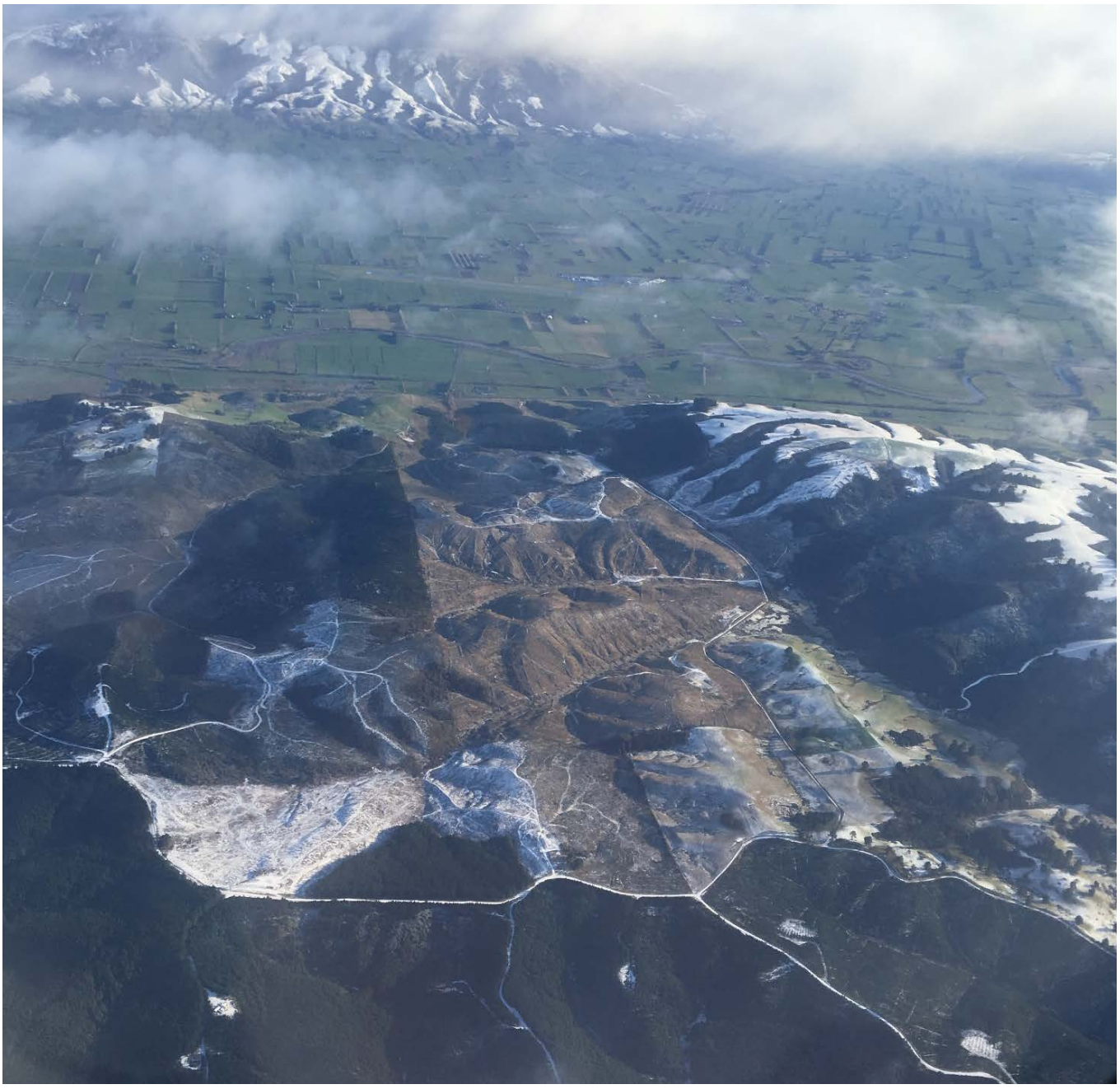
Boffa Miskell

Smooth Hill Landfill

Assessment of Environmental Effects for Updated Design

Prepared for Dunedin City Council

August 2020 (Updated May 2021)



Document Quality Assurance

Bibliographic reference for citation: Boffa Miskell Limited 2021. *Smooth Hill Landfill: Assessment of Environmental Effects for Updated Design*. Report prepared by Boffa Miskell Limited for Dunedin City Council.		
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Status: FINAL	Revision / version: 1	Issue date: 31 May 2021

Template revision: 20190509 0000

File ref: BM200252_FINAL_Updated_Smooth_Hill_Landfilll_AEE_20210531.docx

CONTENTS

1.0 Introduction 1

1.1 The Smooth Hill Landfill Project 1
1.2 Summary of Applications 4
1.3 Purpose of this Document 4

2.0 Applicant and Application Site Details 6

3.0 Background 8

3.1 Legislative Framework for Waste Management 8
3.2 Smooth Hill Landfill Background 10
3.3 Dunedin Waste Futures Project 12

4.0 Existing Environment 16

4.1 The Landfill Site 16
4.2 Topography and Geology 17
4.3 Climate 18
4.4 Hydrogeology and Hydrology 19
4.5 Water Quality 23
4.6 Terrestrial and Freshwater Ecology 24
4.7 Surrounding Land Use 34
4.8 Landscape and Natural Character 34
4.9 Archaeological Values 35
4.10 Cultural Values 37
4.11 Transportation Infrastructure 40

5.0 Description of the Project 43

5.1 General Landfill Description 43
5.2 Waste Types 46
5.3 Landfill Siting, Capacity, and Staging 46
5.4 Landfill Formation 48
5.5 Leachate Containment and Management 49
5.6 Landfill Gas Collection and Management 51
5.7 Surface Water Management 52
5.8 Groundwater Management 54
5.9 Landscape and Ecological Mitigation and Enhancement 55
5.10 Landfill Access 55

5.11 Landfill Facilities 57
5.12 Landfill Construction 58
5.13 Landfill Operation 61
5.14 Landfill Closure and Aftercare 62
5.15 Landfill Management Plan 63

6.0 Description of Alternatives Considered 66

6.1 Alternative Landfill Options 66
6.2 Alternative Access Locations 67
6.3 Alternative Discharge Methods 68

7.0 Description of the Applications 69

7.1 Application Overview 69
7.2 Applications for Resource Consent from Otago Regional Council 70
7.3 Resource Consents Required from the Dunedin City Council 77
7.4 Permitted Baseline 81
7.5 Other Approvals Required 82

8.0 Assessment of Environmental Effects 83

8.1 Assessment Overview 83
8.2 Social and Economic Effects 86
8.3 Land Stability Effects 89
8.4 Waste Contaminant Effects 94
8.5 Water Quantity Effects 99
8.6 Water Quality Effects 105
8.7 Air Quality Effects 121
8.8 Terrestrial and Freshwater Ecology 138
8.9 Natural Character, Landscape Character, and Visual Amenity 156
8.10 Archaeological Values 159
8.11 Cultural Values 162
8.12 Transportation Network 172
8.13 Noise 176
8.14 General Community Effects 180
8.15 Conclusion of Assessment of Environmental Effects 183

9.0 Statutory Assessment 189

9.1 Statutory Planning Documents 189

9.2 Other Matters (s104(1)(c) RMA) 208
9.3 Section 107 RMA 210
10.0 Purpose and Principles of the RMA 212
11.0 Consultation 214
12.0 Conclusion 219

Appendices

Appendix 1: Computer Freehold Registers
Appendix 2: General Arrangement Plan
Appendix 3: Landfill Concept Design Report
Appendix 4: Concept Design Plans
Appendix 5: Geotechnical Interpretive Report
Appendix 6: Geotechnical Factual Report
Appendix 7: Economic Assessment Report
Appendix 8: Groundwater Report
Appendix 9: Surface Water Assessment Report
Appendix 10: Air Quality Report
Appendix 11: Ecological Impact Assessment Report
Appendix 12: Landscape and Visual Assessment Report
Appendix 13: Archaeological Assessment Report
Appendix 14: Cultural Impact Assessment
Appendix 15: Integrated Transport Assessment Report
Appendix 16: Acoustic Assessment Report
Appendix 17: Draft Conditions of Consent
Appendix 18: Objectives and Policies of the Statutory Planning Documents
Appendix 19: Preliminary Site Investigation

1.0 Introduction

1.1 The Smooth Hill Landfill Project

The Dunedin City Council (DCC) collects residential waste and manages the disposal of both residential and the majority of commercial waste for the Dunedin City area and environs. The Council has embarked on the Waste Futures Project to develop an improved comprehensive waste management and diverted material system for Dunedin, including future kerbside collection and waste disposal options. As part of the project, the Council has confirmed the need to develop a new landfill to replace the Council's current Green Island Landfill which is envisaged to reach full capacity in the next few years. Final closure could be around 2028 depending on the closure strategy adopted by the Council. ~~likely to come to the end of its functional life sometime between 2023 and 2028.~~

The Council commenced ~~a search~~siting studies for a new~~future~~ landfill location in the late 1980's and early 1990 and selected the Smooth Hill site in south west Dunedin, shown in **Figure 1** below, as the preferred ~~option~~location. At that time the site was designated in the Dunedin District Plan, signalling and enabling its future use as a landfill site. The Council also secured an agreement with the then landowner, Fulton Hogan Ltd, to purchase the land. ~~Over the following period~~Since the 1990's the Council has extended the life of the Green Island landfill and further development of the Smooth Hill site has been on hold.

As part of the Waste Future's Project, the Council has reconfirmed the technical suitability of the Smooth Hill site for the disposal of waste, including its attributes that support the natural containment of waste. The Council ~~has~~ proceeded to develop a concept design for the landfill, and associated road upgrades~~. The concept design has been developed~~, created by consulting engineers GHD with technical input from Boffa Miskell~~, to represent contemporary good practice landfill design that is consistent with adopted New Zealand landfill design standards. Specifically, the design provides for a high degree of engineered containment that will avoid discharge of waste contaminants to the downstream receiving environment of the Ōtokia Creek that ultimately flows to Brighton~~.

~~The existing District Plan designation of the site enables the development and use of that part of the site for a landfill in terms of section 9 of the Resource Management Act 1991 (RMA).~~ The Council ~~is now applying for the remaining RMA authorisations~~subsequently applied for resource consents from Otago Regional Council (ORC) and DCC's consenting authority arm required to enable the construction, operation, and aftercare of the landfill, and construction of the associated roading upgrades in August 2020 based on the original concept design. The applications were accepted by both Councils in October 2020. ORC and DCC both subsequently requested further information on the applications under section 92 of the RMA in October 2020. The section 92 requests included questions regarding the impact of the development on wetlands and associated ecological environments. Both the landfill design and the upgrade of McLaren Gully Road presented in the application had some direct impacts on wetlands, and the section 92 requests noted this was of particular interest given the enactment of the National Policy Statement and National Environment Standard for Freshwater 2020 shortly after the applications were lodged.

The Council has also continued to review the likely waste stream for Smooth Hill. The documents supporting the application had assumed an average waste stream of 90,000 tonnes per annum to Smooth Hill. However, review of recent data and assumptions regarding likely future increase in diversion has resulted in a revised estimate. The likely average waste stream is now assumed to be 60,000 tonnes per annum to Smooth Hill.

Based on the s92 requests and the revised waste stream estimate, the Council requested GHD to review the landfill and road design and identify if a revised layout was possible that both avoided to the extent practicable existing wetlands, while still cost effectively meeting the future waste stream needs of Dunedin City. An updated design that largely meets these requirements has been developed and is presented and assessed in this updated assessment of environmental effects (AEE). The design has also been refined in response to other matters raised in the further information requests.

The updated proposal includes the following key components (which are described in more detail in **section 5.0**):

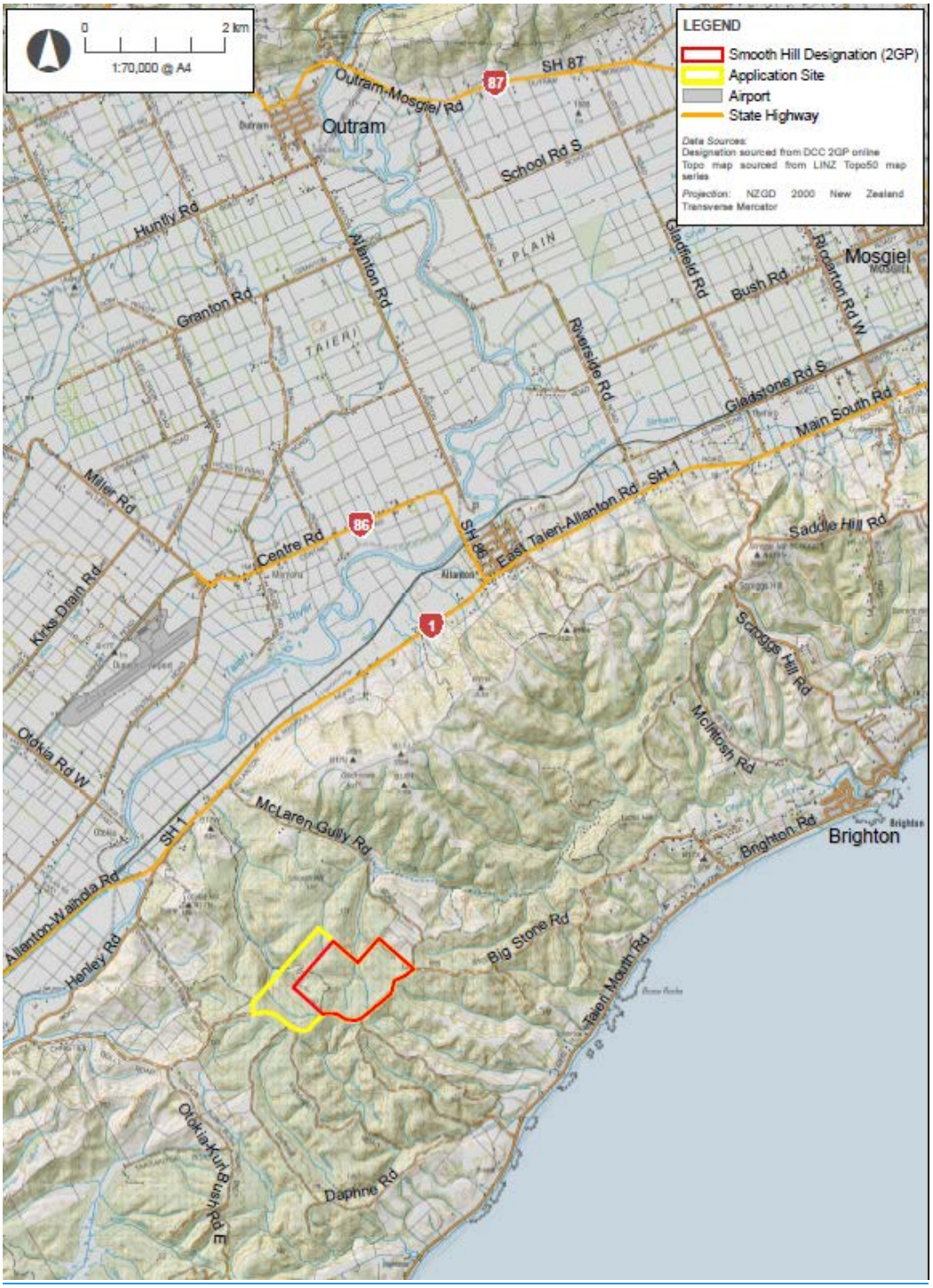
- The staged construction, operation, and aftercare of a class 1 landfill within the existing designated site to accept municipal solid waste, and hazardous waste. The landfill will have a footprint of 18.6ha, a net waste capacity of approximately ~~6~~ 2.94 million cubic ~~metres (equivalent to 5 million tonnes)~~, and an expected life at current assumed Dunedin waste disposal rates of approximately ~~55~~ 40 years. This is compared to a footprint of 44.5ha, a net waste capacity of 6.2 million cubic metres, and an expected life of 55 years under the original design. The landfill will receive waste only from commercial waste companies or bulk loads.
- Infrastructure to safely contain, collect, manage, and dispose of leachate, landfill gas, groundwater, and stormwater so as to avoid consequential adverse effects on the receiving environment.
- Facilities supporting the operation of the landfill, including staff and maintenance facilities.
- Environmental monitoring systems.
- Landscape and ecological mitigation/offsetting, including planting.
- Upgrades to McLaren Gully Road (including its intersection with State Highway 1) and Big Stone Road, to facilitate vehicle access to the site. Parts of the upgrade will fall outside the road reserve, requiring the adjustment of legal boundaries.

The updated design continues to represent contemporary good practice landfill design that is consistent with adopted New Zealand landfill design standards. Specifically, the design provides for a high degree of engineered containment that will avoid discharge of waste contaminants to the downstream receiving environment of the Ōtokia Creek that ultimately flows to Brighton. Aside from the reduced impact on wetlands, the updated design also better provides opportunities for ecological enhancement of existing wetlands and native vegetation in gullies on the site, and protection of existing archaeological features. This AEE concludes that the overall effects on the environment from these updates to the design result in reduced adverse effects.

Until recently, the designation in the 2GP fell over two separate land parcels bisected by an unformed paper road that ran through the site between McLaren Gully Road and Big Stone Road. The road was formally declared as being stopped on the 21st of July 2020. DCC subsequently

applied to alter the designation boundary, and the Council issued a decision formally altering the designation on the 26th of March 2021.

Figure 1 – Smooth Hill Site Location (Updated May 2021)



1.2 Summary of Applications

In order to deliver the project, the DCC ~~is~~ has applied~~applying~~ for the following RMA authorisations:

1. Resource consents from Otago Regional Council (ORC) under the Regional Plans for:
    - Discharge of waste, stormwater, and contaminants to land, water, and air.
    - Damming, diversion, take, and use of surface water and groundwater.
    - Activities within the beds of wetlands and rivers.
    - ~~Drilling of land.~~
2. Resource consents from DCC (as consenting authority) under the District Plans for upgrades to McLaren Gully Road (including and its intersection with State Highway 1), and Big Stone Road to the site~~ and the creation/enhancement of wetlands outside the designation~~.

~~3. Outline plan of works to the DCC (as consenting authority) under section 176A of the RMA for the proposed landfill within the designated land.~~

The RMA authorisations ~~will be~~are being sought in two stages. The first stage comprises the applications~~ 1 and 2~~ above, namely for all of the resource consents required from ORC and DCC. Those applications were applied for in August 2020 and are the subject of this updated AEE. The authorisations ~~being~~ that have been applied for are described in detail in **section 7.0**.

The second stage will comprise submitting an application~~ 3 above~~, for an outline plan of works to DCC's consenting authority arm. This application will be submitted following the completion of detailed landfill design. The detailed design and outline plan of works will be developed so as to align with the conditions of any approved resource consents and meet the requirements of the operator responsible for constructing and operating the landfill.

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 updated design introduced in **section 1.1** above.

This document:

- Describes the legislative framework for waste management in New Zealand, and the background to the project (**section 3.0**).
- Describes the existing environmental, social, economic, and cultural setting impacted by the project (**section 4.0**).
- Describes the updated landfill design and associated road upgrades, including design, construction, operation, and aftercare (**section 5.0**).
- Describes the alternative site, design, access, and discharge options considered (**section 6.0**)

- Describes the resource consents ~~being~~ applied for (**section 7.0**).
- Assesses the environmental effects of the project, including mitigation and monitoring measures, and proposed conditions (**section 8.0**).
- Assesses the project against the relevant RMA statutory planning documents and considerations (**sections 9.0 – 10.0**).
- Describes the consultation undertaken (**section 11.0**).

2.0 Applicant and Application Site Details

The applicant and subject site details are as follows:

Applicant's Name:	Dunedin City Council
Address for Service:	Anderson Lloyd Private Bag 1959 Dunedin 9016 Attention: Michael Garbett Phone: 03 467 7173 Email: michael.garbett@al.nz
Address for Fees:	Dunedin City Council PO Box 5045 Dunedin 9054 Attention: Chris Henderson
Site Details:	Landfill Site:

Site	Legal Description	Size of entire property	Owner
~~700~~ 750 Big Stone Road	Part Lot 1 DP 457417 and Section 1 – 2 SO 547235 (~~CFR~~ RT ~~598005~~971405)	~~117.6382~~118.8517 ha	Dunedin City Council ~~(after 30 September 2020)~~
~~750~~ 700 Big Stone Road	Lot 2 DP 457417 (~~CFR~~ RT 598006)	58.9603 ha	
~~Stopped paper road~~	~~Section 1 SO 547235~~	~~0.8510 ha~~	~~Dunedin City Council~~
	~~Section 2 SO 547235~~	~~0.3625 ha~~	

Upgrade to McLaren Gully Road, Big Stone Road, and State Highway 1 intersection:

Site	Legal Description	Size of entire property	Owner
949 Allanton-Waohola Road	Part Section 71 Irregular Block East Taieri Survey District, Section 2 of 6, Section 8-9, Section 2 of 17, Section 26-27, Section 1 of 28, Section 2 of 28, Section 3 of 28, Section 1 of 29, Section 41, Part Section 10-11, Part Section 1 of 19, Part Section 2 of 29, Part Section 7 and Part Section 30 Block II Ōtokia Survey District and Deposited Plan 2677 (CFR OT17C/503)	467.9659 ha	Cook Allan Gibson Trustee Company Limited and Graeme John Wallace
108 McLaren Gully Road	Lot 1 DP 19819 (CFR 11A/153)	12.0200 ha	Peter Karl Huemmer, and Jillian Mary Huemmer

109 McLaren Gully Road	Lot 7 DP 21420 (CFR 19C/49)	20.4150 ha	Her Majesty the Queen
200 McLaren Gully Road	Lots 3-5 DP 21420 (CFR 244203)	42.8600 ha	Saffhill Forestry Estates Limited
	Lot 6 DP 21420 (CFR 209914)	38.2199 ha	
	Lot 1 DP 21420 (CFR 209912)	24.5000 ha	
	Lot 2 DP 21420 (CFR 209913)	185.5000 ha	
211 McLaren Gully Road	Section 2 of 19 and Section 21 Block II Ōtokia Survey District (CFR OT7A/953)	74.4622 ha	Lawrence George Henderson
949 Allanton-Waohola Road	Section 2 of 22, Section of 23, and Part 34 Block II Ōtokia Survey District (CFR OT253/283)	26.1022 ha	Cook Allan Gibson Trustee Company Limited and Graeme John Wallace
	Part Section 3 of 23, 2 of 25 Block II and Part Section 1 of 22 Block III Ōtokia Survey District (CFR OT13C/900)	69.8226 ha	
200 Christies Gully Road	Section 1-2 Section 21 Block III Ōtokia Survey District (CFR OT245/105)	23.6565 ha	David Arnold Irvine Brent, Eunice Gerogina McLeod, George Leonard McLeod and Russell Stewart Melville~~George Leonard McLeod~~
350 Big Stone Road	Lot 1 DP 21447 (CFR209915)	436.5960 ha	Safhill Forestry Estates Limited
645 Big Stone Road	Lot 8 DP 427870 (CFR 510238)	26.9539 ha	Ngai Tahu Forest Estates Limited

Note: The DCC is in negotiations with the relevant landowners to purchase the necessary land needed for the upgrade works. The final footprint of the planned roading upgrades may result in some of the sites identified not being affected by road widening.

Copies of the Computer Freehold Registers are included in **Appendix 1**.

3.0 Background

3.1 Legislative Framework for Waste Management

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

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

These documents are 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.'*[1] The WMA incorporates a number of 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 of $10 per tonne (plus GST) on waste disposed of at disposal facilities, to be used for funding waste minimisation activities undertaken by territorial authorities, businesses and community groups.[2]
- 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.

[1] Section 3, Waste Minimisation Act 2008.

[2] The Government has proposed to progressively increase the waste level over 4 years to $60 per tonne, commencing from 1 July 2021.

The WMMP is required to have regard to the New Zealand Waste Strategy or any equivalent replacement government policy. The New Zealand Waste Strategy 2010 outlines the government's current high-level direction for waste management and minimisation by central and local government, businesses, and communities. The strategy allows for a flexible approach that is adaptable for local situations. The goals of the strategy are:

- *Reducing the harmful effects of waste – when planning waste management and minimisation activities, local government businesses, and communities should assess the risk of harm to the environment and human health from waste to identify and take action on those wastes of greatest concern.*
- *Improving efficiency of resource use – when planning waste management and minimisation activities, local government, businesses and communities should improve the efficiency of resource use to reduce the impact on the environment and human health and capitalise on potential economic benefits.*

DCC's current WWMP was adopted in 2020. The plan is described further in **section 3.3**.

3.1.2 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."* [3] A key method to achieve this is to provide solid waste collection and disposal facilities.

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.

3.1.3 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 landfill gas 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.

[3] Section 10, Local Government Act 2002.

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) 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, contaminated soils, and plantation forestry. The Resource Management (National Environmental Standards for Air Quality) Regulations 2004 (NESAQ) in particular requires the capture and flaring of landfill gas once landfills reach a capacity threshold.
- 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 disposal facilities, and provide policy direction guiding the assessment and determination of applications.

3.2 Smooth Hill Landfill Background

The Council commenced a search for a new landfill location in the late 1980's and early 1990 to replace the Green Island landfill at the end of its life. The Council investigated thirty-two possible sites with input from consultants, iwi, the public, and regulatory agencies. The sites were initially assessed against a range of ecological, physical, social, and economic criteria, resulting in eleven sites being selected for further analysis.

Following consultation with a range of stakeholders, Smooth Hill and an extended Green Island landfill were subsequently selected for detailed evaluation and completion of environmental impact assessments by consulting engineers BECA. That evaluation for Smooth Hill considered the site was suitable for a landfill, including:[4]

- Progressive construction of a landfill at the site was technically feasible and could provide for 50 years of waste capacity.

[4] Environmental Impact Assessment of the Proposed Smooth Hill Sanitary Landfill, BECA Ltd, 1992.

- Underlying soils were suitable for leachate containment/protection against groundwater contamination, and the location at the head of the catchment would enable management of stormwater.
- The isolated location of the site and access from State Highway 1 would minimise traffic, noise, visual, or property effects from operation.
- Development costs for the landfill were considered reasonable and ongoing management will be economic.

Public submissions on the extended Green Island and Smooth Hill options were called for during early 1993, with a higher percentage of submissions favouring the extended Green Island option. The Council confirmed at its meeting on the 17th of May 1993 that the extended Green Island landfill be selected as the preferred interim solution, but that the Smooth Hill site should be secured to provide a long-term landfill solution for the city.

Subsequently the Council moved to negotiate to purchase of the Smooth Hill site and proceed with designation of the land. The Smooth Hill site was designated for use for *'proposed landfilling and associated refuse processing operations and activities'* in the Dunedin City District Plan in 1996.

The designation (reference D659) has been rolled over into the current Proposed Second Generation Dunedin City District Plan (2GP), and has a lapse date of 2058 (unless given effect to prior to that date). The 2GP was notified on 26 September 2015 and the initial submission process ran until 24 November 2015, and the further submission period ran until 3 March 2016. Only two submissions were received on the rollover of the designation. Decisions on the 2GP were notified on 7 November 2018 and the hearings panel confirmed the designation. No appeals were subsequently received and the 2GP designation is beyond challenge.

The extent of the designation is shown in **Figure 1** above. The designation, is subject to the following three conditions:

1. *This designation shall lapse on the 40th anniversary of the date on which this designation becomes operative.*
2. *A landscape plan showing proposed initial planting, final landform and final planting shall be prepared by the Requiring Authority under the direction of a qualified landscape architect prior to the commencement of landfilling operations. Development of the site shall be in accordance with this landscape plan.*
3. *Noise generated by any activity on the site shall comply with the following standards within 50 metres of the nearest house existing at the date on which the designation becomes operative - 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 is therefore enabled, subject to the requirement under section 176A of the RMA to submit an outline plan of works of the landfill design to the DCC, as consenting authority, as well as obtaining all necessary resource consents from the ORC.

