact Assessment Report

Appendix 16: Cultural Impact Assessment Report

Appendix 17: Draft Conditions of Consent

Appendix 18: List of Proposed Updates to Landfill Development Management Plan

Appendix 19: Engagement Collateral

Appendix 20: Interim Human Health and Environmental Risk Assessment

Appendix 21: Landfill Gas Risk Assessment