Until recently, the ~~The current~~ designation in the 2GP ~~falls~~ fell over two separate land parcels bisected by ~~land that was until recently~~ an unformed paper road that ran through the site between McLaren Gully Road and Big Stone Road. As a precursor to the current applications, DCC

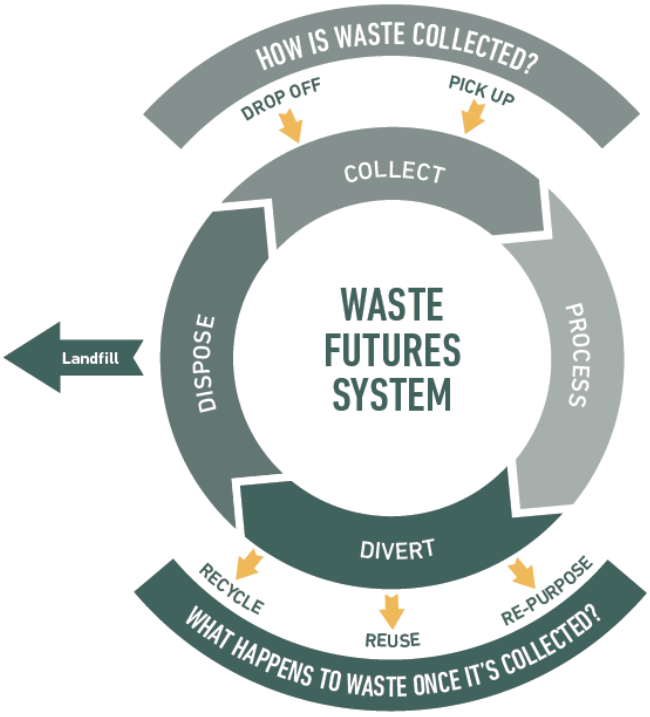
initiated separate processes to formally close the paper road. The road was formally declared as being stopped by the Minister for Land Information New Zealand on the 21st of July 2020. ~~The~~ DCC subsequently applied to ~~will separately apply to~~ alter the designation boundary under section 181(3) of the RMA to encompass the stopped road into the designation. The Council issued a decision formally altering the designation on the 26th of March 2021.

3.3 Dunedin Waste Futures Project

The Council has embarked on the Waste Futures Project to develop a comprehensive waste management and diverted material system for Dunedin that aligns with the Council's responsibility under the WMA to '*promote effective and efficient waste management and minimisation'*. The aim of the Waste Futures Project is to improve Dunedin's whole waste system, including what is collected, recycled, or reused, and what has to be disposed to a landfill. It is based around a circular economy approach[5] and will help the Council achieve its carbon emissions and waste reduction goals.

The Waste Futures system is graphically shown in **Figure 2** below.

Figure 2 – Waste Futures System



The Waste Futures Project includes three principal work streams:

- ~~Reviewing the current Waste Management and Minimisation Plan (WMMP).~~
- ~~Improvements to the kerbside refuse and recycling system.~~

[5] 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.

- ~~Replacement of the Green Island landfill after 2023 with a new landfill at Smooth Hill.~~
- Implementation of – the updated Dunedin City Council Waste Minimisation and Management Plan (2020)[6].
- Improvements to the kerbside collection service, recycling system and waste diversion 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.

3.3.1 Implementation of Waste Minimisation and Management Plan 2020 (WMMP)

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

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 WMMP outlines how waste management will be funded, sets measurable performance indicators, and describes the existing provision of waste and diverted materials facilities and services in Dunedin.~~

~~The plan covers collection, recovery, recycling, treatment and disposal, services and facilities.~~

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 ~~2030~~ 2040.*

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

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

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

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.

~~3.3.1~~3.3.2 Improvements to kerbside collection and recycling services

~~In conjunction with the WWWP process,~~ The Council~~the Council~~ 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~~four-bin option which adds a "green" bin for food and garden waste. As part of the changes it was also proposed to include central city residents in the new kerbside collection system. The consultation ~~will inform~~ was used to inform further development of kerbside options and costs suitable for inclusion in the Council's draft 10 -year plan 2021-2031.

In May 2020, as part of Council's ~~2021-31~~ 10~~-~~ -year plan consultation document 2021-31 (tō tātou eke whakamuri – the future of us) the C~~c~~ouncil consulted the community on the ~~included~~ two ~~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.

3.3.3 Preparing for the closure of the Green Island landfill

~~A key driver for the Waste Futures Project is the need for confirmation of a medium to long-term waste disposal solution for Dunedin.~~ Green Island Landfill is envisaged to reach full capacity in the next few years and DCC is currently preparing for its closure, which could be around 2028 depending on the closure strategy adopted by the Council. The Council's Green Island Landfill plays a significant role in Dunedin's waste management system, being the only landfill in Dunedin that can accept municipal solid waste. ~~However, the current resource consents expire in October 2023, and the landfill will reach the end of its functional life between 2023 and 2028. Furthermore, nationally, waste generation is increasing, both in quantity and per capita.~~

Whilst the Council is actively committed to achieving its waste reduction and diversion targets, as outlined in the WMMP, there is demand for the future provision of a landfill for waste disposal in Dunedin. Council is therefore progressing the establishment of a modern landfill facility at the designated Smooth Hill site to meet this future demand.[7]

~~realising 'zero waste' and enabling appropriate diverted material solutions, Dunedin therefore needs to secure access to a landfill that can accept municipal solid waste for the foreseeable future. Progressing a future landfill solution is urgently needed, given the process of investigation, decision making, and implementation of a future total solution is complex, costly and likely to take some time.~~

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

~~As part of the first phase of the programme, t~~The Council initially engaged Stantec to carry out a feasibility analysis of extending the Green Island Landfill and for developing the designated Smooth Hill site. With respect to Smooth Hill, the work concluded that Smooth Hill has the capacity to accommodate current waste quantities ~~to 2063 and beyond.~~. ~~No barriers which would affect the consentability of the project were identified during the feasibility assessment, thereby effectively confirming the 1992 evaluation findings~~.

With respect to Green Island, the analysis concluded that it was possible to better manage the operations and filling of Green Island so that it might have an operational life to around 2028. The Council has subsequently put in place measures to preserve the remaining Green Island Landfill capacity and proceeded with developing a concept design and applying for the necessary ~~obtaining~~ resource consents for the Smooth Hill landfill.

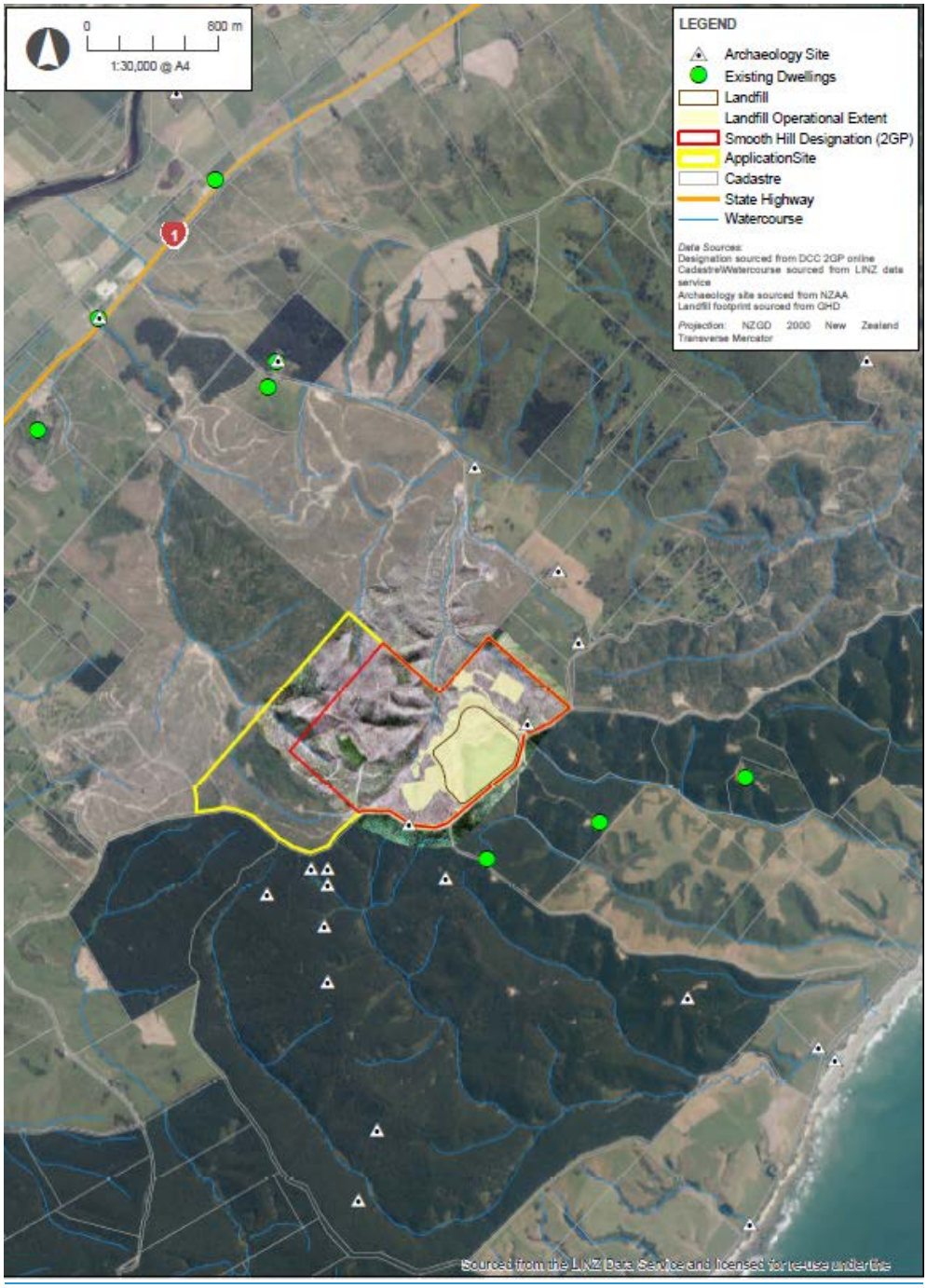
~~The current Council Long Term Plan is based on undertaking business as usual. The Plan does not currently allocate funds to develop the Smooth Hill site, or make improvements to kerbside or other waste and resource recovery services.~~ The Council has ~~recenlty~~recently consulted ~~will therefore comprehensively consulted~~ on ~~the preferred kerbside collection option, and~~ funding for development of Smooth Hill ~~in 2021~~ as part of the ~~next~~ Council~~'s Long Term~~10 Year Plan process for 2021-2031. Roll out of the final kerbside collection system, and development of Smooth Hill (subject to obtaining resource consents) is then expected to occur from 2022. Final options to be adopted as part of the Council 2021-2031 10-year plan will be confirmed in June 2021.

4.0 Existing Environment

4.1 The Landfill Site

The landfill site and surrounding area is shown in **Figure 3** below, and also shows the extent of the existing District Plan designation. The landfill site has an overall area of 177.812 ha, with the landfill designation covering all but the western portion of the site.

Figure 3 – Landfill Site (Updated May 2021)



The site is located approximately 28km southwest of Dunedin in the hills between the Taieri Basin and the South Island east coast. Access to the site is primarily from State Highway 1 (SH1), McLaren Gully Road and Big Stone Road to an existing vehicle entrance located on the south eastern boundary of the site.

The majority of the site until recently was covered by a mature pine forest plantation. Following harvesting in 2017, the site now comprises of a mixture of scrub, bare earth, forestry waste, and newly planted pine seedlings. Several forestry access tracks are present across the site. Areas of remnant indigenous vegetation (described in **section 4.5.1**) are present in some gullies.

There are no structures on the site, however two archaeological sites (I45/71 and 145/72) that contain the remains of two pre-1900 buildings exist along the Big Stone Road frontage (described in **section 4.8**). The site is not currently connected to utility, electricity, and telecommunication networks.

~~From the 30th of September 2020, t~~The entire site ~~will be~~is owned by DCC, following its purchase from Fulton Hogan Ltd.

4.2 Topography and Geology

The landfill site ~~sits~~ lies in a natural amphitheatre bisected by a series of ridges and gullies trending in a south to north direction. The base elevation of the site commences at RL 100m adjacent to the northern boundary, and rises up to the ridgeline on Big Stone Road, which typically sits at RL 140m to RL 150m, and up to RL 180m in the southwest corner of the site. The landform typically has side slopes of 20%.

Geological maps of the area show the main lithology underlying the site is the Henley Breccia unit which comprises a terrestrial sequence of piedmont breccia's and conglomerates up to 1000m thick. The Henley Breccia unit is overlain by up to 5 metres of loess deposits, and locally by alluvium and colluvium.[8] ~~Investigations have also encountered Taratu Formation deposits on hilltops in the south-western corner of the site.~~

The geology underlying the landfill site has been confirmed by extensive geotechnical and hydrogeological investigation works undertaken by GHD to inform the design of the landfill. These investigations are described in the Geotechnical Factual Report in **Appendix 6** and summarised in the Geotechnical Interpretive Report in **Appendix 5**, and Groundwater Report in **Appendix 8**. Two phases of site investigation were undertaken in 2019, involving drilling of boreholes and excavation of test pits across the site.

The following five distinct layers were identified across the site (in order from the land surface):

- **Topsoil** was encountered at depths of up to 0.25 m below ground level across most of the site.
- **Areas of Instability** were encountered in localised areas across the site at the surface and extended to depths ranging between 0.4 m to 2.7 m below ground level. Typically, the areas of instability comprised disturbed gravelly silt, silty sand, sand, silt, and organic material such as tree roots and branches. Observations of the morphology and

[8] Geology of the Milton Area, Institute of Geological and Nuclear Sciences, 1994; Geology of the Dunedin Area, Institute of Geological and Nuclear Sciences, 1996.

composition of the features ~~of the instability areas and composition of the material~~ suggests that these comprise of surface materials (i.e. loess) with no obvious evidence of deeper seated slips.

- **Alluvium** was encountered in the base of the gullies ~~around~~ in the northern area of the site to depths of up to 2.7 m below ground level. The alluvium typically comprises waterlogged sand, silt and gravel in varying amounts.
- **Loess** was encountered across most of the site to depths between 1.25 to 4.1 m below ground level and typically comprises silt of non-plastic to low plasticity, with varying amounts of clay, sand and fine gravel.
- **Henley Breccia Formation** underlies the site and comprises sandstone, siltstone, and conglomerate~~, and~~ breccia with localised thin interbeddings~~s~~ and lamination of organic mudstone / lignite. Assessed strengths were variable both within lithologies and vertically and range from extremely weak to very weak in completely to highly weathered material to moderately strong in unweathered sandstones and breccia. Few defects were identified, with defects being generally widely spaced bedding partings with occasional joints cross~~-~~-cutting the bedding profile.

Published data indicates there are no faults underlying the site, and none have been identified on the site during geotechnical investigations. There are however a number of faults within 100 km of the site, including the Titri Fault located approximately 3 km north west of the site, which separates the elevated topography in the vicinity of the site from the Lower Taieri Basin. These faults however are geologically not active, as defined by GNS Science, as they have a recurrence interval >2000 years. The closest geologically active fault to the landfill site, is the Alpine Fault, which is located 240 km to the northwest.

4.3 Climate

An Automatic Weather Station (AWS) has been established on-site and has been collecting data since mid-2020. At the time of lodging the application in August 2020 and through to May 2021, insufficient data had been collected to allow meaningful correlation with observations and records available from long-established nearby weather stations, variously referenced below.

4.3.1 Rainfall and Evapotranspiration

The mean annual rainfall (measured over the period 1981 – 2010) was 652 mm at Dunedin International Airport, approximately 6 km north west of the site, 738 mm at Musselburgh, Dunedin, approximately 23 km north east of the site, and 968 mm at the Botanical Gardens, Dunedin, approximately 25 km north east of the site.[9] Rainfall at the landfill site is predicted to be greater than the rainfall recorded at the airport due to its elevated coastal location.

On average, more rainfall occurs in the summer months, and soil moisture deficit occurs over the period from October to April in response to temperature and sunshine hours. Mean potential evapotranspiration is 856 mm/year at Musselburgh, Dunedin (over the period 1981 – 2010), which is considered indicative of conditions at the site.

[9] The Climate and Weather of Otago, NIWA, 2015

4.3.2 Temperature

The mean daily maximum and minimum temperatures (measured over the period 1981 – 2010) ranged from 18.9 to 11.6 degrees in January and 10.0 to 3.1 degrees in July at Musselburgh, Dunedin. The average number of frost days per month was 0 days in January, and 15.2 days in July. It is anticipated that the landfill site will be cooler and experience more ground frost days, due to its higher and more distant location from the coast.

4.3.3 Wind

Wind strength and directions measured at Dunedin Airport are strongly influenced by the topography of the Taieri Valley, with dominant wind directions being from the west-southwest and east-northeast.

In lieu of generating sufficient records from the on-site AWS, predicted wind patterns have been modelled for the site, as described in **section 8.7**. Although the wind rose generated for the site generally aligns with predominant west-southwest and east-northeast flows, the ridgeline location of the site causes predicted wind patterns to contain a slightly greater westerly component than those observed at the airport.

4.4 Hydrogeology and Hydrology

4.4.1 Catchment Setting

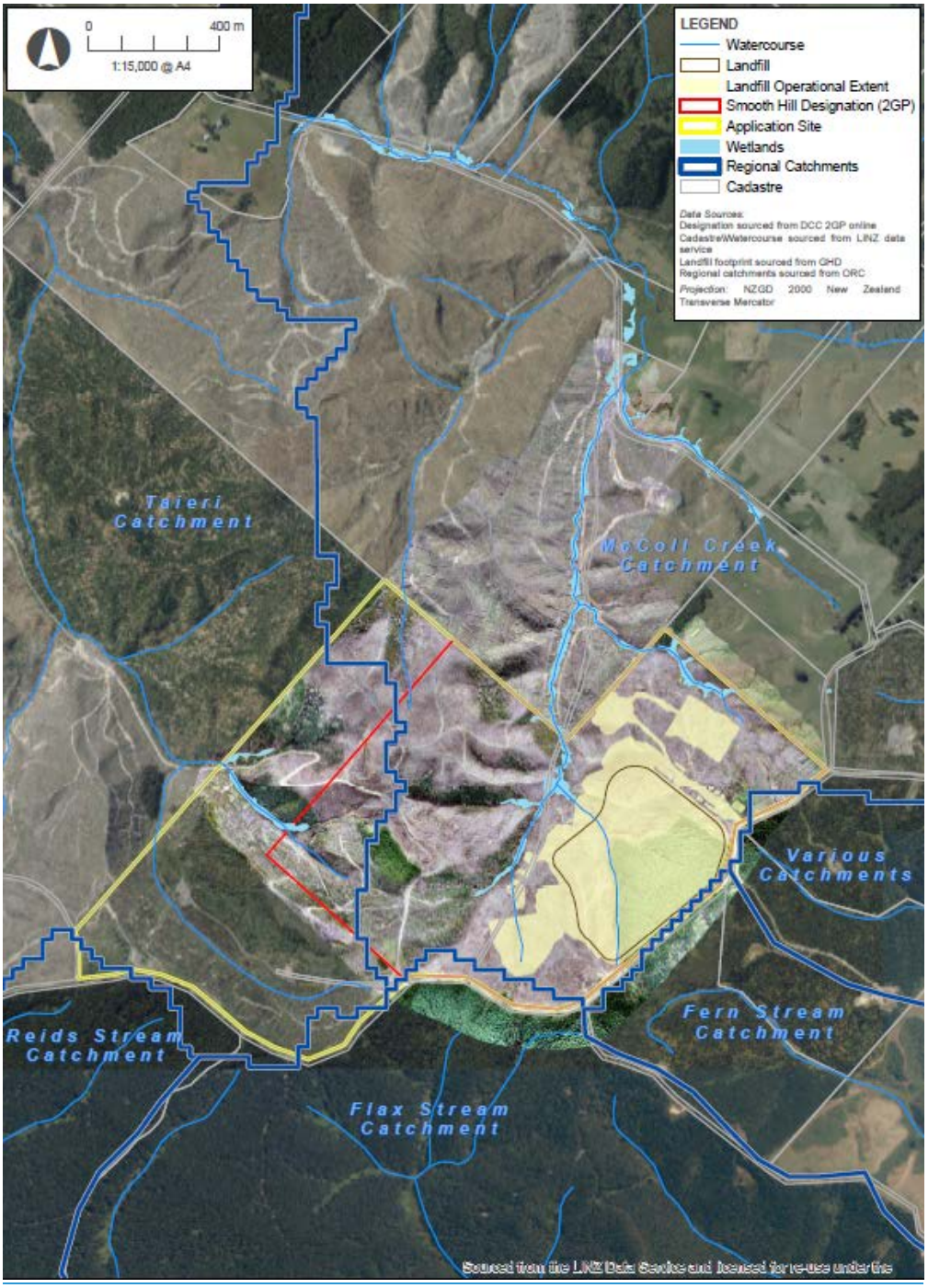
The catchment boundaries, and watercourses across the landfill site and downstream are shown in **Figure 4** below, based on information derived from ORC [10] and on-site investigations.

The landfill site falls within the following two catchments defined by ORC:

- The **McColl Creek catchment**, which is approximately 2700 ha in area, and discharges via the Ōtokia Creek to the coast at Brighton approximately 8 km from the landfill site. The catchment has an available allocation of 0.93 L/s and there are no recorded active bores or consents to take surface water or groundwater.
- The **Taieri catchment**, which is approximately 566,500 ha in area, and discharges via the Taieri River to the coast. The catchment includes the Taieri Basin aquifer comprising quaternary and tertiary alluvium deposits and is a source of groundwater for the Taieri Plain. The aquifer is predominantly recharged from three rivers, the Taieri, Silver Stream, and Waipori.

[10] Otago Regional Council Mapping Tool, ORC.

Figure 4 – Surface Hydrology (Updated May 2021)



The part of the site to be used for the landfill and associated works is located within the McColl Creek catchment. A branch of the Ōtokia Creek originates within the landfill site, that ultimately flows to the coast near Brighton, approximately 10 km south-east of the landfill site. The catchment area for the part of the Ōtokia Creek that falls within the site is approximately 69.2ha in area. This incorporates a ~~A~~ series of south to north ephemeral watercourses run through the landfill site that contain flowing water only after persistent rainfall. The watercourses have no clearly defined bed and a general absence of natural bed substrates. The watercourses ~~coalesce~~

merge at the northern edge of the site where standing water exists associated with diffuse seepage, forming a swamp wetland (described further in **section 4.~~5~~6.4**).

The swamp wetland connects via a defined channel to a tributary of the Ōtokia Creek beyond the northern boundary of the site that appears to be perennial or likely to have surface water present all or most of the year. However, during dry periods such as that over the 2020/2021 summer, surface water flow ceases as far downstream as at least the culvert, and surface water retreats to occasional isolated pools where water is impounded. The tributary ~~flows~~ moves approximately 1km downstream where it ultimately reaches a culvert beneath McLaren Gully Road. The tributary and valley floor forms part of a valley floor marsh wetland system (described further in **section 4.~~5~~6.4**). Beyond McLaren Gully Road, the tributary ultimately joins the main stem of the Ōtokia Creek.

There is a narrow well-defined meandering channel along much of the tributary (200 – 300 mm wide). The bed substrates are predominately fine silts and sands, with some small coarse substrates including gravel and cobbles. The wetted width of the tributary was observed in June 2020 as variable, being approximately 1-2 m in most places and up to 5-10 m wide on occasion. The observed water depth along the tributary ranged from approximately 100 mm or shallower, to 500-700 mm in pools. A large and deep pond (probably human made) is located approximately ~~200~~ 300 m downstream of the designation site above an historic artificial bund. Observations during the summer months indicate that when flows occur, the typical flow rate adjacent to McLaren Gully Road is less than 10 litres/second.

The remaining western part of the landfill site is located within the Taieri catchment. The upper reaches of the Palmer Stream fall within the landfill site, which ultimately flows to the Taieri River approximately 3.4 km north of the site. Similar wetland habitats to that found at the bottom of the site exist in gullies in the upper parts of the catchment within the application site, but outside the designation.

Big Stone Road forms the catchment divide along the south-eastern edge of the landfill site. South of Big Stone Road, the land falls towards the coast and is bisected by a series of streams that fall within the Fern Stream and Flax Stream catchments defined by ORC. ~~The Flax Stream catchment has an area of 612 ha, and has an available allocation of 0.22L/s and has no recorded active bores or consents to take surface water or groundwater.~~

4.4.2 Groundwater Systems

The hydrogeology underlying the landfill site has been confirmed as part of the site investigation works undertaken by GHD. These investigations are described in the Groundwater Report in **Appendix 8**. The investigations involved hydraulic conductivity testing of the differing hydrological units, and monitoring of groundwater levels.

The investigations have identified the existence of both a **shallow** and **deep groundwater system** underlying the site. The shallow and deep systems are separated by an intermittent semi-confining ~~siltstone layer~~fine-grained low permeability layer within the Henley Breccia. Low rates of seepage from the shallow system to the deeper low permeability unweathered Henley Breccia occurs.

The **shallow groundwater system** is located within the bottom of the gullies of the site, and comprises relatively permeable alluvium and colluvium, and shallow weathered Henley Breccia materials. The system receives recharge directly from rainfall, as well as from runoff over the low permeability loess soils and groundwater from the shallow Henley Breccia. The shallow Henley Breccia underlying the alluvium and colluvium typically has a greater permeability than the low permeability breccia that hosts the deep groundwater system, due to the presence of gravel and sandstone layers and due to greater weathering and relaxation of the rock mass.

Horizontal flow through the shallow groundwater system is predicted to be less than 1% of the total rainfall over the catchment area. Groundwater flows in the shallow system follow topography north towards the valley floor. Groundwater levels are near the surface in the valley bottom, and the shallow system contributes baseflow to the perennial valley floor marsh wetland system and downstream Ōtokia Creek. The Ōtokia Creek is also likely to receive runoff during rainfall events, which has the potential to transport a substantial sediment load given the steep topography and recent harvesting of forestry at the site.

A discontinuous ~~brown siltstone~~fine-grained low permeability layer within the Henley Breccia, ~~possibly an historic lake deposit,~~ underlies the shallow breccia in a number of locations and is interpreted as ~~separating~~ providing a degree of separation between the localised shallow groundwater system ~~from~~ and the deep groundwater system. Downward vertical hydraulic gradients are typically observed between the shallow and deep groundwater systems, however recharge from the shallow to deep unit may be impeded at some locations by ~~the siltstone~~this layer.

The **deep groundwater system** is located within the Henley Breccia. Some minor rainfall recharge occurs however it is constrained by the low permeability loess materials that overlie the breccia. Given recharge to the more permeable shallow groundwater system is predicted to be less than 1% of total rainfall, recharge to the deep system is likely to be no greater than this~~, with recharge from the shallow groundwater system also potentially limited by the discontinuous siltstone layer~~.

The deep groundwater system has very low permeability due to the presence of unweathered to slightly weathered breccia and conglomerate units. Groundwater within the Henley Breccia is subject to vertical downwards hydraulic gradients. Horizontal groundwater gradients are relatively flat, with an inferred flow direction towards the Pacific Ocean southeast of the site. Groundwater discharge is expected to occur in relatively insignificant quantities.

It is not known where the groundwater divide occurs in the elevated coastal region between the Titri Fault and the coastline, however if this follows topography it is expected the divide is located along the north south trending ridgeline in the western portion of the site designation between Big Stone Road and McLaren Gully Road.~~will be located along the ridge bounding the west of the site, which separates the McColl Creek Catchment and the Taieri Catchment~~ Under this assumption, ~~G~~groundwater within the deep system east of this ridgeline is anticipated to flow ~~approximately~~ south east and discharge towards the coast.

There are no recorded active groundwater takes from the Henley Breccia. The nearest recorded borehole is greater than 1.5 km west of the site (I45/0001), and no recorded bores or consents are ~~recorded~~ located south east of the site. The deep groundwater system within the Henley Breccia is not considered as a viable groundwater resource in the Otago Regional Council Lower Taieri Groundwater Allocation Study (Rekker and Houlbrooke, 2010), given the low permeability

and minimal potential yields. In addition, there are no environmental receptors within 2 km of the site that are likely to be impacted by the deep groundwater system.

4.4.3 Ōtokia Creek Flood Flows

The recorded flows for various flood events in the Ōtokia Creek, the valley floor above McLaren Gully Road (including the landfill site), and the upper catchment comprising the landfill operational footprint are shown in **Table 1** below.[11] Climate change is expected to result in an increase in these flows in the order of 16% by 2100. The projected year 2100 flows are shown italicised in brackets.

Table 1 – Ōtokia Creek Catchment Flood Flows (Updated May 2021)

Flood Event	Ōtokia Creek (m^3/s)	Valley floor upstream of McLaren Gully Road (m^3/s)	Landfill Footprint (m^3/s)
Mean annual flood	10.7 *(12.4)*	1.0 *(1.16)*	0.~~33~~ 14 *(0.~~38~~16)*
50-year flood	27.4 *(31.8)*	2.5 *(2.9)*	0.~~96~~ 40 *(~~1.11~~0.47)*
100-year flood	30.9 *(35.8)*	2.8 *(3.2)*	~~1.08~~0.45 *(~~1.25~~0.52)*

The landfill catchment and the Ōtokia Creek catchment will have significantly different times of flood flow concentration due to the size of the landfill catchment being relatively small in the context of the overall catchment. The extreme events are unlikely to coincide and flows from the landfill area will contribute no more than approximately 1.5% of flood flows in the Ōtokia Creek.

4.5 Water Quality

Existing ground and surface water quality downstream of the landfill site is influenced by landform, soils vegetation cover, and cycles of forestry land use. The landform of the landfill site is relatively steep with grades of up to 20% and the loess soil covering is relatively erodible. During the harvest/replanting cycle of the forestry land use, the removal of the vegetative cover and the associated soil disturbance results in increased runoff and erosion of the surface soils with associated impacts on water quality downstream. Reduced water quality will occur until the surface cover is restored. As a result, there can be a significant variation in the water quality and runoff volumes from the catchment over time as forestry is cleared, replanted, and grows to maturity.

The groundwater quality underlying the landfill site was confirmed by sampling undertaken ~~between 6 and 25~~in November 2019 and March 2021 as part of GHD's site investigation works. The sampling is described in the Groundwater Report in **Appendix 8**. Samples were compared against the following relevant water quality ~~guidelines~~criteria:

- Australia New Zealand Guidelines (ANZG) for Fresh and Marine Water Quality 2018 – Default Guideline Values for Freshwater – Protection 95% of species.

[11] Derived from the NIWA Stream Explorer online flood estimation tool.

- Regional Plan: Water for Otago, Schedule 16A: Discharge Thresholds for Discharge Threshold Area 2 Catchments.

Comparison of groundwater samples against these ~~guidelines~~criteria, identified Nitrate-N concentrations of up to 26.7mg/L which exceeds the Regional Plan threshold of 1.0mg/L. Ammonia as N concentrations of up to 2.59 mg/L were also recorded which exceeds the Regional Plan threshold of 0.2 mg/L. These exceedances indicate groundwater quality underlying the site may have been impacted by fertiliser use during forestry operations.

Elevated concentrations of copper, nickel, ~~and~~ zinc, and cadmium, which exceeded the ANZG ~~guidelines~~ criteria were also recorded in ~~a number of on site monitoring wells~~groundwater samples, which is likely a result of the reducing groundwater conditions observed at these locations and sourced from the minerals in the rock material.

Surface water sampling was in the downstream tributary of the Ōtokia Creek was undertaken in July 2020. Further sampling was scheduled in March 2021 however samples were not collected as the majority of the stream was dry during this time, with only stagnant isolated pools of water present. Collected data indicates surface water quality complies with the criteria with the exception of copper in one sample reaching a value of 0.012 mg/l compared to ANZG guideline value of 0.0014 mg/l. However, given the highly ephemeral nature of the flows it is likely that water quality varies significantly during flow events. Variables such as initial flushing events immediately following high rainfall and contribution from the shallow groundwater system as the groundwater level rises and falls in response to rainfall will impact surface water quality.

4.6 Terrestrial and Freshwater Ecology

The landfill site sits within the Tokomairiro Ecological District (ED). In terms of the Threatened Environment Classification[12], the area is entirely within a Category 2 (previously called 'Chronically Threatened') land environment (Q4.3c), where 10-20% indigenous vegetation remains on this land environment, nationally. Some valley floor areas adjacent to McLaren Gully Road immediately below Gledknowe Hill are within a Category 3 land environment (Q4.3a), where 20-30% indigenous vegetation remains nationally.

The original vegetation of the Tokomairiro ED prior to the arrival of humans comprised of kahikatea, matai, totara, narrow-leaved lacebark, cabbage tree and kowhai forest on the hills of East Otago. These vegetation communities are now present only as remnants in deep gullies that survived fire, logging, and clearance for farming.

In the hills from Taieri Mouth to Saddle Hill dividing the plain from the sea, there are extensive areas of pasture and plantation forests (mostly radiata pine). Remnant or secondary indigenous forest or scrub / shrublands is occasionally present in gullies not managed as pasture or plantation forestry. Although there is a large protected area in the west of the Tokomairiro ED, very little protected area in the ED includes indigenous forest types of the sort that occur, or would have formerly occurred, within the site.

[12] The Threatened Environment Classification is a combination of three national databases: Land Environments of New Zealand, Land Cover Database (Version 2) and the Protected Areas Network. The Threatened Environment Classification shows how much indigenous vegetation remains within land environments, how much is legally protected, and how the past vegetation loss and legal protection are distributed across New Zealand's landscape.

The existing ecology of the landfill site and downstream receiving environment have been confirmed by desktop and on-site studies of the vegetation communities, avifauna, herpetofauna and freshwater ecology. These investigations are described in the Ecological Impact Assessment Report prepared by Boffa Miskell in **Appendix 11**. The ecological value of existing areas of vegetation, habitats, or communities was assessed in accordance the Environment Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment (EcIA) Guidelines.[13] The ecological significance of areas of indigenous vegetation and habitats of indigenous fauna in terms of section 6(c) of the RMA, was assessed using the criteria in the Partially Operative Otago Regional Policy Statement (PORPS)[14], and 2GP.[15]

4.6.1 Vegetation Communities

The vegetation types present range from highly modified plantation forestry areas of negligible ecological value, to degraded wetland habitats of moderate ecological value and regenerating / secondary indigenous forest habitat of high ecological value. With the exception of kānuka, no At-Risk, Threatened, or locally uncommon or important plant species have been found on the landfill site.

The vegetation communities and their ecological value, identified within the landfill site, downstream receiving environment, and adjacent to McLaren Gully/Big Stone Road, are summarised in **Table 2** and their spatial extent shown in **Figure 5** below.

Table 2 – Vegetation Communities

Description of Vegetation Community	Location
~~**(Pūrei - Rautahi - Yorkshire fog) - cocksfoot / floating sweetgrass – watercress grassland**~~**(Pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland** A ~~grassland~~ sedgeland occupying low lying permanently or intermittently saturated areas within and downstream of the site. The ~~grassland~~ sedgeland is dominated by ~~cocksfoot, with abundant~~ rautahi with abundant~~, and~~ Yorkshire fog and cocksfoot. Assessed as having **moderate** ecological value.	Valley Floor Marsh Wetland East gully Swamp wetland West Gullies 2 and 4 Adjacent to McLaren Gully Road and Big Stone Road
[Large-leaved pohuehue] / (Himalayan honeysuckle) – gorse scrub Dense scrub occupying the northern parts of the landfill site, which is dominated by gorse which contains frequent Himalayan honeysuckle, and in places large-leaved pohuehue. The scrub may provide habitat for indigenous lizard species including southern grass skink (At Risk – Declining). Assessed as having **moderate** ecological value.	West Gully 1 Hill slope near West Gully 2 Swamp Wetland

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

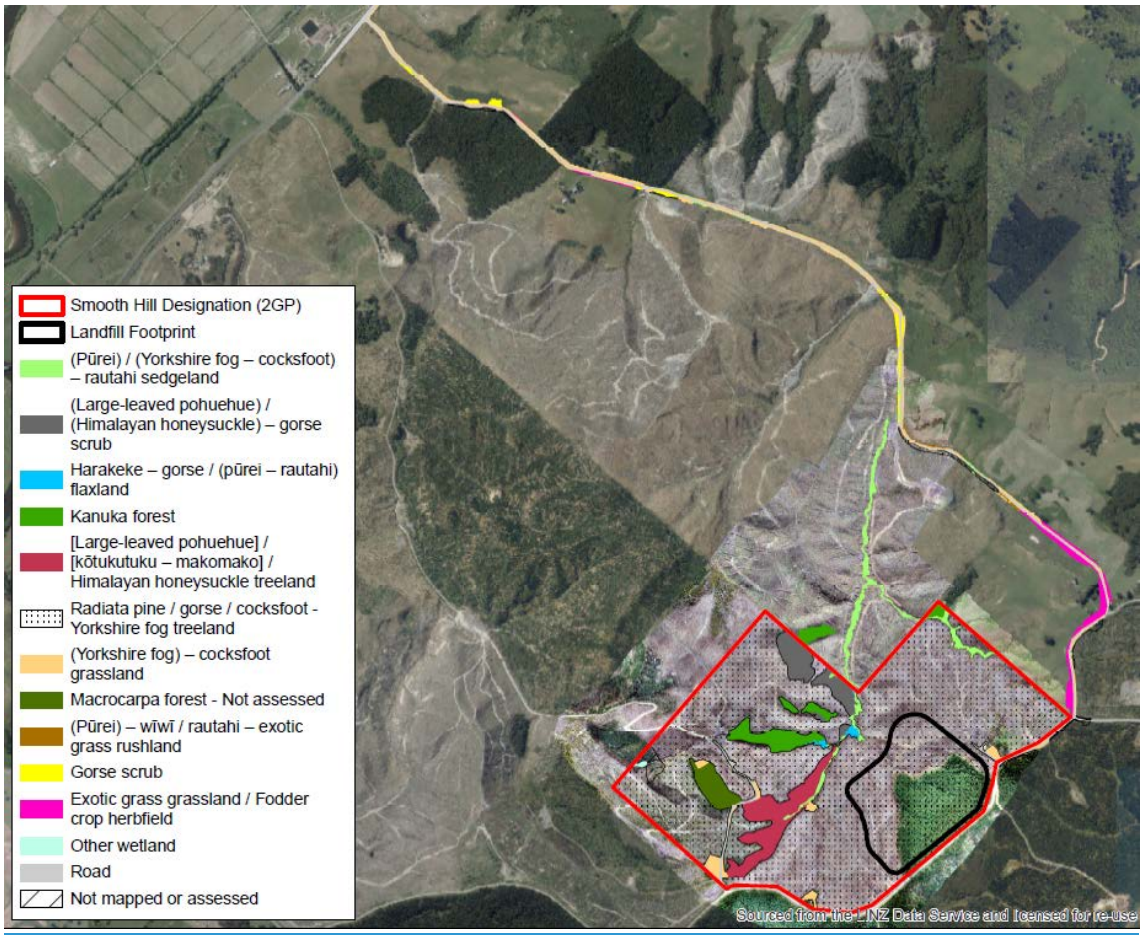
[14] Schedule 4 of the Partially Operative Otago Regional Policy Statement.

[15] Policy 2.2.3.2 of the Proposed Dunedin City District Plan (2GP).

Description of Vegetation Community	Location
Harakeke – gorse / (pūrei – rautahi) flaxland A flaxland dominated by gorse and harakeke occupying the central area of a swamp wetland. It also sits at the confluence of several minor eastern gully systems. Assessed as having **moderate** ecological value.	Swamp Wetland West Gully 3
Kānuka forest Regenerating forest containing reasonably mature stands of kānuka and mature individuals of other indigenous tree species occupying West Gully 3, and patches in other gullies. West Gully 3 supports a reasonable diversity of indigenous forest birds including eastern falcon (*Falco novaeseelandiae* "eastern", At Risk – Recovering). It may also support lizard species such as southern grass skink and possibly jewelled gecko (also At Risk – Declining). Assessed as having **high** ecological value.	West Gully 1 West Gully 2 West Gully 3 East Gully
[Large-leaved pohuehue] / [kotukutuku – makomako] / Himalayan honeysuckle treeland An area of regenerating treeland located in West Gully 4 comprising immature indigenous makomako and kotukutuku and rare or occasional mahoe, kānuka and ti Kōuka, interspersed among dense Himalayan honeysuckle. A small number of radiata pine exist within the treeland. The treeland supports a reasonable diversity of widespread and common indigenous bird species and is likely to offer seasonal feeding habitat for frugivorous and nectivorous bird species. Assessed as having **low** ecological value.	West Gully 4
~~**Radiata pine – gorse / cocksfoot – Yorkshire fog shrubland / treeland**~~**Radiata pine / gorse / cocksfoot – Yorkshire fog treeland** Recently cutover and re-planted radiata pine forest, and recently harvested macrocarpa forest with extensive and dominant gorse in between radiata pine saplings. Assessed as having **negligible** ecological value.	Recently cutover pine and macrocarpa forest (designation site) Other forestry areas adjacent to Big Stone Road and McLaren Gully Road
(Yorkshire fog) – cocksfoot – grassland Exotic rank grasses such as cocksfoot and Yorkshire fog and weed species with occasional gorse and broom. This vegetation type may provide habitat for indigenous lizard species (southern grass skink), particularly in the areas bordering West Gully 4, and north-facing roadside areas. Assessed as having **moderate** ecological value.	Recently cutover pine forest (main designation site) Forest edges Roadsides verges along McLaren Gully Road
~~**(Pūrei) – wiwi / cocksfoot rushland**~~**[Pūrei] – wīwī / rautahi – exotic grass rushland** Areas of ~~marsh wetlands with some minor areas of swamp~~ seasonally wet pasture in paddocks containing exotic grasses (largely cocksfoot), dominant wiwi rushes, occasional or patchy pūrei, and a small number of ti kōuka trees. Assessed as having **moderate** ecological value.	Areas adjacent to McLaren Gully Road

Description of Vegetation Community	Location
Gorse scrub Areas of essentially pure gorse scrub. Assessed as having **negligible** ecological value.	Areas adjacent to McLaren Gully Road
Exotic grass grassland / fodder crops Areas of exotic grass grassland dominated by cocksfoot and browntop, and fodder crop herbfield. Assessed as having **negligible** ecological value.	Working farmland paddocks adjacent to McLaren Gully Road

Figure 5 – Vegetation Types (Updated May 2021)



All identified wetland areas meet the National Policy Statement for Freshwater Management 2020 (NPS-FM 2020) definition of 'natural inland wetland.' The wetland boundaries are the outer boundaries of the (pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland and / or harakeke – gorse / (pūrei – rautahi) flaxland vegetation types. Areas of (pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland and [pūrei] – wīwī / rautahi – exotic grass rushland along McLaren Gully Road are likewise natural inland wetlands that have formed at the base of tributary gullies and valleys of Ōtokia Creek and in the vicinity of road culverts.

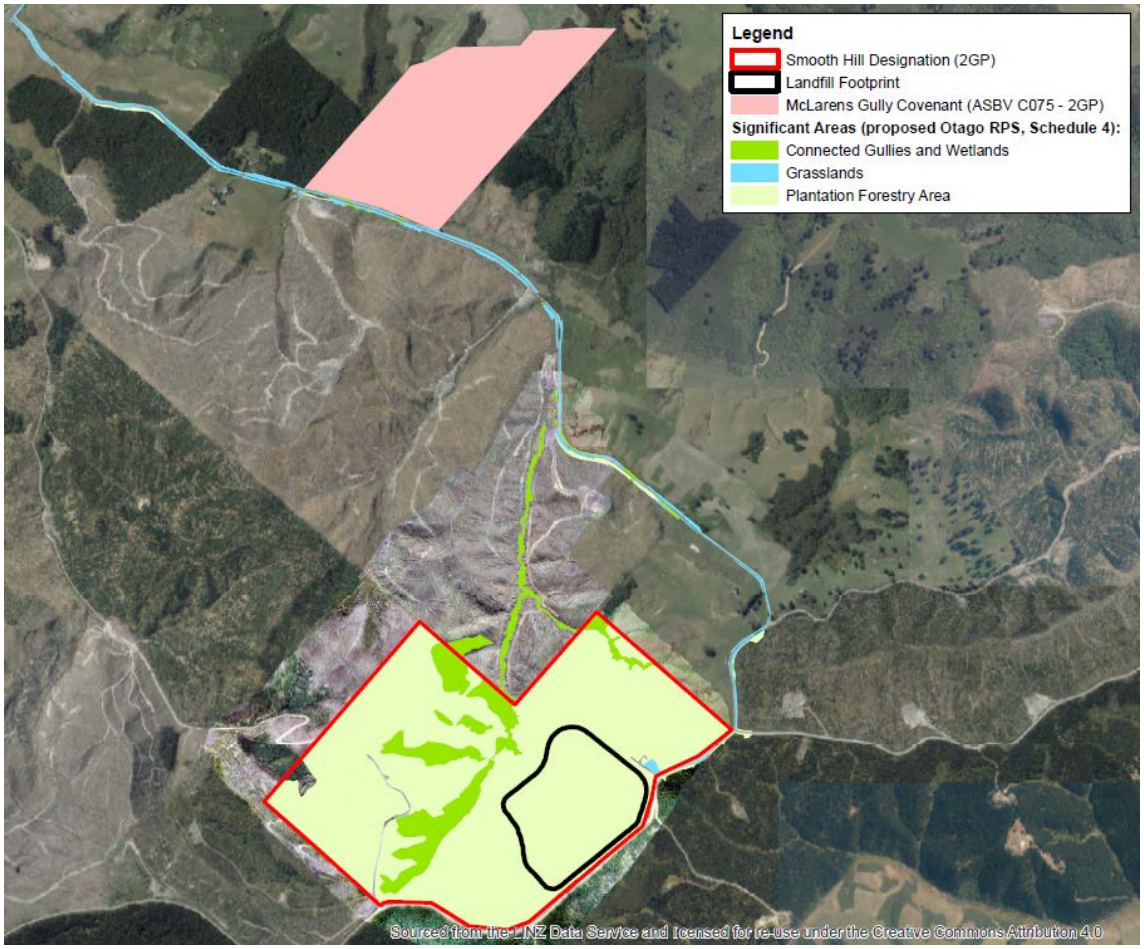
~~The above~~All the identified vegetation types have been assessed as to whether they comprise areas of significant indigenous vegetation and significant habitat in terms of section 6(c) of the RMA, using the PORPS and 2GP criteria.

Indigenous vegetation under the 2GP definition within the landfill site includes the (pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland~~(pūrei – rautahi – Yorkshire fog) – cocksfoot / watercress – floating sweetgrass grassland~~, ~~the~~ harakeke – gorse / rautahi – pūrei flaxland, kānuka forest, and [large-leaved pohuehue] / [kōtukutuku – makomako] / Himalayan honeysuckle treeland described above. Other vegetation types present are not indigenous under the 2GP definition, because indigenous plant or lichen species do not comprise 30% of the taxa present, 30% of the plants present, or 30% of the cover, or do not comprise 20% cover where indigenous species are the tallest stratum or are visually conspicuous. Indigenous vegetation along roadsides are (pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland and [pūrei] – wiwi / exotic grass rushland.

The following three areas mapped in **Figure 6** below, have been identified as areas of significant indigenous vegetation and significant habitat:

- An interconnected area of gullies and wetland habitat comprised largely of indigenous vegetation types within the landfill site, and the valley floor marsh wetland to the north. This overall area supplies water to (forms part of the catchment of) Ōtokia Creek and includes other connected tributary wetlands that are well outside the designation site adjacent to McLaren Gully Road.
- Plantation forestry areas ~~including macrocarpa forest and the~~comprising the main cutover areas radiata pine / gorse / cocksfoot – Yorkshire fog treeland)~~(radiata pine – gorse / cocksfoot – Yorkshire fog shrubland / treeland)~~ within the landfill site~~, and similar areas adjacent to McLaren Gully Road and Big Stone Road~~. While not including indigenous vegetation types, this area is significant as a habitat supporting the indigenous At Risk – Recovering bird species (eastern falcon), and provides breeding, refuge, feeding or resting habitat for that species.
- Areas of rank grassland that fringe the cutover area and roadsides ((Yorkshire fog) – cocksfoot grassland). While not including indigenous vegetation types, this area is likely to be significant as a habitat for indigenous At Risk – Declining lizard species (southern grass skink) and may offer feeding habitat for that species.

Figure 6 – Areas of Significance Indigenous Flora and Habitats (Updated May 2021)



4.6.2 Avifauna

The landfill site, and wider landscape of the Taieri Plain, Lake Waihola – Lake Waipori and Sinclair wetland complex, production pine forestry, and coastline provide habitat for a range of avifauna. Ornithological Society of New Zealand (OSNZ) data has recorded 69 bird species across this landscape, including 21 exotic species, and 48 native species. The avifauna present in the wider area, are summarised in **Table 3** below, based on published information, and surveys undertaken for the project.

Table 3 – Avifauna Recorded Within the Wider Area

Area	Recorded Avifauna Present
Taieri Plain, including Dunedin Airport	The area provides foraging, breeding and roosting habitat (including around the Airport) for a range of native and exotic bird species including gulls, passerines and waterfowl. South Island pied oystercatchers also sometimes forage in inundated pasture. During surveys, 24 bird species were recorded or observed incidentally during surveys conducted around Dunedin Airport, including 11 native species and 13 exotic species. One At-Risk species, South Island pied oystercatcher, was recorded (two birds were observed foraging in a paddock).

Area	Recorded Avifauna Present
	324 native birds were recorded during the surveys and 774 exotic birds. However, these abundances, particularly that of exotic birds, underestimate the number of small passerines (e.g. finches, starlings, blackbirds, sparrows) present in the area. Of the larger species, black-backed gulls were the most abundant species, followed by mallard ducks and rock pigeons. The flight patterns of the passerines observed were sporadic and largely comprised short, low flights across the paddocks to forage, or as a result of disturbance from planes, vehicles or farm work. Waterfowl were observed traversing the airport and looping around and landing in the paddocks. Dominant flight directions were north and south. The average flight height of ducks ranged between 3 and 30m and the maximum flight height recorded was approximately 50m. North and south movements were also the dominant directions of flight for black-backed gulls. The average flight height of black-backed gulls ranged between 10 and 100m and the maximum flight height recorded was approximately 150m. Many of the birds recorded during the surveys were observed flying across the runway and directly over Dunedin Airport.
Lake Waihola – Lake Waipori and Sinclair wetland complex	The area makes up a large lake-wetland complex (approximately 2000 ha in total) located 6 km southwest of Dunedin Airport and approximately 8 km west of the proposed landfill site. This complex is one of the largest and most significant wetland systems remaining in New Zealand. The wetland complex supports a high number of bird species that are resident or regular visitors to the area, and is recognised as a significant bird habitat that supports large numbers of waterfowl; up to approximately 10,000 birds have been recorded during surveys conducted. High numbers of black-backed gulls, starlings and lesser redpolls have also been recorded in this area. The area also supports At Risk and Threatened wetland bird species including a moderate population of South Island fernbird and low numbers of Australasian bittern and marsh crake. During surveys, 17 bird species were recorded or observed incidentally, including 10 native and 7 exotic species. One Threatened species, black billed gull, was observed. Two At Risk species, black shag and red-billed gull, were observed. 189 native birds were recorded during the surveys and 30 exotic birds. More small passerines were observed in the wider area than were recorded as the focus was on larger, more mobile birds in the area. The most abundant species observed were black-billed gull, black swan, and Canada goose. There were no distinct flight patterns as most birds were observed on land or resting on the lake, given the windy and choppy conditions during both surveys.
Pine forest	Exotic production pine forest is prevalent northwest and south of Dunedin. These plantations provide good habitat for eastern falcon (an At Risk species) for up to approximately four years post-felling. This is because the open areas created attract many small birds that provide prey for falcon. The piles of pine slash also provide good nesting sites for falcon, as do young re-planted pine adjacent to mature pine stands. As scrub regenerates and newly planted seedlings grow, these areas become less suitable for falcon. Surveys conducted in October 2015 in 10 pine forest blocks northwest and south of Dunedin identified falcon at seven sampling points, and included six single birds and one pair. A more recent survey during the 2016/17 falcon breeding season conducted northwest to south of Dunedin in an approximately 150,000 ha area of plantation pine and native forests surrounding the Taieri Plain detected a minimum of

Area	Recorded Avifauna Present
	16 breeding falcon pairs. During these surveys, falcon was the only At Risk or Threatened species detected using the exotic forest habitats.
Otago coast	A section of the Otago coast borders the eastern/north-eastern extent of the wider landfill site and includes the Taieri River mouth/estuary, the Kaikorai Stream mouths/estuary and Brighton Beach. The wider coastal area supports a diverse number of bird species including native coastal and oceanic species such as gulls, terns, swans, ducks, shags, stilt and oystercatchers. High numbers of black-backed gulls have been recorded at Taieri Rivermouth and Kaikorai Rivermouth.

Within the landfill site, the habitats available for avifauna include recently re-planted radiata pine forest~~, mature macrocarpa forest (due to be harvested)~~, exotic grasslands, weeds and scrub, four regenerating native forest gullies (two of which are dominated by kanuka trees), and ~~a small wetland area associated with waterways~~swamp wetland.

During surveys, 22 bird species were observed out of the 31 species determined from desktop sources that use or may use the site or surrounding area. Of the 22 species observed, 14 were native and eight were introduced. One At Risk species, eastern falcon (Falco novaeseelandiae), was observed on site. Seventy-three percent of the observations were of exotic birds and 27% of native birds.

The most abundant native birds on site were tui and harrier hawk, which collectively made up approximately 10% of all observations. The abundances of small passerines were greater than that reported, given the difficulty to accurately identify and count flocks of birds traversing the site. Overall, the avifauna community assemblage at the proposed landfill site was characterised by an abundance and diversity of passerines and occasional harrier hawks, black-backed gulls, magpies and ducks, as well as a falcon pair.

With respect to falcon, two observations were made during the formal survey periods constituting 0.5% of all observations made during the survey period; one was recorded during the May 2019 survey, the other during the July 2019 survey. Two falcons were also incidentally observed on the proposed landfill site in October 2019 outside of the formal survey period. Falcon were also heard, but not seen, in the wider area (not within the landfill site) during other fauna surveys conducted on site in spring. No nesting falcon were detected on site during the breeding season survey conducted. A falcon pair, however, did nest on site the previous breeding season and four falcon pairs have been recorded at, and/or in, the vicinity of the Smooth Hill area. Falcon were heard in native forest to the north of McLaren Gully Road in June 2020.

Pre-dominant flight patterns observed by the species on site included short, low flights to and from the gullies, between the gully areas and patches of mature pine forest and recently re-planted pine, and within the recently re-planted pine. Exceptions to this were black-backed gulls, falcon and harrier hawks. These species were observed flying and soaring at higher elevations above the site and adjacent pine blocks and in the case of the black-backed gulls five of the seven observations headed west or north-west from the coast towards the Taieri Plains. The average flight height of black-backed gulls ranged between 20 and 25 m and the maximum flight height recorded was approximately 25 m.

No Threatened species were recorded on the landfill site, nor are any likely to utilise the site. Eastern falcon was the only species recorded on the site that has an At Risk classification. According to the EIANZ guidelines this species is considered to be of **moderate** ecological value. In addition, all the native Not Threatened and introduced species recorded on site are considered to have **low** and **negligible** ecological value.

4.6.3 Herpetofauna

The existing environment consists of variable, low to high quality habitat for native lizards. Habitat types that lizards often persist in are considered to be low value ecologically, such as rank grasslands, weed fields and regenerating scrub. Such habitats are present within the landfill site and along roadsides, as discussed in **section 4.~~5~~6.1**.

In order to determine the potential presence of lizards on the site, 145 Artificial Cover Objects (ACOs) were deployed on the landfill site, and left in place for at least 8 weeks, before being checked and retrieved from the site. No lizards were found under the ACOs when these were checked in March 2020. However, potential skink sign (scat) was observed on some ACOs, which indicates a potential population of skinks within the landfill site.

Given the habitat types present on site, records held within the DOC Bioweb database, and survey results, **Table 4** describes the lizard species potentially present on the landfill site and along roadsides:

Table 4 – Lizard Species that May be Present within the Landfill Site and Roadsides

Species	Habitat preference ~~within site~~	Likelihood of presence within designation	Threat classification
Southern grass skink	~~Grassland (cutover pine / Yorkshire fog), gorse scrub and kānuka forest~~Rank grassland, weedy areas of cutover pine forest, marginal habitats	High	At Risk – Declining *taxonomically indeterminate
McCann's skink	~~Cutover pine / Yorkshire fog Scrubland~~Rank grassland, weedy areas of cutover pine forest, cobble / rock outcrops	Very Low	Not Threatened
Jewelled gecko	~~Kānuka forest~~Scrub, forest	Low	At Risk - Declining
Cryptic skink	Scrub, rock outcrops	Very Low	At Risk - Declining
Korero gecko	Rock outcrops, schist, scrub	Very Low	At Risk - Declining

No threatened species were recorded on the landfill site or along roadsides, nor are any likely to utilise these areas. Southern grass skink may be present within the cocksfoot / Yorkshire fog grassland, large leaved pohuehue and gorse scrub and kānuka forest habitats found within in Gully 2 and 3. According to the EIANZ guidelines, this species is considered to be of **high** ecological value. McCann's skink might be present within cutover pine / Yorkshire fog scrubland found within the site. This species is considered to be of **low** ecological value. Jewelled gecko (At Risk – Declining) might be present within the kanuka forest of West Gully 3. While the presence of this species is considered of a low likelihood, the species is considered of **high** ecological value. There is a very low likelihood that Cryptic skink and Korero gecko are present.

4.6.4 Freshwater Ecology

As outlined in **section ~~4.3.2~~4.4.1**, a series of south to north ephemeral watercourses pass through the landfill site that contain flowing water only after persistent rainfall. The watercourses have no clearly defined bed and a general absence of natural bed substrates, and do not provide any intermittent or permanent habitat for freshwater macroinvertebrate or fish fauna.

The watercourses ~~coalesce~~ merge at the northern edge of the site where there are isolated areas of standing water associated with the swamp wetland habitat located at the bottom of the site. The swamp wetland and defined channel connecting it to the downstream tributary of the Ōtokia Creek may contain some surface water throughout the year. However, it's unlikely that there is sufficient water depth or permanence to support indigenous fish populations within the designation site, except possibly juvenile eels. The downstream tributary and associated valley floor marsh wetland system between the northern boundary of the site and McLaren Gully Road appears to be perennial or likely have surface water present all or most of the year. During dry periods such as that over the 2020/2021 summer, surface water flow ceases as far downstream as at least the culvert, and surface water retreats to occasional isolated pools where water is impounded.

The macroinvertebrate community, which provides a good indication of stream or ecosystem health, is dominated by "soft-bottom taxa" that tend to be more tolerant of slow-flowing waterways and / or degraded conditions. The macroinvertebrate community index (MCI), and its variant (SQMCI), indicate the tributary has "poor" stream health and water quality.

No fish were found during survey in June 2020, however habitat suitable for fish species (e.g. pools with overhanging vegetation), ~~such as eels and possibly banded kokopu, and possibly also kōkōwai (freshwater crayfish),~~ was present in the survey reach. Freshwater fish surveys were conducted in April 2021. At the time of survey, the only location within the downstream receiving environment with sufficient surface water present for assessing fish communities was the large pond located approx. 300 m downstream of the designation site.

One longfin eel (Anguilla dieffenbachii) and two shortfin eel (Anguilla australis) of approximately 500mm in length were captured. Longfin eel has a conservation status of "At risk, declining"; shortfin eel is "Not threatened" (Dunn et al. 2018). It is possible that the eels captured were a few years old and migrated up the tributary from Ōtokia Creek. It is also possible that, despite the limited presence of surface water in the defined channel in April 2021, the surrounding wetland soils were still relatively water-logged in places. It is plausible that these adjacent wetlands provide refuge habitats for fish (in this case eels) during drier periods when surface water in the stream channels is limited or absent.

~~According to the~~The New Zealand Freshwater Fish Database records show the Ōtokia Creek catchment supports indigenous fish species including koaro, banded kokopu, longfin eel, and giant kokopu and inanga in the lower catchment. However, it is likely that the tributary between the designation site and McLaren Gully Road provides limited habitat for freshwater fish species other than eels. The large, deep pond likely provides refuge for eels during times of extreme drought.

~~Surveys for the presence of fish were due to be undertaken in the first quarter of 2020, however did not occur due to Covid-19 travel restrictions. Additional freshwater surveys are proposed to occur between November 2020 and April 2021 to determine the presence of freshwater fish.~~

Overall, ~~T~~the freshwater ecological values of the tributary between the designation site and McLaren Gully Road are ~~low~~**moderate.**~~, however the ecological values would be considered moderate if the waterway is found through further survey to support freshwater fish species (e.g. banded kokopu and longfin eel) and kōkōwai.~~

The Lower Ōtokia Creek Marsh is located towards the bottom of the catchment. Schedule 9 of the Regional Plan: Water, identifies the Lower Ōtokia Creek Marsh approximately 7.6 km north east of the site at Brighton, as a regionally significant wetland.

4.7 Surrounding Land Use

The land use surrounding the landfill site and along McLaren Gully Road and Big Stone Road predominately consists of commercial plantation forestry on large landholdings. Much of this land has been harvested and replanted in the last 5 years resulting in a landscape comprising a mixture of scrub, bare earth, forestry waste, and recently planted pine seedlings. Some localised areas of pastoral farming exist, notably adjacent to the sites north eastern boundary, and land at the bottom end of McLaren Gully Road.

Rural residential activity exists in isolated pockets and at low densities in the surrounding area. Two houses are located along McLaren Gully, approximately 1km from the SH1 intersection, and approximately 1.7km from the landfill site. One of these was constructed in the late 1870's or early 1880's and is recorded as an archaeological site (site reference I45/67), and further described in **section 4.~~8~~ 9** below. Direct views of the site from these locations are curtailed by intervening landforms.

Two further houses are located in the hills between Big Stone Road and the coast, approximately 380m and 605m southeast of the landfill site respectively. Both houses were constructed in 2012/13 and are encircled by forestry plantations ~~which restricts views towards the site~~. Other houses are located at distances beyond 1km along Big Stone Road in the direction of Brighton.

4.8 Landscape and Natural Character

The existing landscape character of the site and surrounding area, and natural character of rivers and wetlands is described in the Landscape and Visual Assessment Report prepared by Boffa Miskell, contained in **Appendix 12**.

The landscape in this area forms rolling to steep hill country, within which the site is contained within folded gullies and ridges and largely concealed from view. The site and immediate vicinity are not identified in the 2GP as being in the coastal environment or as part of any outstanding

natural feature or landscape, or highly valued for their contribution to the amenity values or the quality of the environment.

The Dunedin Landscape Management Area Review[16] has identified the landscape character areas (LCAs) which make up Dunedin. Within this study, the site is identified within the Taieri Slopes LCA which comprise a series of rural hillsides which encircle the Taieri Plains. The defining characteristics of this landscape include:

- *Low hills enclosing the Taieri Plain, incorporating prominent landform features*
- *Spur and gully hillside morphology, incorporating streams and gullies, with varied vegetation types and cover*
- *Rural dwellings generally located within lower slopes alongside pastoral farming*
- *Ridgeline breached by significant watercourses draining into the Plain*

The overall significance of the Taieri Slopes was identified in the review as Medium-High with citywide importance. Collectively, the rural hillsides that surround the Taieri Plain were described as having inherent visual amenity, landscape and ecological values. They include iconic landmark features of citywide importance, founded on strong cultural associations. The diversity of natural remnant vegetation covering the collective hillsides and emerging valleys provide an important green backdrop to the modified Plain below.

As outlined in **section** ~~4.3.2~~4.4.1, ephemeral watercourses pass through the site, and a swamp wetland associated within standing water is located at the bottom of the site, connected to the downstream tributary of the Ōtokia Creek. The existing wetlands ~~and ephemeral streams~~ form part of a modified rural landscape which includes a predominant cover of exotic forestry and exhibit limited levels of natural character.

4.9 Archaeological Values

An Archaeological Assessment has been completed by New Zealand Heritage Properties to identify the archaeological values of the landfill site and surrounding area. The Archaeological Assessment Report is contained in **Appendix 13**.

The archaeological sites in **Table 5** below and shown on **Figure 3** were identified in the area where the proposed works will take place.

Table 5 – Archaeological Sites within the Area of Proposed Works (Updated May 2021)

NZAA Site ID	Site Name	Site Location	Description
I45/71	Fletts' Farm	700 Big Stone Road	1880s farmstead associated with the Flett family. Remnants of pre-1900 timber and roughcast building remain. The building is surrounded by Macrocarpa and Eucalyptus trees associated with pre-1900 occupation of the site.

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

I45/72	Fletts' Farm	750 Big Stone Road	Likely pre-1880s farmstead associated with the Flett family. Foundations of pre-1900 earth walled building remain. The building remains are surrounded by Macrocarpa and Eucalyptus trees associated with pre-1900 occupation of the site.
I45/67	McLarens' Farm	109 McLaren Gully Road	Farmstead associated with the Flett family from the 1860s. Pre-1900 building exists on the site. No other physical remains are evident on the site.
I45/79	Palmer's Farm	3 Henley Road and Part 200 McLaren Gully Road	Farmstead associated with the Palmer family from the 1860s. Pre-1900 building exists on the site. No other physical remains are evident on the site.
I45/80	Rileys' Farm	200 Christies Gully Road	Farmstead associated with the Riley family from the 1860s. No physical remains are evident.
I45/81	Guthries' Farm	949 Allanton-Waihola Road	Farmstead associated with the Guthrie family from the 1870s. No physical remains are evident.
I45/82	Souness' Farm	949 Allanton-Waihola Road	Farmstead associated with the Souness family from the 1860s. No physical remains are evident.

Two previously recorded archaeological sites have been recorded within the existing designation; I45/71 and I45/72. ~~Several archaeological sites associated with other farmsteads have been recorded in the properties adjacent to McLaren Gully Road (sites I45/67, I45/80, I45/81, and I45/82).~~ Archaeological sites (I45/71 and I45/72) have been assessed to have **medium** archaeological values given the presence of archaeological structural remains, which although in poor condition, have the potential to contribute to understanding of the development of farming by individual families and the wider district.

Several archaeological sites associated with other farmsteads have been recorded in the properties adjacent to State Highway 1 and McLaren Gully Road (sites I45/67, 145/79, I45/80, I45/81, and I45/82). Archaeological site (I45/67) along McLaren Gully Road is assessed to have **medium-high** archaeological values as the entirety of a pre-1900 building still remains on the property and the exterior of which is easily visible from the road and appears to be in good condition. Archaeological site (I45/79) to the north of SH1 is assessed to have **medium** archaeological values. While it is unconfirmed if pre-1900 buildings or structures exist within the extent of the recorded archaeological site, the farm is associated with a prominent nineteenth century family and has the potential to provide a contrast to the smaller farms seen throughout the project area as the entirety of a pre-1900 building still remains on the property.

The remainder of the sites (I45/80, I45/81, and I45/82) have been identified to have **low-medium** archaeological values as there are no structural remains visible from the roadside or current aerial images. However, they too may contribute knowledge of small family run farms in the Ōtokia district.

4.10 Cultural Values

Kāi Tahu whānui, represented by Kā Papatipu Rūnaka and Te Rūnanga o Ngāi Tahu, comprise people of Kāi Tahu, Ngāti 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 whänau and hapü who hold mana whenua status to an area and resource.

Te Rūnanga o Ōtākou have mana in the project 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. Te Rūnanga o Ōtākou as kaitiaki have two responsibilities, protecting the life-supporting capacity of Dunedin's natural environment and resources and passing the environment to future generations in a state which is as good as, or better than, the current state.

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, including Smooth Hill in mid-2019, resulting in a series of briefing meetings, hui, and a site visit.

DCC engaged Aukaha on behalf of Te Rūnanga o Ōtākou to prepare a Cultural Impact Assessment (CIA) for the project to form the basis for ongoing engagement between DCC and mana whenua. The CIA is contained in **Appendix 14**, and describes the cultural values identified by mana whenua relevant to the proposal, including cultural values with regard to waste management. It also assesses the proposal against these values, based on the relevant objectives and policies of the Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP).

Te Rūnanga o Ōtākou has an enduring relationship with all areas of their takiwā, reflecting the highly mobile nature of their tūpuna (ancestors). The Taieri Plain and its resources were used and settled by Kāi Tahu for generations and contained a number of fortified pā. Traditionally, the rivers and streams in the wider project area were utilised as ara tawhito (traditional travel routes), that provided a connection inland and facilitated the seasonal gathering of food and resources. The Taieri River itself was utilised as the key pathway from inland areas to the ocean. The rivers and streams were also wāhi mahika kai (food gathering places) where tuna (eel) and pātiki (flounder) were gathered.

Smooth Hill is part of a wider cultural landscape which is imbued with the lived experiences of mana whenua tūpuna. These experiences and the values passed down through the generations inform mana whenua and Kāi Tahu Whānui identity, cultural practices and approaches to environmental management.

Mana, mauri and whakapapa are core values which underpin the Kāi Tahu worldview with respect to this project. These values are interconnected and the degradation of one value can affect other values. The cultural values identified by mana whenua as relevant to the project and Kāi Tahu ki Otago NRMP as summarised as follows:

- **Mana**, which means the 'authority' or 'prestige' that mana whenua hold over their respective regions. The possession of mana means that mana whenua have the 'authority' to make decisions over the land and sea within their takiwā. All development projects that occur within tribal territories are expected to recognise and uphold the mana of mana whenua. Mana whenua are Council's Treaty Partner. The test of partnership is the ability to influence critical decisions.
- **Mauri,** which is the 'life force' or 'life principle' of a place or thing. Mana whenua believe that there is an active phenomena within everything and thus, whether living or inanimate, all things possess mauri. Mauri is often used as a benchmark when measuring the health of the environment. Assessing cultural effects involves examining effect of mauri in the short and long term.
- **Whakapapa**, which is often referred to as 'genealogy' and is at the core of how mana whenua express their identity. The notion of whakapapa extends beyond familial relationships and ties amongst people. From the stories of creation, to how mana whenua introduce themselves through their pepeha (introduction), to all parts of the natural and spiritual environment, everything in existence is acknowledged and connected through whakapapa. Whakapapa gives the mana whenua over the project area to Te Rūnanga o Ōtākou. Whakapapa establishes the ancestral rights which give mana whenua the mana and kaitiaki responsibilities over their takiwā. A key way in which whakapapa can be understood in the context of projects is by recognising and respecting ancestral landscapes, associations and place names. It can also be applied to understanding and regenerating biodiversity with whakapapa to an area.
- **Ki Uta Ki Tai**, which means 'from the mountains to the sea' and emphasises interconnectedness. It is a concept that emphasises holistic management of the interrelated elements within and between catchments, from the air and atmosphere to the land and the coastal environment, whereby implementation will require a collaborative approach.
- **Kaitiakitaka**, which is the intergenerational and inherited responsibility to support and protect people, the environment, knowledge, culture, language and all resources on behalf of future generations. It is often translated to include the concepts of 'guardianship' or 'stewardship'. For Kāi Tahu ki Otago, kaitiakitaka is not only about the physical resources, it is about being mana whenua and maintaining a relationship to the spiritual dimension and influences of wairua and tapu.
- **Mahika kai**, which is the gathering of foods and other resources, the places where they are gathered and the practices used in doing so. Mahika kai is an intrinsic part of Kāi Tahu identity. It has formed the basis of the Kāi Tahu economy for hundreds of years, and remains at the core of tribal economic development today. Mahika kai relates not only to the ability to feed whānau, but to also feed visitors and show the highest level of hospitality (manaakitaka). Mahika kai heavily relies on a healthy functioning ecosystem including access to these sites and areas. A good resource is an indicator of a healthy

ecosystem. Historically, mana whenua would travel great distances following seasonal food routes. Kā rūnaka treasure the ability to gather these foods and resources in the same places as their tūpuna (ancestors).

- **Wai Māori**, or water, which is central to Te Ao Māori (the Māori worldview). There can be no life without water, as expressed through the whakataukī (proverb) Ko te wai te ora o ngā mea katoa - water is the life giver of all things. All waterways sustain some form of life and are valued as sources of mahika kai, mana whenua creation stories, settlement and as access or travel routes. Mana whenua consider water a taoka (treasure) left to them by their tūpuna and seek to protect waterways for future generations. Protecting and enhancing the wellbeing of all bodies of water is directly related to mana whenua's role as kaitiaki. The degradation of water bodies through land use activities is considered to have resulted in 'material and cultural deprivation.
- **Hau**, which refers to maintaining healthy air quality and refraining from activities that have immediate and prolonged negative impacts on the quality of air. This is also an important part of kaitiakitaka and the holistic approach to resource management highlighted by 'Ki Uta ki Tai'.
- **Manaakitaka,** which is the acknowledgment of the mana of others through the expression of aroha, hospitality, generosity, and mutual respect. Mana whenua express manaakitaka when they practice their duties as kaitiaki and act in the interests of others, including future generations. Proposals can enable manaakitaka through ensuring that social and environmental outcomes, communities and future generations are considered properly in the decision-making process.
- **Haere Whakamua,** or future focus, which emphasises the need for activities or projects to focus on how future generations might be affected. Mana whenua have the obligation to advocate for the needs of future generations as well as the protection of the natural environment into the future. This is crucial when considering the intensification of climate change and the potential for it to exacerbate the adverse impacts of projects on their receiving environments.
- **Utu,** which highlights the importance of reciprocity and the opportunity to restore imbalances in both the physical and spiritual realm. In practical terms, some land use activities may cause degradation to the mauri of the natural world, so there would be a corresponding need to address any imbalances. The concept of utu can also be explored through regenerative practices of ecosystem restoration and enhanced native planting.
- **Tikaka,** which refers to the correct method or appropriateness of carrying out an activity. In this context tikaka should be considered to ensure that short term gains do not override the consideration of potential adverse effects on both people and the environment that could accumulate over time. Tikaka is often linked to customary practices that have been sustained throughout generations. In generic terms it translates to undertaking the most appropriate actions.

4.11 Transportation Infrastructure

4.11.1 Road Network Configuration

The landfill site is accessed primarily from SH1, McLaren Gully Road, and Big Stone Road, as shown in **Figure 3**. An existing vehicle entrance is located on the south eastern boundary of the site fronting Big Stone Road.

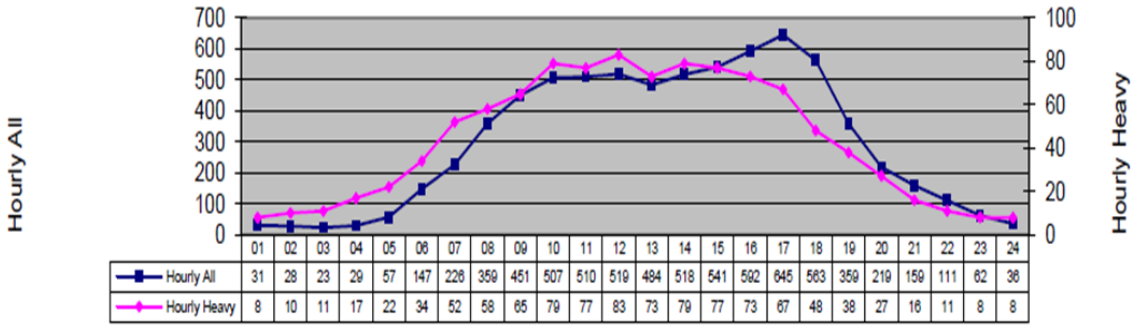
SH1 is the main road link between Dunedin and Southland, and within the project area is named as Allanton-Waihola Road. The road in this location is formed as a sealed two-way carriageway. The road has a typically straight and flat alignment, and operates under the default open road speed of 100km/hr. Mean operating speeds have been recorded as being between 90 – 94km/hr.

McLaren Gully Road and Big Stone Roads are low volume rural roads providing vehicle access to surrounding commercial plantation forests, and rural residential properties. Access to McLaren Gully Road from State Highway 1 is via a priority T intersection. The roads in their current configuration have substandard geometry, particularly width and visibility, to safely accommodate two-way traffic. The roads are unsealed and the existing road corridor and formed carriageway do not fully align with the legal road boundaries in places, particularly at the bottom end of McLaren Gully Road closest to State Highway 1. There is no formal provision for walking or cycling on the existing roads, typical of a remote rural location.

4.11.2 Traffic Volumes

The New Zealand Transport Agency telemetry site at Milton approximately 30km south of the site records the average weekday hourly traffic volumes along SH1. The average weekday hourly traffic volumes for 2018 are shown in **Figure 7** below. The telemetry data indicates that the average weekday traffic (all vehicles) rises steadily across the morning period, remains consistent during the middle of the day, and rises to a peak between 5pm and 6pm.

Figure 7 – 2018 State Highway 1 Average Weekday Hourly Traffic – Telemetry Site 27, Milton

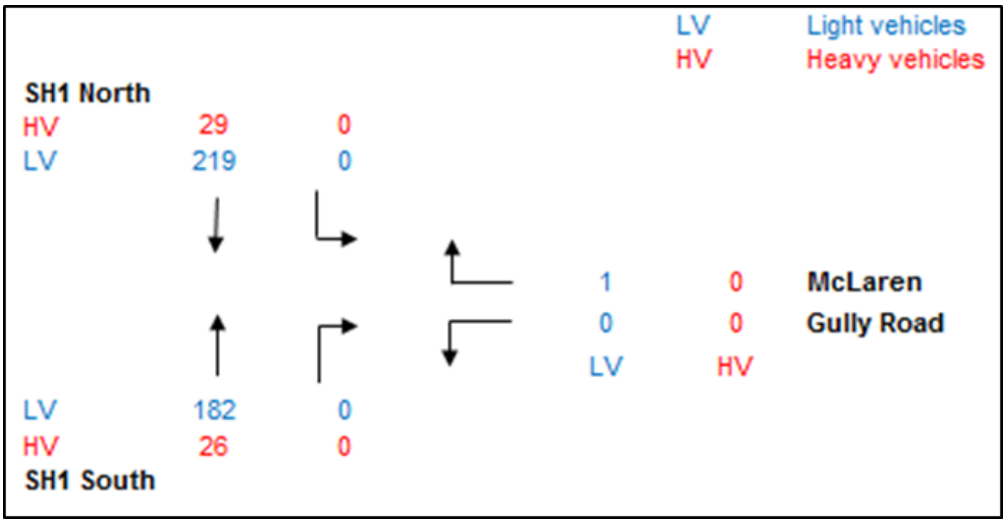


	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hourly All	31	28	23	29	57	147	226	359	451	507	510	519	484	518	541	592	645	563	359	219	159	111	62	36
Hourly Heavy	8	10	11	17	22	34	52	58	65	79	77	83	73	79	77	73	67	48	38	27	16	11	8	8

Existing traffic volumes at the intersection of SH1 and McLaren Gully Road have been determined by completing a traffic survey on a Wednesday between 6am – 8am in May 2019. The survey is described in the Integrated Traffic Assessment Report in **Appendix 15**. The hour between 7am – 8am is representative of the intended morning peak for the proposed landfill, taking into

consideration the estimated future peak arrival and departure of trucks to the site. Vehicle movements recorded by the survey between 7am – 8am are shown in **Figure 8** below. The data is considered to represent the morning peak of a typical working day in the winter season.

Figure 8 – Existing Traffic Movements (7am – 8am) for the State Highway 1 / McLaren Gully Road Intersection.



High state highway traffic volumes were recorded between 7am – 8am, with a slightly higher number of southbound traffic movements compared to northbound movements. There were no recorded turning movements into McLaren Valley Road during the period of the survey, and only one right turn movement out of McLaren Valley Road heading north. Across the two-hour traffic count, four overtaking manoeuvres were recorded along SH1, adjacent to the McLaren Gully Road intersection.

Between 2009 and July 2019, nineteen crashes were reported for the intersection of SH1 and McLaren Gully Road, and 750 m north and 750 m south of the intersection on SH1.[17] In summary there were:

- One minor injury crash, and one non-injury crash on McLaren Gully Road, both as a result of the driver losing control travelling towards SH1.
- One minor injury crash, and two non-injury crashes on SH1 just to the north or south of McLaren Gully Road. Two crashes were the result of the driver losing control, and the other the result of the load of a truck hitting a power cable.
- Fourteen other cashes on SH1 – three of which resulted in serious injury near the junction with Henley Road and SH1.

[17] Reported crash data from the New Zealand Transport Agency's Crash Analysis System (CAS).

4.11.3 Dunedin International Airport

Dunedin International Airport is situated 4.5 km to the northwest of the landfill site on the Taieri Plain. The airport provides domestic passenger connections to cities throughout New Zealand, as well as internationally to Brisbane, Australia. The airport also caters for a range of general aviation and flight training aircraft movements. The airport served 1,077,475 passengers in 2018/19 financial year, a 5.8% increase over 2017/18. Over the last 4 years, the airport has seen passenger growth of 20%.[18] However, this does not account for the recent disruption to services caused by Covid 19.

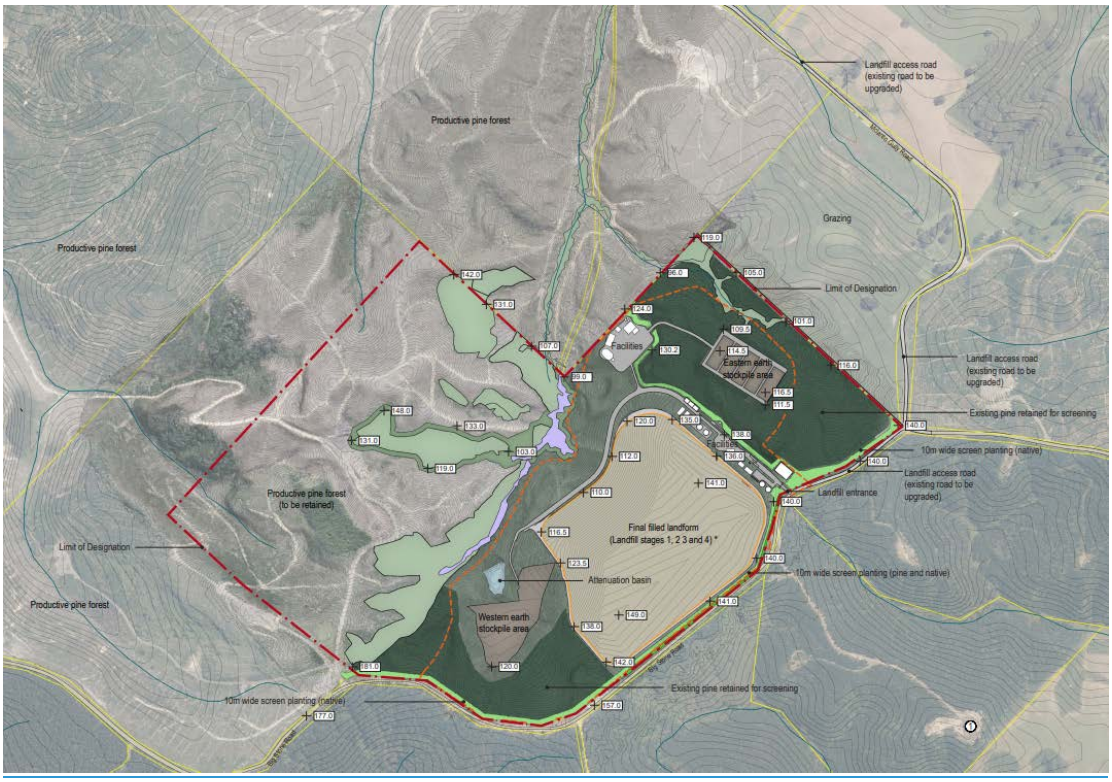
[18] Dunedin International Airport Annual Report, 2019

5.0 Description of the Project

5.1 General Landfill Description

The project involves the staged construction, operation, and aftercare of a class 1 landfill for the disposal of municipal solid waste and hazardous wastes, and associated upgrades to McLaren Gully Road (including its intersection with SH1) and Big Stone Road. The general arrangement of the updated landfill design is shown in **Figure 9** below, and on the General Arrangement Plan in **Appendix 2.**

Figure 9 – Smooth Hill Landfill General Arrangement (Updated May 2021)



The landfill will be located fully within the designated part of the application site. The landfill will have a capacity of approximately ~~6~~ 2.94 million cubic metres and expected life at current Dunedin disposal rates of approximately ~~55~~ 40 years. The concept design for the updated landfill design is described in detail in the Landfill Concept Design Report, contained in **Appendix 3**, and shown on the associated Concept Design Plans, contained in **Appendix 4**.

Compared with the original proposal as lodged, the landfill size has been reduced under the updated design as a result of moving the toe of the landfill to avoid the wetland areas within the site. The landfill lies within the footprint of Stage 1 and Stage 2 of the original design, with the western Stages 3, 4 and 5 no longer included. The finished maximum height of the landfill following closure remains unchanged. In overall terms:

- the footprint of the landfill is reduced from 44.5 ha to 18.6 ha.

- landfill (gross) capacity is reduced from appropriately 7.9 million cubic metres to 3.3 million cubic metres.
- net waste capacity is reduced from 6.2 million cubic metres to 2.94 million cubic metres.
- Based on the lower predicted waste generation rates (from 90,000 tonnes per year to 60,000 tonnes per year), the predicted landfill life has reduced from 55 years to approximately 40 years.

In addition, practical adjustments to the general construction of the landfill, have been made including:

- Landfill staging and construction sequencing, to a more typical 'bottom-up' filling methodology, which improves the intermediate and overall landform stability of the new design.
- Leachate containment and collection systems adjusted to reflect the updated construction sequencing.
- Construction phase systems for stormwater diversion, treatment and control.
- Relocation of the attenuation basin to the west of the updated landfill footprint rather than immediately downstream of the landfill toe.

The following sections of the AEE provide a summary of the updated concept design, and the intended construction, operation, and aftercare of the landfill. The final form of the project is expected to generally accord with that conceptually described, however a broad development envelope is sought through the resource consents (and their conditions) to provide flexibility for detailed design of the landfill.

The updated concept design for the landfill has been developed by consulting engineers GHD to meet the design standards of the WasteMINZ *Technical Guidelines for Disposal to Land (August 2018)*, and *Resource Management (National Environmental Standards for Air Quality) Regulations 2004*. That includes the design achieving a high level of containment; providing engineered environmental protection by way of a liner, leachate and landfill gas collection and management, and a cap, all with appropriate redundancy.

The updated concept design has also been developed to meet the following design objectives developed in consultation with DCC:

- *Provide ~~C~~capacity such that ~~for~~ the lifespan of the landfill ~~to~~ meets Council's waste management strategy requirements while also allowing for unexpected events ~~which~~ that may increase waste volumes in the future or the potential for a significant reduction in waste volumes allowing for the landfill footprint to be reduced.*
- *Contain~~ment of~~ waste and leachate to the standards required of ~~appropriate for~~ a Class 1 landfill.*
- *Avoid contamination of groundwater and downstream surface water.*
- *Avoid or minimise migration of landfill gas (LFG) from the site.*
- *Minimise amenity effects for surrounding rural-residential activities.*
- *Retain existing areas of ~~indigenous~~ native vegetation/habitats, and archaeological values where practicable to do so.*

- *Construct a~~A~~ free draining final landform where ponding of surface water is avoided through grading towards the perimeter swale drains.*
- *Ensure slope stability in construction and following closure~~Stable slopes~~.*
- *Provide ~~A~~access for maintenance, rehabilitation or monitoring purposes.*
- *Develop an e~~E~~conomically viable refuse placement capacity through optimisation of the footprint and height of the resultant landform.*
- *Provide a ~~A~~ final landform suitable for future light stock grazing and shallow rooted vegetation.*

The scope of the project includes the following components which are described further in **sections 5.2 – 5.14** below.

- Earthworks to construct the required landfill shape including the base grade and final cap.
- Low permeability lining system to prevent leachate seepage into the surrounding environment, including a groundwater collection system beneath the liner.
- Leachate collection system above the low permeability lining system, and storage of leachate, prior to transport by tanker from the site for disposal.
- Stormwater control around the landfill and other areas of the site with appropriate treatment and attenuation of stormwater before it ~~leaves the site~~discharges to watercourses within the site.
- ~~Landfill gas collection (~~LFG~~)~~ collection system, and destruction of LFG by ~~flaring~~combustion. In future LFG may also be used electricity generation, and space has been reserved for generating plant.
- Progressive filling of the landfill, including application of daily and intermediate cover, and final capping.
- Vehicle movements to and from the site, and within the site, including heavy vehicles, and vehicles for staff, contractors, and visitors.
- Operational infrastructure, including weighbridge and vehicle wheel wash.
- Additional ancillary services including operation of small backup diesel generator to power leachate extraction pumps.
- Facilities for site staff.
- Maintenance facilities for site plant and equipment.
- Overhead power supply lines to the site capable of HV transmission of electricity from future LFG fired generating plant.
- Provision of water supplies for operational (non-potable) and staff (potable) requirements.
- Landscape and ecological mitigation, including perimeter planting.
- Environmental monitoring ~~systems~~infrastructure, including groundwater and LFG wells.
- Upgrade and sealing of McLaren Gully Road, including its intersection with SH1, and Big Stone Road.

- Landfill site access from Big Stone Road, and permanent and temporary internal roads required to access the various parts of the site.

5.2 Waste Types

~~The landfill will only receive waste from commercial waste companies or bulk loads and will not be open to the public. Waste minimisation is expected to occur before waste reaches the landfill, based on the Council's future model for achieving waste minimisation (i.e. kerbside collection to transfer station – waste segregation and recycling and reuse – to landfill).~~

The landfill will accept municipal solid waste (MSW), and ~~potentially~~ hazardous waste that meets the leachability limits in the Ministry for the Environment Module 2: Hazardous Waste Guidelines (2004) - Class A. Contaminated soils and special wastes that meet these criteria will be accepted, including biosolids from the Green Island Waste Water Treatment Plant.[19]

Generally, cleanfill such as demolition waste, and organic bulk green waste will be diverted from the waste stream and managed at facilities closer to Dunedin. It is however expected that some cleanfill or organic green waste will be intermingled with other waste and ~~may from time to time~~ be deposited in the landfill.

The landfill will only receive waste from commercial waste companies or bulk loads and will not be open to the public. Waste minimisation is expected to occur both before and during the operating life of Smooth Hill. This will include Council-led initiatives such as enhanced kerbside collection services and waste segregation at transfer stations, as well as non-Council initiatives driven by a broader response to increasing waste disposal levies and emissions trading scheme costs.

Over time, these initiatives will change both the quantity and composition of waste disposed at Smooth Hill landfill, preserving void space and reducing landfill gas generation. Over time, the proportion of organic green waste may reduce. Furthermore, a review of DCC's long-term biosolids strategy is being undertaken in 2020/21 with a view to reduce biosolids to landfill long term. Regardless the future management option chosen, the option of landfill disposal will need to remain available alongside other biosolids management strategies to ensure the resilience of DCC's management of biosolids.

~~before waste reaches the landfill, based on the Council's future model for achieving waste minimisation (i.e. kerbside collection to transfer station – waste segregation and recycling and reuse – to landfill).~~

5.3 Landfill Siting, Capacity, and Staging

The concept landfill operational area occupies approximately ~~44.5~~18.6 ha of the 177.8 ha landfill site. The landfill location takes advantages of the existing topography, placing it within the head of an amphitheatre shaped gully system so that it is buttressed against the existing hillsides, and so as to minimise the amount of earthworks needed for construction. This is while also avoiding,

[19] Special waste is material that requires special handling at the landfill to ensure it does not pose a risk to the environment or human health during the disposal process and includes sludge, animal carcases, asbestos and ashes.

~~to the extent practicable,~~ wetlands and areas of higher ecological value within the site, including West Gully 3 identified in **section 4.~~5~~6.1** as containing a kanuka forest of high ecological value.

Construction, filling, and final capping of the completed landfill will occur progressively in ~~five~~ four stages ~~from east to west around~~supported by a 10m high toe embankment constructed at the northern end of the site. Stage~~s~~ 1 ~~and 2~~ involves filling behind the toe embankment. Stages 2 to 4 will then progress in a clockwise fashion from northeast to west filling over Stage 1 and buttressed against the surrounding gully. ~~will be located in the north-eastern portion of the site, separated from Stages 3, 4 and 5 by an intervening low ridge which will be retained, and enables the segregation of the leachate collection system into two halves.~~

Each stage will in turn be developed and filled sequentially in a number of sub-stages. The filling sequence will be developed during detailed design. As filling of each stage progresses, incoming waste will first be covered with daily cover, followed by placement of intermediate cover, and then the final cap.

The landfill will have a total waste volume of approximately ~~6M~~ 2.94 million cubic metres, which is equivalent to approximately ~~5M~~2.35 M tonnes of refuse. This does not account for potential additional capacity that may result from waste settlement within the landfill over its life. The anticipated life of each landfill stage, based on ~~current~~ a likely average Dunedin waste disposal rate~~s~~ of ~~90~~60,000 tonnes per year, are set out in **Table 6** below.

Table 6 – Indicative Landfill Development Filling Rates (Updated May 2021)

Stage	~~Waste Available~~ **void net of** ~~drainage, daily cover~~intermediate cover & capping **(m³)**[20]	**Waste tonnage (t)**[21]	**Placement period (years)**
~~1~~	~~680,119~~	~~544,095~~	~~6~~
~~2~~	~~1,980,340~~	~~1,584,272~~	~~17.6~~
~~3~~	~~632,599~~	~~506,080~~	~~5.6~~
~~4~~	~~2,264,940~~	~~1,811,952~~	~~20.1~~
~~5~~	~~627,850~~	~~502,280~~	~~5.6~~
~~**Totals**~~	~~**6,185,849**~~	~~**4,948,679**~~	~~**55**~~
1	642,000	514,000	8.6
2	524,000	419,000	7.0
3	857,000	686,000	11.4
4	921,000	737,000	12.3
Totals	**2,944,000**	**2,356,000**	**39.3**

~~[20] Based on 150mm of daily cover for each 1m of compacted waste.~~

[21] Tonnage is calculated ~~as a percentage of~~in direct proportion to volume and may vary where settlement allows additional tonnage to be placed.

While the landfill has an expected life of ~~55~~ 40 years based on ~~current~~ a likely average disposal rate of 60,000 tonners per years~~,~~ those rates may not be sustained over the course of the landfill's life. In particular, actual waste disposal rates will be influenced by the success of waste minimisation efforts, population and economic growth, and future unforeseen events which drives increased demand (e.g. natural disasters).

The design capacity of the landfill and staging therefore provides flexibility and resilience in response to fluctuating waste demands. ~~For example, reduction in waste disposal rates may mean that stages 1 and 2 are sufficient for waste disposal over a longer period, delaying the need to develop stages 3 – 5for the foreseeable future. Alternatively, the landfill will provide sufficient capacity to cater for a sudden increase in waste demand.~~

5.4 Landfill Formation

The landfill concept has been designed to ensure that it will be stable during construction, filling, and in the long-term following closure. The landfill is buttressed against existing hill sides on three sides, with the northern low end of the landfill being supported by a 10m high toe embankment constructed from engineered fill, which facilitates placement and retention of waste, and containment of leachate (described further in **section 5.5**). The embankment will be constructed in its entirety across the base of ~~all stages~~the landfill as part of the initial landfill development works.

Construction of each stage of the landfill will require cutting into the existing valley to remove compressible/problematic soils. This includes removal of all loess and organic soils and some of the underlying weathered and unweathered breccia rock. Excavated material (other than unsuitable organic soils) will be used to form the landfill base grade. All other material will be stockpiled for future use as engineered fill, daily waste cover, intermediate cover, or final cap (described further in **section 5.13**).

The landfill base grade ~~generally follows the broad~~ will be formed within the broad gully profile at slopes ranging ~~and is between~~from 4% for the flatter base and up to 25% for the inclined liner faces. ~~It has~~ The inclined faces will have 10m wide benches at 10m vertical intervals to facilitate staged construction of the landfill low permeability liner which will prevent seepage of waste derived leachate into the underlying soils or groundwater (described further in **section 5.5**). The benches will also provide interim vehicle access routes and stormwater diversion, prior to their infilling; and before filling will be re-graded with at least 10% crossfall to facilitate leachate flow. ~~The benches are graded at 5% to facilitate leachate flow~~

The final cap will be progressively established as filling is completed. The finished land profile has been designed to integrate with the surrounding landscape to the extent possible. The lower part of the landfill cap slopes at a grade of 1V:~~4H~~ 5H with provision for contour drains to be positioned up the slope to provide a break in stormwater runoff flow-paths on this steep capping surface and to provide long-term maintenance access.~~10m wide benches provided for every 10m increase in height to allow for maintenance access and surface drainage~~ The upper portion of the landfill cap slopes more gently at a grade of 1V:20H, ultimately rising to a ridge that is approximately 5m above the elevation of Big Stone Road to the south. ~~A small extent (approximately 150m) of the final cap is up to 8m above Big Stone Road where there is a dip in the road level.~~ The finished

maximum height of the landfill under the updated design is that same as that under the original design.

5.5 Leachate Containment and Management

Leachate is the liquid by-product of ~~produced through~~ waste degradation which typically combines with ~~and~~ rain water ~~that~~ percolat~~ing~~es through the placed waste. As these liquids percolate downwards, they further combine and~~,~~ collect~~ing~~ dissolved and/or suspended matter from the waste ~~as it passes through~~profile. The landfill concept has been designed to both minimise the volume of leachate produced, and contain and collect any leachate to prevent it from the entering the underlying soils, groundwater, or downstream receiving environment.

The volume of leachate generated will be managed through the following measures:

- Preventing clean upslope surface water from entering the placed waste mass and leachate collection system (described further in **section 5.7**).
- Minimising the size of the active waste tipping area where waste is exposed to rainfall.
- Covering areas with intermediate cover or final capping as soon as is practicable so that as much water as possible is ~~shed into the~~diverted to stormwater collection systems and to further prevent water ingress to placed waste.~~minimising percolation of water through these layers into the underlying waste~~.

A low permeability liner system placed on the landfill base grade will be constructed progressively as the landfill stages are developed to contain leachate within the landfill and prevent it from entering the underlying soils or groundwater. The WasteMINZ guidelines prescribe the use of two different liner options for Class 1 landfills:

- **Type 1 lining system**, comprising:

a. Leachate drainage material, with underlying cushion geotextile to protect the geomembrane; overlying

b. Synthetic flexible membrane liner (FML), typically 1.5mm high density polyethylene (HDPE) geomembrane; overlying

c. 600mm compacted ~~clay~~ cohesive soil with a coefficient of permeability (k) not exceeding ~~<~~ 1 x 10^{-9} m/s.

- **Type 2 lining system**, comprising:

d. Leachate drainage material, with underlying geotextile to protect the geomembrane; overlying

e. FML of 1.5mm HDPE geomembrane; overlying

f. Geosynthetic clay liner (GCL) of minimum 5 mm thickness and with k < 1 x 10^{-11} m/s, comprising:~~; overlying~~

   – 600mm of compacted ~~clay~~ cohesive soil with a coefficient of permeability (k) not exceeding < 1 x 10^{-8} m/s; or

   – 300mm of compacted cohesive soil with k < 1 x 10^{-9} m/s.

~~Completed laboratory testing of the on site loess material indicates it can be compacted to achieve a permeability of 3x10^{-8} to 5x10^{-10} m/s, which is a relatively low permeability and desirable as material for the 600mm compacted clay liner. However, dispersion testing has confirmed the loess as being potentially dispersive, which may require the addition of lime or bentonite to address its dispersive characteristics.~~

The concept design has been based on adopting a Type 2 lining system. However, both liner options provide an equivalent level of containment, and either option may ultimately be utilised for the proposed landfill. The option to be used will be determined at the time of detailed design. ~~, based on further permeability testing of the on-site loess material, to confirm the effect of lime or bentonite stabilisation on the plasticity of compacted loess and its ability to self-anneal.~~

Permeability testing completed on laboratory compacted loess samples from the site have indicated a permeability of between 3x10^{-8} to 5x10^{-10} m/s can be achieved using non-stabilised loess. The on-site loess soils may therefore be able to be used to construct a 600 mm compacted clay liner. However, dispersion testing has confirmed the loess as being potentially dispersive, which may require the addition of lime to address dispersive properties whilst retaining plasticity and self-annealing properties during deformation. Additional permeability testing is required to confirm repeatability and to assess the anticipated benefit of lime amendment (to address dispersive properties) and/or bentonite amendment.

Under both lining systems, leachate contained by the liner will flow to a leachate collection system at the base of the landfill toe embankment from where it will be removed off site for treatment and disposal. The leachate collection system ~~for each stage~~ comprises:

- 300mm thickness of granular drainage media overlying the landfill liner and overlaid by a geofabric.
- 200mm perforated pipework ~~placed within~~near the base of the drainage media to effectively ~~collect~~drain leachate into the drainage sump located ~~for transfer to~~ at the lowest point of the landfill liner and designed to withstand the proposed waste load.
- Leachate sump~~s~~ located at the base of the toe embankment containing highly porous ~~sity~~ media capable of attenuating peak leachate inflows that may be caused by~~arising from a~~ excessively heavy or long duration rainfall events.
- Multiple ~~i~~inclined leachate pumps and risers laid down the internal face of the toe embankment and into ~~in each of~~ the leachate sump~~s~~. ~~Three~~ Four pumps are installed in the leachate ~~each~~ sump, with ~~2~~ 3 pumps capable of removing the accumulated leachate. The ~~third~~ fourth pump provides redundancy to allow maintenance and additional capacity in emergencies.
- Leachate riser pipes conveying leachate from the submersible leachate pumps to above ground leachate storage tanks.
- Emergency power supply in the form of a 300kVA diesel generator, to power the leachate pump system in the event of the loss of network supply.

Leachate storage tanks will be located in the upper landfill facilities area (described in **section 5.11**) and provide ~~72~~48-hour storage capacity and are bunded to fully contain the contents of one failed tank.

Leachate volumes will be relatively low during the initial period of landfill development and will therefore be transported from the site by tanker to the Dunedin City Waste Water Treatment Plan (WWTP) for disposal. Ultimately the DCC proposes to install a pipeline from the site along public roads to the nearest connection into the WWTP system at Brighton, approximately 7.5 km to the north east of the site. ~~This may occur during stage 2 of the landfill. Consents for the pipeline are not being sought as part of the current applications~~Based on assumed filling rates, this will be approximately during the ninth year of landfill operation. Consents for the pipeline are not being sought as part of the current applications.

Down gradient monitoring wells will be installed between the landfill toe embankment and northern site boundary to provide advance warning of any leachate leakage that may affect the downstream receiving environment.

5.6 Landfill Gas Collection and Management

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

The NESAQ requires the collection and destruction of LFG in a landfill that will exceed 1M tonnes of waste, and that the system be in operation before 200,000 tonnes of waste is placed. Based on the predicted waste stream of ~~90~~60,000 tonnes / year, a LFG collection and destruction system will be installed and commissioned ~~within 2 years of~~ approximately 3 – 4 years after the commencement of landfilling at the site.

The LFG collection system will comprise:

- Lining and capping systems (described in **section 5.5 and 5.14**) that will retain LFG within the landfill and prevent off-site migration
- A network of collection wells and pipework.
- LFG destruction flares.
- Emergency power supply in the form of a 300kVA diesel generator, to power the LFG flare system in the event of the loss of network supply.
- LFG monitoring bores outside the waste boundary.

During landfill development landfill gas extraction pipes/wells will be installed and connected to the gas extraction system. Collected gas will be pumped through surface pipework to gas flares located in the lower facilities area for destruction by combustion. The opportunity also exists to use gas to generate electricity once quantities are sufficient. Consent for air discharges associated with gas fired generation is not being sought as part of the current applications, however space has been reserved in the facilities area for future potential generation plant.

A network of LFG monitoring bores will be installed around the perimeter of the landfill to confirm the effectiveness of the landfill gas collection system and enable detection of any LFG escape that may present a hazard or nuisance to sensitive receptors.

5.7 Surface Water Management

The landfill will be constructed at the upper end of the McColl Creek catchment. Ephemeral watercourses convey flows of water during rainfall events into the downstream tributary of the Ōtokia Creek. Stormwater management and control will be required across the landfill construction, operation, and aftercare phases to divert and separate stormwater from construction areas and waste; minimise and contain sediment runoff; and discharge diverted stormwater into the Ōtokia Creek receiving environment in a way that avoids adverse effects on downstream flows and water quality.

Surface water collection and conveyance will comprise both permanent and temporary systems. Consistent with the WasteMINZ guidelines, the permanent systems will be designed to accommodate a 1% AEP storm event, and temporary systems designed to accommodate a 10% AEP storm event. The stormwater systems will divert and enable separation of all stormwater flow from areas where waste is placed. They will also enable monitoring of stormwater from areas of intermediate cover or final cover and ability to redirect contaminated surface water to the leachate system if it is found to be contaminated.

The stormwater management systems include:

- For stage 1 only, stormwater outlet pipes through the toe bund for the discharge of stormwater collected within the stage 1 area to the downstream ephemeral watercourse. This recognises that for stage 1, the base of the landfill and stormwater control systems are at a lower elevation than the perimeter swale drain (described below), and gravity drainage of the stormwater to the swale drain is not possible. Once stage 1 is complete, the pipes through the bund will be permanently sealed, and stormwater from the completed stage 1 surface will be directed to the swale drain and attenuation basin.
- Permanent perimeter swale drain to intercept upslope flows and divert them around the landfill to ~~an~~ the attenuation basin ~~below the landfill toe embankment~~to the west of the landfill (described below). As there is no significant external catchment this drain will primarily collect stormwater from the interim and final landfill surfaces. This is except for stage 1, for which stormwater will be drained via pipes through the toe bund to the downstream watercourse until stage 1 is completed (as described above). The swale drain will remain in operation following closure of the landfill.
- Permanent attenuation basin, receiving stormwater from ~~69~~ 35.4 ha of the landfill site, including from: ~~upslope gullies;~~ the perimeter swale drain; pre-construction areas; construction areas; western stockpile 2, landfill operational areas not subject to waste contamination; the upper facilities areas; and the final cap. As noted above, stormwater from stage 1 will be drained via pipes to the downstream watercourse until stage 1 is completed, after which stormwater will be directed via the swale drain to the attenuation basin. The basin will remain in operation following closure of the landfill.
- Sediment ~~control~~ retention ponds (SRPs). SRPs will be constructed to collect and provide primary treatment of stormwater from the eastern stockpile 1, western stockpile 2, and lower facilities area to remove sediment prior to discharge. In addition, within the landfill footprint a~~n~~ SRP will be constructed at the immediate base of the excavation for each stage of the landfill. ~~constructed at the base of excavation prior to construction of each stage of the landfill to collect and provide primary treatment of runoff to remove sediment~~

prior to discharge to the attenuation basin. The sediment control pondsSRP for each stage will remain in operation for the life of that stage until subsequent stage works require their removal. An SRP sediment control pond will will then be installed for the subsequent development stage. Stormwater from the SRP's will be discharged either to the attenuation basin or downstream watercourses.

- Temporary stormwater drains and grades on the landfill operational surfaces, as required for the stage of operation, that diverts all stormwater to the landfill perimeter drain. This is except stormwater that has come into contact with waste, which will be diverted to the leachate collection system (described in **section 5.5**).
- Grading of the final cap to flow to the perimeter swale drain. Where final cap slopes exceed 1V:10H5H, permanent contour drains discharging to the perimeter swale drains will be installed every 50 mup slope to control flows.
- Stormwater generated by the upgraded roads outside the site will continue to discharge either viato roadside swales, or directly to , and existing discharge points to roadside watercourses and wetlands as currently occurswill be retained.

The perimeter swale drain will be constructed progressively as the landfill stages are developed and will provide for a continuous down gradient flow from the southern high point of the landfill. The drain will be constructed to accommodate a 1% AEP storm event (plus 300 mm freeboard), and consist of a mix of grass channel, reinforced earth (grass root matting), and rock rip-rap to provide scour protection where flows exceed 0.8 m/s.

The attenuation basin will be constructed as part of the initial landfill development works. The attenuation basin is designed to accommodate a 1% AEP storm event and will attenuate increased surface runoff from the landfill site and provide additional water treatment prior to discharge to the Ōtokia Creek receiving environment. Surface runoff will first enter an unlined "wet" forebay which has a depth of 1.5 m and a capacity of 700 m^3. The forebay will provide initial treatment and for soakage to recharge the downstream groundwater system. Higher flows that exceed the capacity of the forebay will pass through a waioro filter consisting of gabion baskets, and enter a second unlined "dry" basin for infiltration or discharge via a low flow outlet to the Ōtokia Creek.

The second basin will have a retaining structure with a retained height 4.8 m to the crest of the spillway, and will contain up to 3,3005,000 m^3 in a 1% AEP storm event. Flows exceeding this volume in a 1% AEP event will pass over the stabilised spillway downstream. The basin will otherwise typically be dry. The base of the dry basin will be planted with appropriate wetland type plant species. The low flow outlet pipe from the attenuation basin will also be provided with an emergency shut off value that can be closed in the event that leachate contaminated stormwater enters the basin. This will enable containment and removal of the stormwater off site.

The majority of stormwater from the construction and operational areas of the site will report to the attenuation basin, with the exception ofexcept for the soil eastern stockpile 1area which is located in a sub-catchment gully (East Gully), and the lower facilities area that also drains to the downstream tributary of the Ōtokia Creek. Stormwater collected from this these areas will first pass through permanent SRP's, prior to discharge downstream. be managed through a separate stormwater control system. Furthermore, as noted above, stormwater from stage 1 will also be

drained via pipes to the downstream watercourse until stage 1 is completed, after which stormwater will be directed via the swale drain to the attenuation basin.

~~For an approximately 150 m long section of the site adjacent to Big Stone Road, the perimeter drain will be constructed on engineered fill to ensure a continuous downwards flow gradient, with the drain sitting above the adjacent road level. As a result, surface water that falls on the batter below the drain will instead flow to the Flax Stream catchment south of Big Stone Road. Stormwater from this approximately 9000 m^2 area will not be underlain by landfill waste, and will be diverted via a catch sump and culvert beneath Big Stone Road to the upper reaches of Open Stream that flows directly to the east coast.~~

5.8 Groundwater Management

Excavation to create the landfill base grade ~~is expected to~~may expose groundwater seepages ~~towards the landfill toe and at the junction of the landfill base and side walls~~. Control and drainage of groundwater will ~~therefore be required~~ be installed beneath the low permeability liner system to avoid the creation of uplift pressures and risks of ~~that could cause a~~ localised failures of the liner.

Control of groundwater will be achieved by constructing a network of subsoil drains below the upslope toe of the bund and low permeability liner system as part of the development of each stage of the landfill. The groundwater drainage consists of perforated pipework, encased in graded aggregates and filter fabric to prevent soil particle loss to the drainage. In the very unlikely event that leachate seeps through the liner system, the subsoil drains also provide a collection system for leachate seepage.

Collected groundwater will gravitate to the low end of the landfill from where it will be collected and discharged to the ~~the attenuation basin~~watercourse north of the toe embankment or pumped to non-potable water supply storage tanks in the facilities area where it will be used for firefighting supply, dust suppression, and operation of the wheel wash and machinery wash bay. Groundwater collected by the system will be continuously monitored for leachate contamination. In the highly unlikely event of leachate contamination, collected groundwater will instead be directed to the leachate collection system for disposal (described in **section 5.5**).

Groundwater levels are expected to fall below the elevation of the drains in response to the loss of recharge caused by progressive landfill liner construction. It is therefore anticipated that only minor volumes of groundwater will be abstracted through the subsoil drainage system over the life of the landfill, with the greatest rates of dewatering (maximum estimated discharge in the range of 87 m^3/day (approximately 1 litre/second)) occurring when dewatering systems are initially installed. ~~The quantity of groundwater collected by the system is predicted to be up to 4 m^3 per day, however flexibility is sought in the consent to take groundwater to abstract up to 8 m^3 per day~~.

~~In the highly unlikely event of leachate contamination, collected groundwater will instead be directed to the leachate collection system for disposal (described in **section 5.5**).~~

5.9 Landscape and Ecological Mitigation and Enhancement

Plantings of exotic and indigenous vegetation is proposed in selected areas of the site to mitigate the landscape, visual, and ecological effects of the project. These areas are conceptually shown on the General Arrangement Plan in **Appendix 2**, and more specifically on the Landscape Mitigation Plan attached to the Landscape and Visual Assessment Report in **Appendix 12**.

Perimeter tree planting is proposed to provide visual screening and interception of site generated dust. ~~Planting will consist of a minimum 10 m wide strip of fast-growing exotic and indigenous tree species along the boundary with Big Stone Road, and along the north eastern ridge within the site.~~ All trees will be planted as part of the initial landfill development works~~, with the exception of the trees within stages 4 and 5 of the landfill along Big Stone Road which will initially remain occupied by plantation forestry. The forestry will be cleared as part of the development works for stages 4 and 5, and the additional perimeter planting extended~~. Planting will consist of the following:

- Along the central boundary of the site adjoining Big Stone Road, a 10m wide strip comprising~~tree species will include~~ two rows of fast-growing exotic pine, ~~combined~~ with native Kanuka (*Kunzea ericoides*) and Totara (*Podocarpus totara*) behind. The pine trees will be progressively removed once the kanuka and totara are semi-mature and have formed an effective screen to the site (in approximately 30 years). Additional kanuka and totara will be planted in place of the felled pines to reinforce the mature native trees to maintain and effective long term vegetative screen.
- For the remainder of the landfill site adjacent to Big Stone Road, a 10m wide strip of Kanuka and Totara. This planting will occur adjacent to land within the site that will continue to be used for plantation forestry and which will act as a vegetative screen until which time the kanuka and totora are semi-mature.

A final planting plan will be developed as part of the submission of the outline plan of works application following detailed design, and as required by condition 3 of the designation.

The landfill cap will be progressively established with pasture as each stage of the landfill is completed. The remainder of the site outside of the landfill operational footprint is expected to continue to be used for~~as~~ plantation forestry, except where areas of indigenous vegetation and wetlands are to be retained~~,~~ or enhanced~~, or created~~ as part of the finalised ecological mitigation and offsetting for the project (described further in **section 8.8**). This is proposed to include fencing, native planting, and weeding within and upstream of the swamp wetland~~ enhancement and expansion of indigenous treeland between Gullies 2 and 3, and wetlands in the East Gully and upper reaches of the Palmer Stream (Taieri catchment). Wetland enhancement in particular may involve some small scale earthworks to assist with water retention, as well as clearance of exotic species, and extensive planting with native species local to the area~~.

5.10 Landfill Access

Vehicle access to the site will be from SH1 via McLaren Gully Road and Big Stone Road. Secondary alternative access is also available via Big Stone Road which connects through Brighton and Dunedin, in the event that SH1 or McLaren Gully Road are inaccessible.

Traffic will access the site from Big Stone Road from a new access located approximately 350 m from the intersection of McLaren Gully Road and Big Stone Road. The access will be used by all operational staff, construction traffic, and waste and leachate trucks. No public access will be allowed. The access is approximately 200 m long and will be formed with an 8 m wide sealed carriageway, and have a lockable gate at the entrance. Stormwater from the access will be collected and discharged to the landfill perimeter drain and attenuation basin.

Access arrangements within the landfill include:

- Internal roads constructed from aggregate providing access from the upper facilities area to the landfill operational area, lower facilities area, and soil stockpile areas. Stormwater from these roads will be directed to the attenuation basin.
- Temporary roads constructed from aggregate on the landfill operational area to provide passage of the waste delivery trucks. These temporary access roads will be amended regularly as each cell is progressively filled.
- Perimeter access track constructed from aggregate to enable access around the site for environmental monitoring and maintenance purposes. The track will ~~be progressively constructed in conjunction with the adjacent perimeter swale drain which will collect stormwater runoff from the track~~be constructed in its entirety as part of the initial construction works.

Outside of the site, the SH1 / McLaren Gully Road intersection is proposed to be upgraded, including adding a southbound left turn lane on the state highway, and lighting. McLaren Gully Road and Big Stone Road will also be upgraded, widened, and sealed as far as the new site access to ensure they can safety accommodate two-way traffic and increased traffic demands arising from the operation of the landfill. The concept design has been based on the standards in the DCC *Code of Subdivision and Development 2010*, and provides for:

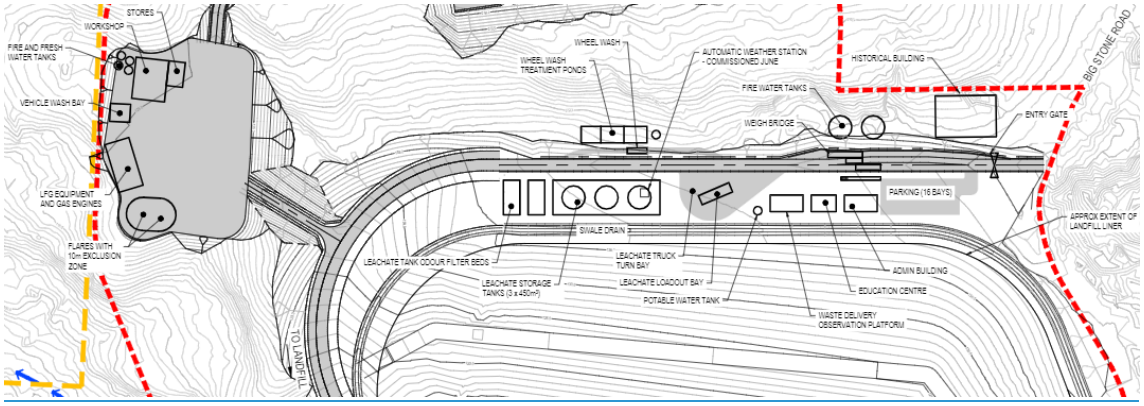
- Vertical gradients limited to 10%.
- Two 3.5 m sealed lanes, with widening to accommodate design vehicle swept paths.
- Shoulders of 0.25 m sealed plus 0.25 m unsealed.
- Swales with a 5H:1V road side slope, 1 m base and 4H:1V boundary side slope. Swales will discharge into watercourses and wetlands where they occur adjacent to the road.
- The legal road boundaries will be adjusted where the upgraded roads fall outside the existing road reserve.

The updated design for the upgrade of McLaren Gully Road and Big Stone Road has taken into account the occurrence of wetlands along the road margins. To the extent practicable, wetlands have been avoided through the updated road design. This has included adjustment of the road centreline and grade.

5.11 Landfill Facilities

Various site facilities are proposed to support the operation of the landfill, as shown conceptually in **Figure 10** below. The majority of these are intended to be located within a facilities area on a high platform located to the east of the landfill and accessed from the site access from Big Stone Road (upper facilities area). Other facilities will be located on a lower platform to the north of the landfill and accessed from an unsealed access from the main facilities area (the lower facilities area).

Figure 10 – Landfill Facilities (Updated May 2021)



The main facilities proposed, and their locations include:

- Vehicle weighbridge and staff kiosk located on the landfill site access from Big Stone Road.
- Landfill gas destruction flares (discussed in **section 5.6**), located in the western part of the lower facilities area within a 10 m safety exclusion zone. Space has also been reserved in this area for future landfill gas electricity generation plant.
- Site office and associated car parking, located in the upper facilities area, containing landfill administration, laboratory, meeting room, and staff amenities, including toilets and showers. The building would be single storey.
- Leachate storage tanks and leachate load out bay (discussed in **section 5.5**), located in the upper facilities area. The leachate storage system and the load-out bay will have containment systems installed to capture and retain any leachate spillage.
- Workshop located in the lower facilities area for plant and general maintenance, along with associated storage, and staff amenities, including toilets and showers. A concrete vehicle wash bay with oil/sediment traps is located near the workshop. Vehicle refuelling will also occur at a dedicated location in the workshop compound.
- Emergency power supply in the form of a 300kVA diesel generator, to power the leachate pump system and LFG flare system in the event of the loss of network supply.
- Wheel wash located on the landfill site access within the upper facilities area for cleaning the wheels of all waste vehicles leaving the site. The wheel wash will comprise a pressure underbody spray wash with rumble bars through which vehicles will drive. Dirty water

from the wheel wash will be captured in coarse sediment traps and further treated in flocculation ponds before being recycled back to the wheel wash.

Non-potable water will be required to provide firefighting supply, dust suppression, and operation of the wheel wash and machinery wash bay. The total non-potable water demand is estimated to be 47 m^3 per day. The groundwater drainage system will initially provide up to ~~8~~ 87 m^3/day but (as discussed in **section 5.8**) rates will reduce over time in response to the loss of recharge caused by progressive landfill liner construction, and will be supplemented by water tanker deliveries. Recognising the estimated daily demand of 47m3 per day, consent is being sought to abstract up to 50m3/day of water from the groundwater collection system for non-potable use. Ultimately the DCC proposes to install a pipeline along public roads to ~~until which time a permanent pipeline is constructed from~~ the Council water supply in Brighton at the same time as the leachate pipeline, approximately 9 years after landfill operation commences. Consents for the pipeline are not being sought as part of the current applications. Water will be stored in tanks in the upper or lower facilities area providing 200 m^3 (4 days' supply). A separate firefighting supply tank of at least 100 m^3 will also be provided.

Potable water suitable for the staff facilities will be tankered or ultimately piped to the site and stored in separate potable water supply tanks. Wastewater from the staff facilities will be connected to the leachate collection system for disposal off site.

Discharges of excess water from the wheel wash recycle system are expected to be minimal and only occur during periods of heavy rainfall. Excess water will flow to the landfill stormwater system and pass through the landfill stormwater attenuation basin for treatment, prior to discharge downstream.

5.12 Landfill Construction

Construction of the landfill will occur progressively over the life of the landfill, and include initial development works, works associated with the development of each stage, and works associated with landfill closure.

The Initial construction works include:

- Upgrades to McLaren Gully Road, including its intersection with State Highway 1, and Big Stone Road.
- Initial site clearance.
- Construction of landfill site access and access between the facilities areas and soil stockpile areas, and the perimeter ~~road for stage 1~~access track.
- Landfill facilities.
- Landfill toe embankment, stormwater attenuation basin, and the sediment control measures and the section of the landfill perimeter drain ~~for~~serving the upper facilities area, and stage 1.
- Formation of the base grade, groundwater collection, low permeability liner system, and leachate collection systems for stage 1.

- Perimeter planting for all stages ~~1, 2 and 3,~~ and required ecological mitigation/offset planting.
- Landfill environmental monitoring systems, including groundwater/LFG wells.
- LFG collection and destruction system to coincide with the timing for placement of 200,000 tonnes of waste in the landfill – approximately ~~2~~ 3 – 4 years after commencement of landfilling.

Construction of the landfill across all stages will involve vegetation clearance, followed by bulk earthworks. Bulk earthworks to construct the landfill base grade of each stage are expected to typically involve cuts of 5 m depth, but ~~could be up to 17 m on the ridges in Stage 3 and Stage 5~~will be deeper on some ridges. Excavated topsoil, loess, and some underlying weathered and unweathered breccia will be progressively stripped, separated, and stockpiled, for reuse over the life of the landfill development. Uses for each of these materials include:

- Topsoil will be stockpiled for placing on the final cap of each stage for establishment of vegetation.
- Organic rich alluvial deposits in the base of the gullies which is unsuitable to establish the base grade will be stockpiled for use as a growing layer on the final cap, or for disposal as daily cover.
- Loess soils will be stockpiled and used in the establishment of the low permeability liner, final cap, and as intermediate ~~fill~~ cover material.
- Underlying weathered breccia will be stockpiled and used as construction fill, including filling of gullies, and construction of the landfill toe embankment.

Stockpiles will be established in the landfill footprint, or ~~a~~ two dedicated stockpile areas located to the east (stockpile 1), and west (stockpile 2) of the landfill. The western stockpile 2 will be no higher than 20 metres in height. The eastern stockpile 1 will be no higher than 5m and used for longer term storage of valuable material such as loess and topsoil. Storage requirements will peak at approximately 350,000m^3, of which up to 70,000m^3 can be stored in the eastern stockpile 1, and the remainder in the western stockpile 2.

Sediment control measures including stabilisation, temporary and permanent cover such as grass, silt fences, sediment retention ponds (SRP), and cut off drains will be established in the stockpile areas to ensure sediment is retained and does not run off into ~~gullies~~watercourses, and ultimately downstream to the Ōtokia Creek.

The indicative overall earthworks volumes associated with the landfill are shown in **Table 7** below. These do not include earthworks associated with the road upgrades outside the site.

Table 7 – Indicative Earthworks Volumes (Updated May 2021)

~~**Total cut available**~~	~~**1,969,975 m^3**~~
~~Total fill required~~	~~855,495 m^3~~
~~Base liner soils required~~	~~345,000 m^3~~
~~Final cover soils required~~	~~669,600 m^3~~
~~Daily cover soils required~~	~~927,900 m^3~~

~~**Total soil required**~~	~~**2,798,585 m³**~~
~~**Total soil deficit**~~	~~828,620 m³~~

Item	Indicative Volume (m³)
Total cut to sub-grade	933,00
Total fill to sub-grade	210,000
Net cut to construction activities or stockpile	**723,000**
Sub-liner soils	151,000
Drainage layer	57,000
Intermediate cover	27,000
Daily cover	384,000
Final capping	291,000
Total construction fill	**910,000**
Net material deficit	**187,000**

The table indicates landfill development will ultimately consume all cut material, and result in a fill deficit of up to 187,000m³ of construction fill or cover soils. This deficit is likely to be offset by:

- Site-won materials not meeting drainage aggregate specifications, requiring that drainage materials be imported.
- The potential for waste soils received by the landfill to be used as daily cover.
- Site won material arising from the construction of the site facility and stockpile platforms beyond the immediate landfill footprint, as well as surplus material from the road upgrades outside of the site.

~~occur during stage 5 of the development. In the event that stage 5 proceeds, t~~There is also the potential to develop a borrow area/s within areas of the existing designated site to provide ~~for up 800,000 m³ of~~ the required fill. Consent for borrow areas is not being sought at this time, however they will be located outside wetlands and areas with ecological value.

Construction of the roading upgrades outside of the site are anticipated to require approximately ~~124,000~~46,700 m³ of cut, and ~~109,000~~18,470 m³ of fill, representing an excess of cut material in the order of 28,230m³ ~~requiring disposal or~~which will be stored at the stockpile areas for reuse ~~stockpiling for reuse as part of ongoing development of the landfill~~. The road upgrades will involve:

- Cut slopes generally up to 4 m in height, but with two sections being between 5 m and 7 m in height.

- Embankments up to 7.5 m in height, but with sections of retaining structures of between 0.5 m and 2.5 m, particularly where the road corridor is adjacent to roadside wetland areas.
- ~~cut slopes up to 4 m high, and fill embankments up to 6 m high, and will potentially require the partial clearance of roadside wetlands and indigenous vegetation~~Cut face slopes will rise at a slope of 1V:0.2H, while fill embankments will slope at 1V:2H.

Following the construction of the base grade of each stage, the groundwater collection pipework will be installed, followed by the liner subgrade, and low permeability liner system. The liner formation provides a minimum transverse gradient of 2% and longitudinal gradient of 4% on the landfill base, to direct leachate to the sumps at the base of the landfill. The landfill liner will be installed to the extent that waste will be placed for the following 18 months. The landfill liner would then be extended annually with provision to continue filling 6 months past a 12-month design period (should the 12-month capacity be achieved at the start of winter). Installation of the landfill liner over winter will not occur as it will not achieve the required quality.

Following engineering acceptance of the landfill liner, the leachate collection pipework will be installed on the base of the landfill and drainage media applied over the base liner. A non-woven geofabric will then be overlaid. Leachate pump risers, pumps, delivery pipes, storage and loading facilities will be installed and made operational prior to placement of waste in the landfill.

5.13 Landfill Operation

Landfill operational activities will include:

- Waste filling.
- Placement of daily cover, and intermediate cover as required.
- Stormwater management and maintenance works.
- Management and maintenance of LFG and leachate systems.
- Environmental monitoring, and response as required.

The landfill will only receive deliveries from commercial operators. General public access will be excluded. The proposed opening hour for waste deliveries are:

- Monday to Saturday 8.00am - 5.30pm.
- Sunday 9.00am - 5.30pm.
- Closed ~~Christmas Day,~~ Easter Friday, Christmas Day, New Year's Day, and the morning of Anzac Day (until 1pm).

The landfill operator may commence operations 1 hour before and up to 1.5 hours after the opening hours to prepare for waste delivery in the morning and to close off the works at the end of the day. Staff or contractors may be on-site outside these hours for required work, monitoring or maintenance.

Vehicle movements to and from the site will include those for worker transport, delivery of waste/clean fill, leachate and water tanker transport, commercial deliveries, service vehicles, and construction vehicles during initial site development and development of each landfill stage. The

average number of truck movements is expected to reach approximately 25 per day. In addition, there is expected to be up to 25 light vehicle movements per day.

Waste trucks arriving at the site will access the landfill via SH1, McLaren Gully Road, and Big Stone Road. The site will be fenced and a main gate at the access point will provide security. Trucks will pass through the gate and travel to a weighbridge inside the gate. Incoming waste will be weighed and inspected for compliance with the landfill waste acceptance criteria.

Trucks will then progress though the facilities area and across the landfill toe embankment and internal site access to discharge waste to the active landfill operational area. Temporary access tracks on the landfill will be amended as the waste level rises. Once empty, trucks will pass through the wheel wash facility to ensure any tracked waste or sediment is removed before departing from the site via the weighbridge.

Initial layers of waste laid on the prepared liner and leachate collection system will be bagged waste or selected waste that has no protrusions that could penetrate the liner. Landfill machinery will not be permitted to traffic over the leachate blanket unless there is at least 1 m thickness of waste. Compaction will not commence until the waste is greater than 2 m thick.

~~At commencement of the Stage 1 landfilling, a low bund will be installed at the interface of Stages 1 and 2 to provide support for the toe slope of the waste and to direct leachate to the leachate collection sump. This bund will also direct surface water from earthworks to the sediment retention pond and avoid entry to the leachate collection system. This will be repeated for the interface between Stages 3 and 4.~~

Daily cover will be applied at the end of each day's waste placement such that there are no uncovered areas of waste while the site is not operating. Daily cover will be 150 mm of stockpiled or imported soils or alternative equivalent cover. These will include contaminated soils that are non-odorous and meet the landfill waste acceptance criteria, or construction and demolition waste. The operating cell of the landfill will be limited to around 300 m^2 to provide for not less than 1m compacted depth of waste to be placed to avoid an excessive percentage of cover soils to waste.

Intermediate cover will be placed where waste will not be overlaid with fresh waste for more than 3 months. This will include most of Stage 1 upon completion. The cover soils will be low permeability loess stripped from subsequent landfill stages or stockpiles and placed in compacted layers not less than 300 mm thick and hydroseed applied. The cover will be graded to the stormwater system where possible to allow runoff of uncontaminated water and reduction in leachate generation. Intermediate cover will be stripped before placement of fresh waste.

5.14 Landfill Closure and Aftercare

Closure activities will include placing the final capping layer on completion of each stage, establishing any final landscaping, removing any infrastructure that is not required during the aftercare period, or modifying such infrastructure for the aftercare period.

Final capping of the landfill will be constructed progressively as the final waste level in any area is reached. The final cap will meet the WasteMINZ guidelines and include not less than 150 mm of topsoil, over not less than 300mm growth media layer, followed by at least 600 mm (and up to 1000 mm) of ~~clay~~ compacted cohesive soils with a permeability less than $1x10^{-7}$ m/s~~, overlaying~~

~~a minimum of 500 mm of intermediate cover~~. Surface contour drains will be established on the cap to intercept and direct stormwater to the perimeter drainage system. Grass or shallow rooted vegetation will then be established.

Completed laboratory testing of the on site loess ~~material~~ soils indicates it can be compacted to achieve a permeability of between $3x10^{-8}$ to $5x10^{-10}$ m/s, suitable for the 600 mm ~~clay layer~~low permeability layer within the capping system. However, dispersion testing has confirmed the loess as being potentially dispersive, which may require the addition of lime to address its dispersive ~~characteristics~~properties. As noted in **section 5.5**, further testing will be undertaken to ~~ensure that the addition of lime will meet the required characteristics~~assess the anticipated benefit of lime amendment.

Following closure of the landfill, all site facilities not required during the landfill aftercare period will be removed. This includes recontouring of the soil stockpile area to conform to the topography, revegetation, and disestablishing any temporary stormwater systems.

Aftercare activities will include:

- Ongoing operation and maintenance of the LFG collection and destruction (or future electricity generation) systems.
- Ongoing operation and maintenance of the leachate collection, treatment and disposal system.
- Maintenance of the permanent site stormwater systems, including the perimeter swale drain, and attenuation basin.
- Maintenance of the landfill cap, including filling any areas that may have been subject to differential settlement, repair of any surface erosion, and maintenance of vegetation as required.
- Maintenance of any remaining site infrastructure, including fences, and buildings not removed following closure.
- Ongoing environmental monitoring, reporting, and event response, as required by resource consents and the Landfill Management Plan.

5.15 Landfill Management Plan

The construction, operation, maintenance, and aftercare of the landfill will occur in accordance with a comprehensive Landfill Management Plan (LMP) prepared in accordance with the WasteMINZ guidelines. Clause 7.6.11 of the Otago Regional Plan: Waste requires the preparation of a landfill development and management plan in the form prescribed in Appendix 2 of that plan. Plan Change 1 to the Waste Plan, which has recently been notified by the Environmental Protection Authority, amends the clause, and requires a site specific management plan be prepared in accordance with the WasteMINZ guidelines.

Implementation of an LMP at all stages of the life of a landfill follows contemporary best practice. The purpose of an LMP is to document site-specific procedures, including monitoring and contingency actions to be implemented to ensure the landfill achieves ~~pre-determined~~the operational and environmental objectives and ~~compliance with resource consent~~ conditions set out in the resource consents, to ensure the potential for adverse environmental effects is

minimised. Importantly it includes contingency actions to adaptively address issues as they arise and pro-actively managed potential breaches.

An LMP covers all aspects of a landfill operation, including:

- Site management structure and responsibilities.
- Planning controls and consents.
- Design parameters to be met.
- Site development and filling sequence.
- Daily operating procedures.
- Waste acceptance criteria and procedures.
- Monitoring requirements.
- Emergency and contingency procedures.
- Record keeping and reporting.
- Closure and aftercare of completed cells and the whole landfill.

It is common practice to prepare a full LMP as part of the detailed design of the landfill, and before construction commences. This enables the LMP procedures to align with the detailed design, landfill operational developer/operator needs and facilitate compliance with the conditions of approved resource consents. The LMP is a living document, and will be regularly reviewed and updated over the life of the landfill to ensure that management practices result in compliance with the conditions of resource consent. Review will also respond as necessary in response to changes in waste demands, best practice design and management, regulatory requirements, and any environmental changes.

It is important that the resource consent conditions provide direction on the expected content of the LMP, the process for its development and approval, and clear and certain objectives to guide the development of procedures, and against which the success of the LMP can be measured.

This AEE sets out proposed design, construction, operational, monitoring, and contingency measures that forms the basis for developing the LMP procedures. This includes the proposed development of a number of individual ecological management plans that will sit under the umbrella of the LMP. Proposed conditions of consent are also included in this AEE which provide direction on the preparation, implementation, and review of the LMP, including proposed LMP objectives to guide the development of procedures, and against which the success of the plan can be measured.

A draft LMP framework has been prepared which accompanies this AEE. The proposed structure of the draft LMP structure will includes provision for the following:

- **Introduction** – the plan purpose, and objectives; schedule of resource consents held; and procedures for plan review, and reporting to consenting authorities which aligns with the resource consent conditions. ; requirements, structure; schedule of resource consents held and designation; relevant documents and guidelines; and procedures for plan review.

- **Site management** – ~~landfill management roles and responsibilities; training requirements for specialist roles; and procedures for community liaison, and receiving and responding to community complaints which aligns with resource consent conditions.~~ description of the site; landfill management roles and responsibilities; training requirements for specialist roles; health and safety requirements; and procedures for communication with the community, and receiving and responding to complaints.
- **Landfill construction** – ~~procedures for landfill design and construction in a way that ensures the landfill achieves design and construction objectives set out in the resource consent conditions.~~ general description of the design; and the parameters and procedures for detailed design and construction of the landfill that achieves the LMP objectives, and resource consent conditions
- **Landfill operation ~~and maintenance~~** – daily ~~operational procedures, including for waste acceptance, that achieve operational objectives set out in the resource consent conditions.~~ procedures for operation of the landfill, including for waste acceptance, that achieves the LMP objectives, and resource consent conditions.
- ~~**Landfill monitoring and contingency planning** – environmental monitoring procedures and parameters, and contingency action in event of non-compliance, that achieve monitoring and contingency objectives set out in the resource consent conditions.~~
- **Landfill closure and aftercare –** procedures for site closure, rehabilitation and ongoing aftercare, that achieves the LMP objectives, and resource consent conditions. ~~site rehabilitation and ongoing management following closure, that aligns with aftercare objectives set out in the resource consent conditions~~.

The above structure also references and incorporates elements of more detailed bird management, ecological, and landscape management plans attached as appendices to the LMP

. Those detailed plans form part of the overall suite of procedures for the management of the landfill in the LMP.

The draft LMP provides a starting point for full completion of the final plan as part of detailed design, and before construction commences. The level of detail provided in the draft LMP reflects the following principles:

- A greater level of detail has been provided for those matters which were specifically raised in the ORC section 92 request for further information as requiring draft management plans to be prepared, for example in relation to bird and ecological management, and odour.
- A lesser level of detail has been provided for those sections which are more contingent on detailed landfill design, and the specific needs of a landfill developer/operator. More detail on these sections will be added as part of the preparation of the final LMP.

The final LMP and plans that sit underneath it will be developed in consultation with Te Rūnanga o Ōtākou.

6.0 Description of Alternatives Considered

6.1 Alternative Landfill Options

An extensive site selection process was completed in the early 1990's to identify a landfill site to replace the Green Island landfill at the end of its life. The process leading to the investigation, selection, and designation of Smooth Hill as a future landfill site is further outlined in **section 3.2**. The Council investigated thirty-two possible sites with input from consultants, iwi, the public, and regulatory agencies. The evaluation of sites ultimately led to the Council confirming at its meeting on the 17th of May 1993 that the Green Island landfill be extended, and the Smooth Hill site be secured to provide a future long-term landfill solution for the city.

Since that time, Green Island has continued to be Dunedin's primary landfill option. The current resource consents for the operation of Green Island expire in 2023, and even if new consents are sought and obtained, the landfill is expected to reach the end of its functional life sometime between 2023 – 2028. The Council therefore resumed investigations and work to enable the Smooth Hill landfill as part of the wider Waste Futures Project.

As part of phase 1 of the Waste Futures Project during 2018/19, DCC engaged consulting engineers Stantec to assess the technical feasibility of the designated Smooth Hill site for a landfill. This included assessing landfill filling plans; financial models; and feasibility in terms of engineering, economics, environment, social and cultural aspects. The work concluded that Smooth Hill has the capacity to accommodate current waste quantities to 2063 and beyond. The work also supported the technical feasibility of the site to be developed and operated as a landfill and didn't highlight any fundamental reasons as to not proceed with the consenting process, thereby effectively confirming the 1992 evaluation findings.[22]

The subsequent concept and updated design process has involved technical input from a range of experts to minimise adverse environmental, social, and cultural effects to the extent possible. Adjustments made to the landfill footprint and final form based on this input have included:

- Relocating the ~~proposed~~ soils stockpiling area from West Gully 3 ~~(to the north of stage 5)~~, which contains regenerating kanuka treeland vegetation with high ecological values. The stockpile area ~~has~~ was instead ~~been~~ located on cleared forestry land to the north east of ~~stage 1~~the landfill.
- Limiting the elevation of the final landfill cap to generally no more than 5 m above Big Stone Road to enable better integration into the surrounding landform, and screening by perimeter planting.
- Adjustment of the landfill footprint adjacent to Big Stone Road to provide sufficient room for landscape planting to screen the landfill from the road and adjacent properties to the south.
- Further updating and adjustment of the landfill footprint in 2021 to avoid wetlands located in the gullies to the north and west of the landfill footprint.

[22] DCC Waste Futures 2023 – Landfill Feasibility Workstream, Stantec, February 2019

~~Avoidance of the swamp wetland at the northern end of the site was also considered, and while technically possible, was discounted due to the significant loss of useable landfill capacity (and a resulting reduction in landfill life), and the need to place the toe embankment in the most optimal location to support the long term stability of the landfill. The embankment location allows for the landfill to be effectively buttressed against the existing hillsides on three sides, with the embankment then buttressing the unsupported end of the landfill. The location also allows for the retention of an existing interviewing ridge between stages 1 and 2, and stages 3 to 5, which enables segregation of the leachate collection system into two halves.~~

The Stantec technical feasibility work targeted a landfill waste volume of 6,000,000 m^3 (equivalent to 5,000,000 tonnes of waste) for the landfill. A similar landfill waste volume was initially targeted for the concept design However subsequent updating of the design and the anticipated annual waste volumes have results in a smaller landfill capacity~~has been adopted for the concept design~~. Current Dunedin annual waste disposal rates are anticipated to be in the order of ~~90~~60,000 tonnes per year. If these rates are maintained the landfill has a life of approximately ~~55~~ 40 years. However, uncertainty exists over future rates of disposal. Issues include:

- The Council is looking to divert waste where possible to recycling as well as promote waste minimisation. This is likely to result in a long-term reduction in landfill waste per head of population.
- This may be offset to some extent by population growth in the Dunedin area. Furthermore, the landfill may accept waste from other districts, increasing the annual rate of waste disposal.
- Significant region wide unexpected events can result in spikes in waste disposal rates.

Given the uncertainty regarding future requirements the landfill has been developed to allow future adaption. A key adaptive approach is that development of the landfill can change pace depending on demand. ~~be developed in two distinct phases. If waste volumes reduce significantly, Stage 1 and 2 of the landfill may be sufficient for many decades and development of Stages 3 through 5 can be delayed long into the future.~~

6.2 Alternative Access Locations

The technical feasibility work completed by Stantec assumed access to the landfill would be via McLaren Gully Road and Big Stone Road to the existing site entrance point. The phase 2 concept design process reviewed this option (Option A), and a further four options were identified and evaluated:

- **Option A (Baseline)** – SH1, McLaren Gully Road, and Big Stone Road to existing site access point.
- **Option B** – SH1, McLaren Gully Road, and new site access across the adjacent property to the north following the approximate alignment of the existing paper road to the designated landfill site.
- **Option C** – SH1, McLaren Gully Road, and new site access across the adjacent property to the northeast to the designated landfill site.

- **Option D** – SH1, McLaren Gully Road, and new site road across the adjacent property to the north to the designated landfill site.
- **Option E** – SH1, and following an existing forestry road to the designated landfill site. This option was identified in the 1990's as part of the site selection and designation process.

All options were qualitatively evaluated against criteria for required earthwork volumes, safety, construction risk, maintenance risk, ecological impacts, residential impacts, and land acquisition requirements. While Option C rated well in terms of providing for heavy truck access, the landowner has indicated they are unwilling to sell the required land for the access. Option A is considered a viable alternative and has therefore been chosen as the site access.

The ~~proposed~~ upgrades to McLaren Gully Road as ~~currently~~ originally designed ~~will~~ encroached on~~,~~ and required the partial clearance of wetlands and indigenous vegetation alongside the road margins. Further design work following the lodgement of the~~se~~ application~~s~~ ~~is proposed to~~has refined the road design to avoid these wetlands to the extent ~~it is~~ practicable.

6.3 Alternative Discharge Methods

Alternative methods of discharge, and other receiving environments for the discharges have been considered however they are not practicable for a landfill in this location. Specifically:

- Class 1 landfills by their nature result in the discharge of contaminants to land.
- There are no practicable other receiving environments. The landfill site is situated predominately within the head of the McColl Creek catchment and drains to a tributary of the Ōtokia Creek north of the application site. Other areas of the site that fall to the Taieri Catchment, and Flax Stream catchment to the south east, are not viable receiving environments for the majority of stormwater due to constraints posed by topography, and natural drainage patterns. ~~This is with the exception of stormwater from an approximately 9000 m^2 part of the site adjacent to Big Stone Road that will be diverted to the Open Stream at the head of the Flax Stream catchment.~~
- There are no practicable alternative methods of discharge. The methods of stormwater discharge have however ~~have~~ been selected to align with best engineering practice, and the guidance contained in the WasteMINZ guidelines. Stormwater from construction and operational areas within the landfill footprint will pass through sediment retention ponds for treatment, prior to discharge to either the attenuation basin at the bottom of the site, or downstream watercourses within the~~which will provide additional treatment prior to discharge to the~~ Ōtokia Creek receiving environment.

  Discharge from the attenuation basin to the receiving environment will typically occur by way of infiltration to ground through the wet bay and dry basin floor, except where higher rainfall exceeds the capacity of the basin, resulting in direct surface discharge via either an outlet (for low flows), or an engineered spillway (for storm flows). ~~Stormwater diverted to the Flax Stream catchment will consist of clean water runoff from the perimeter of the site outside of the landfill waste footprint, and will be discharged via a catchpit sump and culvert to the Open Stream.~~

7.0 Description of the Applications

7.1 Application Overview

The Council applied for the RMA authorisations from ORC and DCC (as consenting authority) required to enable the construction, operation, and aftercare of the landfill, and construction of the associated roading upgrades in August 2020, based on the original concept design.

The following sections outline the applications for resource consent that are required and ~~being~~ have been applied for to enable the construction, operation, and aftercare of the landfill, and construction of the associated road upgrades. The following authorisations under the RMA are being applied for:

1. Resource consents from Otago Regional Council (ORC) under the Regional Plans for:
    - Discharge of waste, stormwater, and contaminants to land, water, and air.
    - Damming, diversion, take, and use of surface water and groundwater.
    - Activities within the beds of wetlands and rivers.
    - ~~Drilling of land.~~
2. Resource consents from DCC (as consenting authority) under the District Plans for upgrades to McLaren Gully Road (including and its intersection with State Highway 1), and Big Stone Road to the site~~, and the creation and enhancement of wetlands outside the designation~~.

The following sections outline the resource consents being applied for in detail, which has been amended where required to reflect the updated design. The updated design does not introduce the requirement to obtain any additional resource consents. Furthermore, the updated design removes the requirement to obtain consents for aspects that were required for the original design, notably the diversion and discharge of water to the Flax Stream catchment.

An application for an outline plan of works will be submitted separately to DCC's consenting authority arm following the completion of detailed landfill design. The detailed design and the outline plan of works will be developed so as to align with the conditions of any approved resource consents and meet the operational requirements.

As noted in **section 3.2**, ~~the current 2GP designation is contained in two separate titles separated by a paper road which was stopped by Gazette Notice on 22 July 2020. DCC will separately apply to alter the designation boundary under section 181(3) of the RMA to encompass the stopped road into the designation.~~ until recently, the designation in the 2GP fell over two separate land parcels bisected by an unformed paper road which was declared stopped by Gazette Notice on 22 July 2020. DCC subsequently applied to alter the designation boundary under section 181(3) of the RMA to encompass the stopped road into the designation. The regulatory arm of the Council issued a decision formally altering the designation on the 26th of March 2021.

7.2 Applications for Resource Consent from Otago Regional Council

The Otago Regional Council administers the following relevant National Environmental Standards, and Regional Plans:

- The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NESFW), which was gazetted on the 3rd of August 2020, and ~~comes~~ came into force on the 3rd of September 2020. The NES relevantly controls activities affecting natural wetlands, and the reclamation of rivers.
- 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 Regional Plan: Air for Otago Air (Air Plan), which was made operative on the 1st of January 2003. The plan controls other discharges of contaminants to air not controlled by the Waste Plan, specifically non-landfill related dust associated with the road upgrades.

The NESFW ~~comes~~ came into force on the 3rd of September 2020, which ~~is~~ was after the date of the lodgement of these applications. The relevant rules have been considered in the assessment that follows. Where the rules of the NES ~~results~~ resulted in a more stringent activity status for some activities than under the Regional Plan: Water, section 88A of the RMA provides that status of the activities at the time the applications were made (controlled, restricted discretionary, or non-complying) remains unchanged.

Plan Change 1 to the Waste Plan, and Plan Changes 7 and 8 to the Water Plan were called in and notified by the Environmental Protection Authority on the 6th of July 2020 and had immediate legal effect from that date. The plan changes do not introduce additional rules or change existing rules that are relevant to the project. The plan changes are currently being heard and considered by the Environment Court.

7.2.1 Application of Rules relating to Wetlands and Rivers

For the purposes of the NESFW regulations 37 – 54 the swamp wetland within the site, wetlands within the road upgrade footprint, and the wetlands in the downstream tributary of the Ōtokia Creek are considered to be “natural wetlands”.

For the purposes of the NESFW and Water Plan, it is considered that the watercourses that run through the site are not “rivers” as defined by the RMA, NESFW, or Water Plan. Accordingly, the NESFW regulation 57, and Chapter 13 rules of the Water Plan for activities in the beds of “rivers”

do not apply.[23] Specifically, as outlined in **section 4.3.2**, the watercourses are not perennial and only convey ephemeral flows of water after persistent rainfall. Furthermore, they have no clearly defined bed, have a general absence of natural stream bed substrates, and do not provide any intermittent or permanent habitat for freshwater macroinvertebrate or fish fauna.

The swamp wetland at the bottom of the site, and the defined channel that connects it to the valley floor marsh wetland north of the site may contain some standing water throughout the year and therefore it may possibly come within the definition of "river". Given that uncertainty, it has been assumed out of caution that the swamp wetland is a "river", and therefore that the relevant NESFW regulation 57, and Chapter 13 rules have been considered in the assessment that follows.

7.2.2 Resource Consents being Applied for

The resource consents that are being applied for each of the proposed project activities, and their activity status, under the relevant rules of the Regional Plans are outlined in **Table 8** below. Components of the project that are a permitted activity, and do not require resource consent are also identified.

Table 8 – Resource Consents Required from Otago Regional Council

Activity	Relevant Plan Rule	Commentary
Discharge of waste and hazardous waste onto land within the landfill, and leachate onto land within the landfill that may result in contaminants entering groundwater.	Regional Plan: Waste: Rule 7.6.1 – 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 – 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 is triggered as compliance with Class 1 waste acceptance criteria will allow some "hazardous wastes" to be accepted – e.g. contaminated soils.
~~Taking of surface water from:~~ ~~(a) the swamp wetland for the construction of the landfill toe embankment and attenuation basin.~~ ~~(b)(a) roadside wetlands for the upgrading of McLaren Gully Road.~~	~~Regional Plan: Water~~ ~~Rule 12.1.5.1 – Taking and use of surface water – discretionary activity.~~	~~The taking of surface water for the purposes of draining wetlands is not otherwise provided for in the plan, and therefore is a discretionary activity, requiring resource consent.~~

[23] The same definition is used in the RMA, NESFW and the Water Plan which is river means "a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal)."

Activity	Relevant Plan Rule	Commentary
Taking of groundwater from~~:~~ ~~(a) the swamp wetland for the construction of the landfill toe embankment and attenuation basin.~~ ~~(b) roadside wetlands for the upgrading of McLaren Gully Road.~~ the landfill groundwater collection system. Use of groundwater from the landfill groundwater collection system for non-potable water supply for the landfill facilities.	Regional Plan: Water Rule 12.2.4 – Taking and use of groundwater – discretionary activity.	Permitted activity rule 12.2.2.2 cannot be met, specifically: (a) The take of groundwater will occur within 100 m of the existing wetlands; and (b) The take of groundwater from the ~~leachate~~ groundwater collection system will at times exceed 25,000 litres per day. The taking and use of groundwater is therefore not otherwise provided for in the plan, and is therefore a discretionary activity, requiring resource consent.
Diversion of surface water: (a) within the McColl Creek catchment for land drainage. ~~(a) from the McColl Creek catchment to the Flax Stream catchment for land drainage of 9000m^2 of the landfill site.~~	Regional Plan: Water Rule 12.3.4 – Damming and diversion of water – discretionary activity.	Permitted activity rule 12.3.2.1 cannot be met, specifically: (a) the size of the catchment upstream of the diversion is more than 50 ha; ~~(b) there will be a diversion of water to another catchment – the Flax Stream catchment.~~ ~~Permitted activity rule 12.3.2.2 cannot be met as the diversion of surface water to the Flax Stream catchment could result in a lower level of water in the Ōtokia Creek.~~ The diversion of surface water for land drainage is therefore not otherwise provided for in the plan, and is therefore a discretionary activity, requiring resource consent.
Damming of surface water by the attenuation basin dam.~~:~~ ~~by the attenuation basin dam.~~ ~~(a) for the purposes of wetland creation or enhancement.~~	Regional Plan: Water Rule 12.3.4 – Damming and diversion of water – discretionary activity.	Permitted activity rule 12.3.2.1 cannot be met, specifically: (a) the ~~size of the catchment upstream of the attenuation basin dam is more than 50 ha~~water immediately upstream of the dam is more than 3 metres deep. The damming of surface water is not otherwise provided for in the plan, and is therefore a discretionary activity, requiring resource consent.

Activity	Relevant Plan Rule	Commentary
~~Discharge of stormwater from 9000m^2 of the landfill site to Open Stream (Flax Stream catchment).~~	~~Regional Plan: Water~~ ~~Rule 12.B.1.8 – Discharge of stormwater from a reticulated stormwater system to water or land where it may enter water – permitted activity.~~	~~The discharge of stormwater is a permitted activity, and no resource consent is required.~~ ~~All rule performance standards will be met, specifically:~~ ~~(a) The discharge is not to a regionally significant wetland, and will not give rise to any of the effects listed in clause (d) of the rule.~~ ~~(b) The discharge does not contain human sewage.~~ ~~(c) The discharge will not cause flooding, erosion, land instability, sedimentation, or property damage.~~
Discharge of stormwater, collected groundwater, and contaminants to the Ōtokia Creek from the attenuation basin, sediment retention ponds, ~~to the Ōtokia Creek~~, and from the site where it may enter water in the Ōtokia Creek.	Regional Plan: Water Rule 12.B.4.1 – Discharge of water or contaminant to water – discretionary activity.	The discharge of stormwater will include residual discharge of sediment contaminant following implementation of treatment measures. The discharge of any contaminant to water is not otherwise provided for in the plan, and therefore is a discretionary activity.
Discharge of stormwater from McLaren Gully Road, Big Stone Road, and State Highway 1 into water, or onto land where it may enter water.	Regional Plan: Water Rule 12.B.1.9 – Discharge of stormwater from any road to water or land – permitted activity.	The discharge of stormwater from roads is a permitted activity, and no resource consent is required. All rule performance standards are met, specifically: (a) The discharge will not cause flooding of any other person's property, erosion, land instability, sedimentation or property damage; and (b) Provision has been made for the interception of any contaminant from the upgrade works to avoid, after reasonable mixing the effects listed in the rule.
Discharge of landfill gas, flared exhaust gases, dust, and odour into air from the landfill.	Regional Plan: Waste: Rule 7.6.1 – New or operating landfills – discretionary activity.	Landfills for the disposal of waste, and associated discharges are discretionary activities.

Activity	Relevant Plan Rule	Commentary
	Regional Plan: Waste: Rule 6.6.1 – 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. Rule 6.6.1 is triggered as compliance with Class 1 waste acceptance criteria will allow some "hazardous wastes" to be accepted – e.g. contaminated soils.
Discharges of exhaust gases from the backup diesel electricity generator to power the leachate collection pumps and LFG flare system.	Regional Plan: Air: 16.3.4.2 – Discharges from fuel burning equipment in Air Zone 3 – permitted activity.	The discharge of products of combustion from fuel burning equipment is a permitted activity, and no resource consent is required. All rule performance standards are met, specifically: (a) The discharge will not exceed a heat generation capacity of 5MW. (b) The chimney height will comply with Schedule 6 of the plan. (c) No material specified in rule 16.3.3.1 will be burnt. (d) Discharges of smoke, odour, particulate matter, or gases will not be noxious, dangerous, offensive, or objectionable beyond the site boundary.
Discharges of dust to air during construction of the upgrade of McLaren Gully Road, Big Stone Road, and State Highway 1.	Regional Plan: Air Rule 16.3.14.1 – Discharges from miscellaneous activities – permitted activity. This rule specifically provides that discharges from a new landfill are regulated by the Regional Plan: Waste.	Discharges of dust to air associated with road construction activity is a permitted activity, and no resource consent is required. All rule performance standards are met, specifically there will be no objectionable discharge of particulate matter at or beyond the boundary of the property.
~~Placement and use of the landfill and toe embankment, attenuation basin, and the~~ ~~u~~Upgrades to McLaren Gully Road within wetlands, and associated alteration of the bed. ~~Alteration of the bed of a wetland, and p~~Planting for wetland creation or enhancement.	Regional Plan: Water Rule 13.1.2.1 – Use of a structure within the bed of a lake, river, or regionally significant wetland – restricted discretionary activity.	The use of the bed of a river is a restricted discretionary activity.

Activity	Relevant Plan Rule	Commentary
	Regional Plan: Water Rule 13.2.3.1 – Erection or placement of a structure within the bed of any lake, river, or regionally significant wetland – discretionary activity.	The placement of a structure within the bed of a river is not otherwise provided for in the plan, and is therefore a discretionary activity, requiring resource consent.
	Regional Plan: Water Rule 13.5.3.1 – Alteration of the bed of any lake or river – discretionary activity.	The alteration of the bed of the river is not otherwise provided for in the plan, and is therefore a discretionary activity, requiring resource consent.
	Regional Plan: Water Rule 13.6.2.1 – The introduction of any plant to or on the bed of any land or river for the purposes of restoring or enhancing habitat – permitted activity.	Planting on the bed of a river is a permitted activity, and no resource consent is required. All rule performance standards will be met, specifically: (a) No crack or grey willow will be planted. (b) No plants listed in the Pest Management Plan will be planted. (c) Reasonable steps will be taken to minimise the risk of sediment. (d) The planting will not cause any flooding or erosion. (e) The site will be left tidy following planting.
~~Drilling of land for groundwater monitoring bores.~~	~~Regional Plan: Water~~ ~~Rule 14.1.1.1 – Drilling for the purpose of creating a bore – controlled activity.~~	~~The use of land for the drilling of bores for groundwater monitoring is a controlled activity, requiring resource consent.~~
Drilling of land for groundwater monitoring bores. Drilling of land for the landfill gas monitoring and collection system.	Regional Plan: Water Rule 14.2.1.1 – Drilling of land – permitted activity.	The drilling of land for the LFG monitoring and collection system is a permitted activity, and no resource consent is required. All rule performance standards will be met, specifically: (a) The drilling will not occur on land over an aquifer identified in the C-series maps; and (b) The hole will be sealed on so that contaminants are prevented from entering the hole at any level.

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

The NESFW, which ~~comes~~ came into force on the 3rd of September 2020 ~~introduces~~ introduced additional rules relating to activities affecting natural wetlands, and the reclamation of rivers. While not ~~currently~~ in force at the time applications were made, the following provisions of the NESFW ~~are noted~~ are relevant to the proposal:

- The diversion of ~~taking of~~ surface water ~~or groundwater~~, and earthworks, within natural wetlands for the ~~construction of the landfill toe embankment and attenuation basin, and~~ upgrading of McLaren Gully Road, that results in the partial drainage of a natural wetland, is a prohibited activity under regulation 53.
- The taking of groundwater from the landfill groundwater collection system~~, and earthworks~~ within 100 m of natural wetlands, that results in the partial drainage of a natural wetland is a non-complying activity under regulation 52, requiring resource consent.
- The diversion of water for land drainage, damming of water by the attenuation basin dam, and earthworks within 100 m of a natural wetland, that results in the partial drainage of a natural wetland is a non-complying activity under regulation 52, requiring resource consent.
- The discharge of water within 100m of a natural wetland is a non-complying activity under regulation 54, requiring resource consent.
- Vegetation clearance within, or within 10 m of a natural wetland, is a non-complying activity under regulation 54, requiring resource consent.
- The reclamation of the bed of a river for ~~placement of the landfill toe embankment and attenuation basin, and~~the upgrading of McLaren Gully Road is a discretionary activity under regulation 57, requiring resource consent.
- ~~The damming of water, v~~Vegetation clearance~~, earthworks, or land disturbance,~~ within or within 10 m of a natural wetland for natural wetland restoration is a restricted discretionary activity under regulation 39 requiring resource consent, where the conditions in regulation 38 cannot be met.

Based on the above assessment, various activities trigger either prohibited or non-complying status under regulations 52, 53, and 54 of the NESFW where they result in the partial or complete drainage of natural wetlands. As outlined in **section 7.2** above, the NESFW ~~comes~~ came into force on the 3rd of September 2020, which is after the date of the lodgement of these applications. Therefore, under section 88A of the RMA, the discretionary activity status at the time the applications were made remains unchanged.

Pursuant to section 123(d) of the RMA, a consent duration of **35 years** is sought for all resource consents involving the following activities:

- Taking and use of groundwater~~, and taking of surface water~~.
- Diversion of surface water.
- Damming of surface water.
- Discharges of stormwater and contaminants to land and water.

- Discharge of contaminants to air.

~~An **unlimited** consent duration is sought for the land use consents for the drilling of land, pursuant to section 123(b) of the RMA~~.

A **10 year** lapse date is proposed for all resource consents, pursuant to section 125(a) of the RMA.

7.3 Resource Consents Required from the Dunedin City Council

The Dunedin City Council administers the following National Environmental Standards, and District Plans:

- The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NESCS).
- Proposed Dunedin City District Plan (2GP), which was notified on the 26th of September 2015, and decisions issued by the Council on the 7th of November 2018. Variation 1 to the Plan was notified on the 20th of November 2019, and decisions were issued by the Council on the 18th of July 2020.
- Operative Dunedin City District Plan (Operative District Plan), which was made operative in 2006.

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. The NESCS applies where the land has been subject to an activity or industry described on the Ministry for the Environment Hazardous Industries and Activities List (HAIL).

A Preliminary Site Investigation of the historical presence of HAIL activities has been completed and is attached as **Appendix 19**. The investigation did not find any HAIL activities associated with the landfill site or proposed road upgrades. The landfill site, and land underlying the road upgrades have historically been used for farming, forestry, and road transport activities. As no HAIL activities have been identified, the NESCS does not apply to the project and resource consent is not required under the NESCS. ~~are no records held by the Otago Regional Council or Dunedin City Council indicating the land has historically been used for any activity contained on the HAIL list. Accordingly, the provisions of the NESCS do not apply to the project.~~

The majority of the rules of the 2GP as amended by Variation 1, that are relevant to the project are beyond challenge, and therefore treated as operative under section 86F of the RMA. The exception is those rules relating to indigenous vegetation clearance, and earthworks~~, and upgrading of roads within the existing legal road reserve~~. These rules remain subject to various appeals and consequently the equivalent rules in the Operative Dunedin City District Plan remain relevant to the project.

~~Variation 1, which makes various changes to the 2GP provisions to ensure that they function as intended; substantive amendments to fix identified problems or gaps within a small number of provisions; and mapping amendments to make minor adjustments to zone or mapped area~~

~~boundaries where boundaries are in the wrong place. Provisions potentially relevant to the proposal currently do not have any legal effect.~~

Variation 2 to the 2GP was notified on the 3d of February 2021 and include a suite of changes to enable additional housing capacity, including rezoning of specific sites. The provisions of Variation 2 are not relevant to the proposal.

The relevant 2GP zones and layers in summary include:

- The site and surrounding area are zoned Rural Coastal under the 2GP.
- The site is designated for use for *'proposed landfilling and associated refuse processing operations and activities'* (reference D659). The landfill site and surrounding area is also covered by a Dunedin International Airport Ltd designation for the airports obstacle limitation surfaces to prevent the encroachment of obstructions into airspace that may affect aircraft operations (reference D274).
- SH1 is designated by the New Zealand Transport Agency for *'state highway purposes'* (reference D463).
- Sections of the upgrades to McLaren Gully Road fall within the Archaeological Alert Layer, and are adjacent to, but outside, an Area of Significant Biodiversity Value (ASBV) covering the McLaren's Gully Covenant, described as an *'area of native bush gullies, podocarps including totara and kahikatea'* (reference C075).[24]

The resource consents that are being applied for the proposed upgrade of McLaren Gully Road (including its intersection with State Highway 1) and Big Stone Road~~, and the creation or enhancement of wetlands outside of the designation~~ under the 2GP and Operative District Plan (to the extent it remains relevant) are outlined in **Table 9** below.

Components of the project that are a permitted activity, and do not require resource consent are also identified. Provisions of the 2GP that remain subject to appeal and are not effectively operative are shown shaded. Where that is the case, the equivalent rule of the Operative District Plan has been considered.

Table 9 – Resource Consents Required from Dunedin City Council

Activity	Relevant Plan Rules	Commentary
Proposed Dunedin City District Plan (2GP)		
Upgrade of McLaren Gully Road, Big Stone Road, and the SH1 intersection within the existing road reserve.	Rule 6.3.2.1 – Operation, repair, and maintenance of the roading network within existing formed road corridor or legal road – permitted activity.	The upgrade of roads within the existing road reserve is a permitted activity.
	Rule 16.3.4.6 – Fences – permitted activity.	Fences are a permitted activity.
	Rule 4.3.2 – Construction – permitted activity.	Construction activity is a permitted activity.

[24] Clearance of indigenous vegetation within the McLaren Gully ASBV will however be avoided, and therefore rule 16.3.4.24 will not be triggered by the application.

Activity	Relevant Plan Rules	Commentary
		All rule performance standards will be met, specifically: (a) Construction noise will not exceed the limits specified in rule 4.5.4.1.
Upgrade of McLaren Gully Road, Big Stone Road, and SH1 outside the existing road reserve.	Rule 6.3.2.2 – New roads or additions or alterations to existing roads outside of existing road reserve – discretionary activity.	The upgrade of roads outside the road reserve is a discretionary activity.
	Rule 16.3.4.6 – Fences – permitted activity.	Fences are a permitted activity.
	Rule 4.3.2 – Construction – permitted activity.	Construction activity is a permitted activity. All rule performance standards will be met, specifically: (a) Construction noise will not exceed the limits specified in rule 4.5.4.1.
~~Creation or enhancement of wetlands outside of the designated site.~~	~~Rule 16.3.3 – Conservation – permitted activity~~	~~Conservation (which includes the establishment, maintenance, or enhancement of indigenous vegetation and/or habitat for indigenous flora) is a permitted activity.~~
	~~Rule 16.3.4.6 – Fences – permitted activity.~~	~~Fences are a permitted activity.~~
Indigenous and other vegetation clearance associated with the upgrade of McLaren Gully Road, Big Stone Road, and the SH1 intersection. ~~Vegetation clearance associated with the creation or enhancement of wetlands outside of the designated site.~~	Rule 16.3.4.24 - Indigenous vegetation clearance – large scale – restricted discretionary activity.	13.8 m^2 or 0.0014 ha of (Pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland and 2.7m^2 [Pūrei] – wīwī / rautahi – exotic grass rushland will be cleared adjacent to McLaren Gully Road. Indigenous vegetation clearance does not meet the performance standards for small scale indigenous vegetation clearance and is therefore a restricted discretionary activity. Specifically, the following rule performance standards will not be met: ~~(a) Indigenous vegetation clearance will exceed more than 500 m2 as specified in rule 10.3.2.1 for the following indigenous vegetation types identified in the Ecological Impact Assessment:~~ ~~• (Pūrei - rautahi – Yorkshire fog) – cocksfoot / watercress – floating sweetgrass grassland = 0.35 ha~~ ~~• (pūrei) – wiwi / cocksfoot rushland = 0.19 ha~~

Activity	Relevant Plan Rules	Commentary
		~~(b)~~(a) Vegetation clearance will occur within 5 m of a waterbody as specified in rule 10.3.2.2. ~~(c)~~(b) Indigenous vegetation clearance will occur in areas where threatened fauna species listed in Appendix 10A.2 may be present, specifically the southern grass skink.
	Rule 16.3.4.25 – All other vegetation clearance – permitted activity.	Small scale vegetation clearance is a permitted activity.
Earthworks associated with the upgrade of McLaren Gully Road, Big Stone Road, and the State Highway 1 intersection. ~~Earthworks associated with the creation or enhancement of wetlands outside of the designated site.~~	Rule 8A.3.2 – Earthworks – Large Scale – restricted discretionary activity.	Earthworks do not meet the performance standards for small scale earthworks and is therefore a restricted discretionary activity. Specifically, the following rule performance standards are not met: (a) Earthworks will exceed the maximum 2 m change in finished ground level for the rural zone, and maximum 0.5 m within 20 m of a water body as specified in rule 8A.5.1.3. (b) Earthworks will exceed the maximum 25 m^2 area within 20 m of a waterbody as specified in rule 8A.5.1.4. (c) Earthworks will exceed the maximum volume of combined cut and fill in the rural zone, and within 20 m of a water body, as specified in rule 8A.5.1.5. (d) Earthworks will not be setback from property boundaries as specified in rule 8A.5.4. (e) Earthworks will not be setback 5 m from any water body as specified in rule 10.3.3.
Operative Dunedin City District Plan		
~~Upgrade of McLaren Gully Road, Big Stone Road, and the SH1 intersection.~~	~~Rule 20.5.1 – Maintenance of existing roads, including realignment within legal road reserve and existing formed road corridors that are not within the legal road – permitted activity~~	~~Upgrading roads within and outside the road reserve is a permitted activity.~~
Indigenous vegetation clearance and earthworks associated with McLaren Gully Road, Big Stone Road, and the SH1 intersection.	Rule 16.6.2 – Indigenous Vegetation and earthworks – discretionary activity	13.8 m^2 or 0.0014 ha of (Pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland and 2.7m^2 [Pūrei] – wīwī / rautahi – exotic grass rushland will be cleared adjacent to McLaren Gully Road. Clearance or modification of indigenous vegetation, and earthworks over 1 m^3 in volume ~~or 25 m^2 in area~~ will occur in

Activity	Relevant Plan Rules	Commentary
~~Vegetation clearance and earthworks associated with the creation or enhancement of wetlands outside of the designated site.~~		wetlands and areas of indigenous vegetation and is therefore a discretionary activity.
	Rule 17.7.5(i) – Earthworks – restricted discretionary activity	Earthworks do not meet the performance standards for earthworks and is therefore a restricted discretionary activity. Specifically, the following rule performance standards are not met: (a) Earthworks will not be setback from property boundaries, as specified in rule 17.7.3(i). (b) Earthworks will exceed the maximum scale thresholds for the rural zone, as specified in rule 17.7.3(ii) and 7.7.4(iii). (c) Earthworks will not be setback 20 m from water, as specified in rule 17.7.3(iii).

Based on the above assessment, the various activities are to be bundled, and considered as a **discretionary activity** under the District Plans.

An **unlimited** consent duration is sought for the resource consents, pursuant to section 123(b) of the RMA.

A **10 year** lapse date is proposed for the resource consents, pursuant to section 125(a) of the RMA.

7.4 Permitted Baseline

The RMA provides that when determining the extent of the adverse effects of an activity or the effects on a person respectively, a council may disregard an adverse effect if a rule or national environmental standard permits an activity with that effect.[25] This is known as the permitted baseline.

An assessment of the project against the rules of the relevant National Environmental Standards, and Regional and District Plans is included in **section 7.0**. From that the following is noted:

- The discharge of stormwater from the upgraded roads outside of the site into water or onto land where it may enter water is a permitted activity under rule 12.B.1.9 of the Otago Regional Plan: Water.
- The discharge of dust to air during construction of the road upgrades outside of the site is a permitted activity under rule 16.3.14.1 of the Otago Regional Plan: Air.
- Drilling of land for the groundwater monitoring bores, and landfill gas monitoring and collection system is a permitted activity under rule 14.2.1.1 of the Otago Regional Plan: Water.

[25] Sections 95D, 95E and 104(1)(a) of the RMA

- The road upgrades that fall within the existing formed road corridor or legal road are a permitted activity under Rule 6.3.2.1 of the 2GP. Construction activity, including associated noise from all of the road upgrades is also a permitted activity under Rule 4.3.2 of the 2GP.

In addition to the above, it is noted that farming and forestry activities occurring on the site and surrounding area are able to occur as of right as permitted activities under the 2GP, and this includes the associated heavy vehicle movements on roads associated with logging trucks.

These activities all form part of the permitted baseline, for which the effects may be disregarded.

7.5 Other Approvals Required

Aside from the requirement to submit an outline plan of works for that part of the landfill that falls within the designation, a number of other approvals will be required to be obtained prior to construction works commencing. These include the following:

- Any obstruction (landform, buildings) within the designated airport obstacle limitation surfaces, requires approval from Dunedin Airport Ltd under section 176(1)(b) of the Resource Management Act 1991. In addition, the Director of the Civil Aviation Authority must be notified under CAA rule Part 77 for a determination as to whether the obstruction constitutes an aeronautical hazard.
- Works required to upgrade the SH1 / McLaren Gully Road intersection requires approval from Waka Kotahi New Zealand Transport Agency (NZTA) under section 176(1)(b) of the Resource Management Act 1991, and sections 51 and 52 of the Government Roading Powers Act 1989.
- Works resulting in the destruction or modification of any archaeological site, requires an authority from Heritage New Zealand under the Heritage New Zealand Pouhere Taonga Act 2014.
- Works disturbing or requiring the catching and release of protected wildlife, requires an authority from the Department of Conservation (DOC) under the Wildlife Act 1953.

Dunedin City Council will obtain all required approvals prior to any construction work commencing on the site.

8.0 Assessment of Environmental Effects

8.1 Assessment Overview

In accordance with Section 104(1)(a) of the RMA, the following sections summarise and assesses the actual and potential effects of the applications for resource consent on the environment, in respect of the updated design. These effects relate to the physical and natural elements that determine these environments, as well as the social, cultural and economic environment associated with the area. The assessment has been informed by the assessments made in each of the technical reports which are contained in the Appendices to this AEE and has had regard to any relevant assessment matters contained in the regional and district plans.

The focus of the assessment is on the actual and potential effects that fall within the scope of the resource consents that have been applied for. Because there is a designation for the landfill, the landfill itself does not require resource consent. Effects which relate to the land use of the designated landfill site will be more specifically assessed through the outline plan of works process following the completion of detailed design. However, they are also discussed in this AEE in order to inform the community and decision makers as to how such effects will be managed.

Table 10 below specifies which effects fall within the scope of the resource consents that have been applied for, and those which will be more specifically considered through the outline plan of works (OPW) application under s176A of the RMA.

Table 10 – Relationship of Effects to the Consents Applied For (Updated May 2021)

Effects	Related Resource Consents Applied For	Relevant to Outline Plan	AEE Section
Positive effects for social and economic wellbeing from the disposal of waste.	All ORC consents. All DCC consents.	No.	8.2
Effects of seismic activity, soil instability, and groundwater seepage on land stability.	ORC consents to discharge waste/hazardous waste, and leachate to land; and place and, use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade.	Yes.	8.3
Effects of the discharge of waste contaminants to land on the receiving environment and human health and safety.	ORC consent to discharge waste/hazardous waste, and leachate to land.	No.	8.4
Effects on groundwater and surface water flows and levels within the site and the downstream receiving environment.	ORC consents to take, use divert, dam water; and place and use structures within, and alter the beds of wetlands/rivers.	No.	8.5

Effects	Related Resource Consents Applied For	Relevant to Outline Plan	AEE Section
Effects on groundwater and surface water quality within the site and downstream receiving environment.	ORC consents to discharge waste/hazardous waste, and leachate to land; and discharge stormwater and contaminants to land and water; and place and use structures within and alter the beds of wetlands/rivers.	No.	8.6
Effects on air quality.	ORC consents to discharge contaminants to air.	No.	8.7
Effects on terrestrial vegetation communities, avifauna, and herpetofauna.	ORC consents to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade ~~and wetland creation/enhancement~~ outside the designation.	Yes.	8.8
Effects on freshwater ecology.	ORC consents to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade.	No.	8.8
Effects on the natural character of wetlands, rivers, and their margins.	ORC consents to take, use dam, divert water; and discharge stormwater and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade ~~and wetland creation/enhancement~~ outside the designation.	Yes.	8.9

Effects	Related Resource Consents Applied For	Relevant to Outline Plan	AEE Section
Effects on landscape character.	ORC consents to take, use, dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade ~~and wetland creation/enhancement~~ outside the designation.	Yes.	8.9
Effects on visual amenity.	ORC consents to take, use, dam, divert water; and discharge stormwater and contaminants to land and water, and place and use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade ~~and wetland creation/enhancement~~ outside the designation.	Yes.	8.9
Effects on archaeology.	ORC consents to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. DCC consents for road upgrade ~~and wetland creation/enhancement~~.	Yes.	8.10
Effects on cultural values.	ORC consents to discharge waste/hazardous waste, and leachate to land; take, use, dam, divert water; discharge stormwater and contaminants to land and water; place and use structures within, and alter the beds of wetlands/rivers; and discharge contaminants to air. DCC consents for road upgrade ~~and wetland creation/enhancement~~ outside the designation.	Yes.	8.11

Effects	Related Resource Consents Applied For	Relevant to Outline Plan	AEE Section
Effects on the road network.	DCC consents for road upgrade.	Yes.	8.12
Effects on aircraft safety from birds attracted to the landfill operation.	ORC consents to discharge waste/hazardous waste, and leachate to land.	Yes.	8.12
Effects of noise on sensitive receptors from landfill/road construction and operation.	DCC consents for road upgrade.	Yes.	8.13
General community effects, including pests, litter, fire risk.	ORC consents to discharge waste/hazardous waste, and leachate to land.	Yes.	8.14

A key component of this assessment, are the monitoring and management measures proposed to be included in conditions of consent and the LMP to avoid, remedy, and mitigate any adverse effects. Proposed conditions and draft LMP objectives are outlined in the following sections and attached as **Appendix 17**. They are expected to be the subject of ongoing discussion with ORC and DCC, and refined, during the processing of the applications.

8.2 Social and Economic Effects

The construction and operation of the landfill will generate social and economic benefits for Dunedin City. These effects are a relevant consideration to all applications for resource consent to ORC and DCC.

Particular benefits of the landfill include:

- Provision for ongoing disposal of municipal solid waste in Dunedin City and resultant public health benefits, recognising the limited functional life of the Green Island landfill, and need for a new facility to meet waste disposal demands.
- Avoids the alternative of having to secure the export waste to suitable facilities outside Dunedin, and the associated economic and employment costs.
- Provision of a new facility designed, constructed, and operated in accordance with contemporary best practice, resulting in improved environmental management and outcomes in comparison to historical waste disposal at Green Island.
- Provision of roading upgrades which will benefit other road users by providing safe and efficient access along McLaren Gully Road and Big Stone Road, including for commercial forestry harvesting activity.
- A proposed upgrade to the intersection of State Highway 1 and McLaren Gully Road. This will be done when work commences on the landfill even though the intersection will not fall below an acceptable level of service until 2040. This means road users will benefit

from an enhanced intersection and there are secondary benefits associated with intersection efficiency and capacity.

The Economic Assessment Report prepared by Market Economics (M.E) and contained in **Appendix 7** has assessed the potential economic implications of the proposed landfill. The assessment has been informed by the projected employment and economic projections for the Dunedin economy determined from a macro-economic projection model; the Economic Futures Model (EFM). The EFM has projected economic activity in Dunedin for the next 30 years to 2048, summarised in **Figure 11** below. The identified growth will not occur at these rates unless Dunedin has a robust waste management system in place.

Figure 11 – Dunedin City Economic Projection, Medium and High Scenario EFM (2018 – 2043)

EFM Projections	2018	2023	2028	2033	2038	2043	2048	2018-2028		2018-2043	
								n	%	n	%
Employment (MECs)											
Medium	82,960	85,370	87,190	88,610	89,490	89,790	90,870	4,230	5.1%	7,910	9.5%
High	83,300	86,630	89,390	91,820	93,670	95,030	97,090	6,090	7.3%	13,790	16.6%
Gross Output ($2016m)											
Medium	10,080	10,790	11,430	12,030	12,580	13,080	13,510	1,350	13.4%	3,430	34.0%
High	10,120	10,930	11,690	12,420	13,090	13,740	14,300	1,570	15.5%	4,180	41.3%
Value Added ($2016m)											
Medium	5,140	5,460	5,740	6,000	6,230	6,440	6,620	600	11.7%	1,480	28.8%
High	5,160	5,540	5,880	6,220	6,520	6,810	7,060	720	14.0%	1,900	36.8%

The economic costs and benefits of the Smooth Hill outlined in the Economic Assessment are summarised in **Table 11** below. An out-of-district disposal option incurs significantly more costs than benefits resulting from increased transport costs and higher CO_2 emissions, as well as an ongoing financial cost to DCC.

Table 11 – Economic Costs and Benefits

Costs	Benefits
Establishment requires substantial investment, in the order of $~~$210.4~~162.7m in capital costs, and $~~$293.5~~120.8m in operational costs over the 35-year consented term out to 2055, noting that the facility will have a physical lifespan beyond 2055~~ over the 57-year life of the project~~. The landfill reflects an optimal design and this in turn will be reflected in the costs of construction. The landfill is located approximately 30 minutes from the city and requires a network of transfer stations. When the future waste and diverted materials system is delivered, there is a risk that landfill revenue will not be maintained which poses flow on effects for DCC.	Investment is expected to address the waste disposal issue in Dunedin and could provide waste disposal for at least 50 years, or longer if waste diversion targets are achieved. The site is already designated for a landfill in the 2GP, and therefore there is no immediate opportunity cost to using the land for waste disposal. Retaining or potentially increasing employment through jobs and supporting waste systems infrastructure that will also be required. The costs associated with transportation of waste will be reduced by having a reasonably accessible in-district waste disposal site. An in-district waste disposal facility will reduce CO_2 emissions from the reduction in distance of transport of trips.

Increased truck volumes on roads requires investment to upgrade roads surrounding the landfill (as proposed).	Developing a new landfill will retain competition for waste disposal facilities in Dunedin. There are benefits associated with avoided costs. The alternative is potentially trucking Dunedin's waste to a land fill in Southland. This has a range of costs associated with transporting waste over 190km (cost and environmental emissions) that are not offset by any of the economic and other benefits from developing infrastructure and employment opportunities locally.

An Input - Output model framework has been used to determine the economic effects the development of the landfill will have on Dunedin. Input – Output models are transactional frameworks of the local regional and national economies, that capture the financial interactions between sectors, households and the government. They reflect the technology of an economy at a point in time and while this changes, they can be used to provide an understanding of how different levels and distributions of investment flow through an economy generating:

- Additional Gross Output – the total value of goods and services produced.
- Additional Value Added (broadly GDP) – the additional value added to goods and services by the contributions of capital and labour.
- Additional Employment measured in full time equivalent jobs.

The economic analysis indicates the consenting, construction, and operation of Smooth Hill will facilitate the following employment and GDP effects over the 25-year consented term out to 2055, noting the facility will have a physical lifespan past 2055 ~~over 57 years~~:

- $~~91.5~~77.1m in total gross output in net present value (NPV) terms in Dunedin City, out to 2055~~over the 57-year life of the project~~.
- $~~28.3~~22.9m in total value add in net present value (NPV) in Dunedin City, out to 2055~~over the 57-year life of the project~~.
- ~~2745~~813 full time job equivalents in Dunedin City, ~~over the 57-year life of the project,~~out to 2055 of which ~~840~~616 occur within the first 10 years. This is dominated by employment in the construction sector in the first 2 years, peaking at ~~240~~189 full year equivalents ~~in year~~during stage 2 of construction.

These outcomes are sensitive to changes in assumptions made about scale, timing, levels of investment, and ownership. For example, by partnering with a private provider to share construction costs and operational activities is likely to increase the benefits locally, because capital costs do not need to be sourced from the local economy. Partnering with a suitably qualified private sector partner in a 50:50 joint venture has the potential to increase total value add to $~~44~~48.9m NPV out to 2055.

Overall the construction and operation of a landfill at Smooth Hill will facilitate significant positive social benefits, and generate employment and economic effects ~~over the 57-year life of the project~~out to the year 2055.

8.3 Land Stability Effects

The construction and operation of the landfill and road upgrades will involve significant earthworks, engineered cut and fill slopes, and waste disposal to land, which has the potential to be impacted by seismic activity, soil instability, and groundwater seepages. Such effects are relevant to the consideration of the applications to ORC to discharge waste/hazardous waste, and leachate to land; place and use structures within and alter the beds of wetlands/rivers; and the applications to DCC for the road upgrades.

Potential land stability effects include:

- Active geological faults and resulting seismic risk to the landfill.
- Any localised subsidence, landslide prone areas, and soil conditions that may result in differential settlement, affecting the stability of the landfill.
- Groundwater seepages and resulting uplift pressures affecting the landfill lining system.
- The stability of engineered cut and fill slopes for the landfill and road upgrades, and waste placement.

The Geotechnical Interpretative Report contained in **Appendix 5** and Landfill Concept Design Report in **Appendix 3** have addressed the effects of the concept design for land stability taking into account the ground conditions and geology described in the Geotechnical Factual Report contained in **Appendix 6**.

The potential stability and seismic risks, and their effects considered in the Geotechnical Interpretative Report and Landfill Concept Design Report are summarised in **Table 12** below.

Table 12 – Assessment of Landfill Stability (Updated May 2021)

Potential stability/seismic risk	Assessment of Effects
There are ~~a number of~~several mapped fault lines within 100 km of the site which present potential seismic risk to the landfill during operation and aftercare. Earthquakes have the potential to affect the stability of the landfill face and toe embankment, result in the lateral displacement of waste, strain or rupture the landfill liner, tear the landfill cap, and cause landslips around the site.	The majority of the existing faults are not considered geologically active, as defined by GNS Science, as they have a recurrence interval >2000 years. The closest geologically active fault to the landfill site, is the Alpine Fault, which is located 240 km to the northwest, which is also classified as 'Major Fault' by NZS 1170.5:2004 Structural Design Actions – Part 5 Earthquake Design Actions. ~~Whilst landfills are not specifically referenced in NZS 1170.5 2004, the landfill has been assumed to have an Importance Level of 2 (IL2 - normal structures and structures not in other importance levels). For a design working life of 50 or 100 years, IL2 structures are required to be designed to resist earthquake loadings with return periods of 500 and 1000 years respectively.~~Whilst landfills are not specifically referenced in NZS 1170.5 2004, on the basis of leachate being classed as a hazardous substance, the landfill has been designed based on an Importance Level of 3 (containing hazardous materials capable of causing hazardous conditions that do not extend beyond the property boundaries). For a design working life of

Potential stability/seismic risk	Assessment of Effects
	50 or 100 years, IL3 structures are required to be designed to resist earthquake loadings with return periods of 1000 and 2500 years respectively For slope stability assessment under seismic load, the New Zealand Transport Agency Bridge Manual (NZBM) provides a method for determining a design ground acceleration, however, NZBM does not use design life and defines annual probability of exceedance (Table 2.3). This table returns a design return period of 1/1000 years. Seismic coefficients for preliminary geotechnical design for slope stability have been calculated using NZBM. Using this methodology, the peak ground accelerations (PGA) derived for the site are 0.31 g for damage control limit state (DCLS) (equivalent to ultimate limit state (ULS)) and 0.08 g for service limit state (SLS) (¼ DCLS). At detailed design stage, a site specific probabilistic seismic hazard assessment ~~will~~ could be completed if seismic shaking is deemed a risk that cannot be mitigated through liner design and leachate management practices. Recent papers by GNS on the Titri Fault and by Taylor-Silva on the Akatore Fault are consistent with the recurrence interval data already considered. [26] On this basis a SSSHA is not considered to be required for the site. ~~to ensure the landfill design appropriately addresses seismic risk consistent with NZS 1170.5 2004~~.
Shallow soil instability features exist around the site, typically in the form of shallow ground movement in the loess cover or weathered rock mass, which have the potential to affect the stability of the landfill.	The depth of instability is typically less than 1 or 2 m and is likely to be a result of mobilisation following saturation during periods of high rainfall. No obvious evidence of deeper-seated ground movement has been observed. Given the shallow and discrete nature of most of these features, they are likely to have little to no effect on development. Where they occur within or adjacent to the landfill footprint or could affect the operation of the landfill, they will be fully excavated and removed as part of development earthworks. Where they occur around the slopes of the facilities areas, geotechnical risk will be mitigated through either stabilisation or removal of unstable materials.
Topsoil, some of the loess, alluvium in the base of gullies, unstable materials, and fill have the potential to be compressible under load, due to their typically weak / loose and variable	Potentially compressible soils will be removed from the landfill footprint and from beneath any areas on which engineered fill is to be placed, including the landfill toe embankment. Removal of this material will ensure there will be low risk of settlement due to soil compression.

[26] Investigation of past earthquakes on the Titri Fault, coastal Otago, New Zealand, DJ Barrel et al ,GNS Science Report 2017/35 October 2020.

Paleoseismology of the Akatore Fault, East Otago, B Taylor-Silva April 2017, Masters Thesis University of Otago

Potential stability/seismic risk	Assessment of Effects
nature. This has the potential to result in settlement affecting the stability of the landfill.	
Alluvium in the base of gullies comprising saturated soft/loose sand, silt and gravel have the potential to liquefy during an earthquake, affecting the stability of the landfill.	~~All of the alluvium will be removed from the landfill footprint.~~There are no areas of alluvium under the footprint of the landfill, and therefore ~~Removal of this material will ensure~~ liquefaction will not be a hazard to the landfill or access.
Groundwater seepage exists in a number of locations around the site predominantly coming from areas of colluvium or alluvium near the base of gullies. Springs/ seepages remaining beneath the lining system could result in uplift pressures and have the potential to cause a local failure of the lining system.	~~For much of the landfill site, groundwater within the underlying breccia is many metres below the base of the landfill. Seepage is however anticipated towards the landfill toe, and at the junction of the landfill base and the sidewalls.~~It is possible that groundwater seepages will be exposed when excavation to base grade levels has been completed. However, as the toe of the landfill is uphill from the base of the gullies at the northern end of the site, any groundwater intercepts may be limited. Groundwater beneath the landfill will be managed by the placement of drainage material and a groundwater collection system beneath the landfill liner to direct groundwater to the base of the landfill. The groundwater drainage will be designed to withstand the design loads and will consist of perforated polyethylene pipework encased in open graded aggregates, and the entire drain encased in filter fabric. The drainage pipework will have filters applied to prevent soil particle loss to the drainage. The drainage pipework that extends under the landfill toe embankment will not be perforated and will have anchor blocks to prevent longitudinal flow of water through the bedding. While significant amounts are not anticipated, any observed seepage in the side batters to the landfill will have secondary drainage pipework extending from the main groundwater drainage to the point of seepage. Collected groundwater will be pumped and report to an access manhole, and then discharge to the ~~landfill attenuation basin~~downstream watercourse or used for non-potable water supply for the landfill facilities. With these management measures, the risk of groundwater seepages for landfill stability will be low.

Potential stability/seismic risk	Assessment of Effects
Construction of the landfill will involve construction of engineered cut and fill slopes to form the landfill base grade, and toe and perimeter embankments. Engineered cut and fill slopes will also be constructed as part of the road upgrades. During landfill operation, waste will be placed on the landfill liner and against the toe embankment. Inappropriate form and design of the cut and fill slopes, toe embankment, and placement of waste has the potential to affect the long term stability of the landfill.	Slope stability analysis has been undertaken for the concept design engineered cut and fill slopes forming the landfill basin. ~~Slope stability was analysed on critical cross sections using Slope/W limit equilibrium software. The analysis captured the following structures:~~ ~~Formation benches composed of engineered fill (site won material) and/or in-situ rock cuts.~~ ~~Stability of upslope perimeter embankment comprising engineered fill.~~ ~~Stability of downslope toe embankment compromised of engineered fill (at end of landfill life).~~ All temporary landfill slopes are proposed to be cut at 1V:3H which generally matches the existing slopes on site and will be cut into favourably dipping rock. As such, it is considered unlikely any slope instability would occur. Further targeted assessments will be completed during detailed design. Slope stability of critical cross sections of the permanent landfill slopes, including the toe bund, with full waste placement has been analysed using Slope/W limit equilibrium software. ~~The c~~Cross sections of the permanent slopes were analysed against the following stability scenarios: • Static Stability – Target Factor of Safety 1.5. • Seismic Ultimate Limit State (ULS earthquake loading) – Target Factor of Safety 1.0. • Seismic Serviceability Limit State (SLS earthquake loading) – Target Factor of Safety 1.0. Three different potential failure slips were analysed for the static, SLS and ULS cases which were: • Local toe bund stability • Global toe bund stability • Waste stability The results of the overall analysis of the stability of the permanent landfill slopes, including the toe bund, with full waste placement are set out below: **Condition** / **Required Factor of Safety** / **Minimum Calculated Factor of Safety**

Potential stability/seismic risk	Assessment of Effects

Static Stability (permanent)	1.5	2.~~0~~7
~~Short Term Static Stability (elevated water levels in landfill)~~	~~1.3~~	~~1.7~~
Seismic Serviceability Limit State	1.0	1.~~6~~9
Seismic Ultimate Limit State	1.0	1.0

All results meet or exceed the required factor of safety and indicate appropriate ~~slope~~ stability ~~for the proposed landfill engineered cut and fill slopes~~of the permanent landfill slopes, including the toe bund, ~~. The results also indicate adequate stability for the landfill~~ with full waste placement.

Waste will be placed against the toe embankment at a stable slope. While the specification of placement techniques ~~Placement of waste in the landfill~~ to ensure waste stability during filling will be addressed during detailed design, the proposed filling sequence is a widely used methodology and provides a level of inherent stability for the waste as prior stages and sub stages provide buttress support to subsequent stages. During detailed design, c~~C~~onsideration will also be given to the interface friction angle at the base of the landfill between the waste and liner to protect against ~~a~~ base slide failures or ~~a~~ potential circular slip failures through the base. Engineered protections against these risks will be addressed in the final liner system design for the site. ~~This will partly depend on the final liner system selected for the site.~~

The upgrades to McLaren Gully Road and Big Stone Road will involve cut slopes of up to typically 4m high, but 5 – 7m in two locations. ~~up to 4 m high, and f~~Fill embankments up to ~~6~~ 7.5 m high are proposed. Cut face slopes will rise at a slope of 1V:0.2H, while fill embankments will slope at 1V:2H. ~~The cut face slopes will be a gradient of 1H:4V, and fill embankment slopes will be 30 degrees~~ based on the known geotechnical conditions. No existing utilities along the road margins will be affected by the road updates. The design of cut and fill slopes will be further addressed through the detailed design to ensure that they are stable. The detailed design of the road upgrades will be informed by geotechnical investigations and be in accordance with the DCC *Code of Subdivision and Development* 2010.

Overall, the geotechnical aspects of the site have been adequately understood and conceptualised, and the site is considered to be suitable location for a landfill in regard to land stability. The proposed landfill and road upgrades will ensure land stability risks are low, subject to ensuring detailed design appropriately addresses seismic risks, the placement of waste to ensure waste stability, and the stability of temporary and permanent cut and fill slopes for the landfill and road upgrades.

Based on the above assessment, measures are proposed to be adopted within the conditions and LMP objectives for the ORC consent to discharge waste/hazardous waste, and leachate to land; and place and use structures within and alter the beds of wetlands/rivers, to avoid, remedy and mitigate any adverse land stability effects. Conditions are also proposed to be incorporated within the DCC conditions of consent for the road upgrade.

The proposed conditions and draft LMP objectives are included in **Appendix 17** and for the purposes of land stability require:

- Supervision of design and certification of completed works by a suitably experienced registered engineer.
- ~~Undertaking a site specific probabilistic seismic hazard assessment as part of detailed design to ensure seismic risk is addressed.~~
- The detailed design ensures engineered cut and fill slopes and the stability of the landfill achieves calculated minimum Factors of Safety (FOS), achieves waste stability, and protects against a base slide failure or a potential circular slip failure through the base.
- The detailed design of road cut and fill slopes is to be informed by geotechnical investigations and be in accordance with appropriate roading design standards
- Ensuring the final LMP addresses: seismic risks, slope failure, landfill stability, and extreme events.

Overall, with these measures, the adverse effects of the project on land stability will be appropriately managed and no more than minor on the environment, and on any persons.

8.4 Waste Contaminant Effects

The disposal of waste will result in the discharge of contaminants to land that has the potential to affect the wider receiving environment and human health and safety. Such effects are relevant to the consideration of the application to ORC to discharge waste/hazardous waste, and leachate to land.

8.4.1 Waste Acceptance Criteria

An important consideration for a new landfill is ensuring the nature of wastes accepted for disposal are compatible with the level of engineered containment and controls in respect to leachate, landfill gas, runoff, or direct exposure to waste material. As described in **section 5.0**, the proposed landfill has been designed a class 1 landfill with appropriate levels of containment and controls consistent with the WasteMINZ guidelines. The specific measures to contain and manage leachate, landfill gas, and surface water are further described in **sections 8.5 – 8.7** below.

The WasteMINZ guidelines specify waste acceptance criteria intended to provide confidence that the materials disposed of to a class 1 landfill will not result in unacceptable adverse effects on human health or the receiving environment. Wastes that do not comply with the waste acceptance criteria are considered not suitable for disposal.

Consistent with the WasteMINZ guidelines for a class 1 landfill, the proposed landfill will accept:

- **Municipal solid waste** (MSW).
- **Potentially hazardous wastes** that meets the leachability limits in the Ministry for the Environment Module 2: Hazardous Waste Guidelines (2004) - Class A Landfills.

Municipal solid waste is defined in the WasteMINZ guidelines as:

> *Any non-hazardous, solid waste from household, commercial and/or industrial sources. It includes putrescible waste, garden waste, biosolids, and clinical and related waste sterilised to a standard acceptable to the Ministry of Health. All municipal solid waste should have an angle of repose of greater than five degrees (5^{O}) and have no free liquid component.*
>
> *It is recognised that municipal solid waste is likely to contain a small proportion of hazardous waste from households and small commercial premises that standard waste screening procedures will not detect. However, this quantity should not generally exceed 200 ml/tonne or 200 g/tonne.*

For **potentially hazardous wastes**, the Ministry for the Environment *Module 2: Hazardous Waste Guidelines (2004) - Class A*, sets out leachability criteria 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 leachate concentrations specified in Appendix A of the guidelines.

Appendix A of the guidelines first provides 'screening criteria'. Where the concentration of the contaminant in the waste is below the screening level, there is no need to test against the leachability criteria. Where the concentration of the contaminant in the waste exceeds the screening level, the US EPA Toxicity Characteristic Leaching Procedure (TCLP) test is used to confirm whether it meets the leachability criteria, and therefore whether it is acceptable for disposal. For wastes with well-defined characteristics, testing may not be required for every load. If the waste is shown by testing to be unacceptable, some form of treatment or immobilisation may be possible to reduce the leachable concentrations to acceptable levels for disposal.

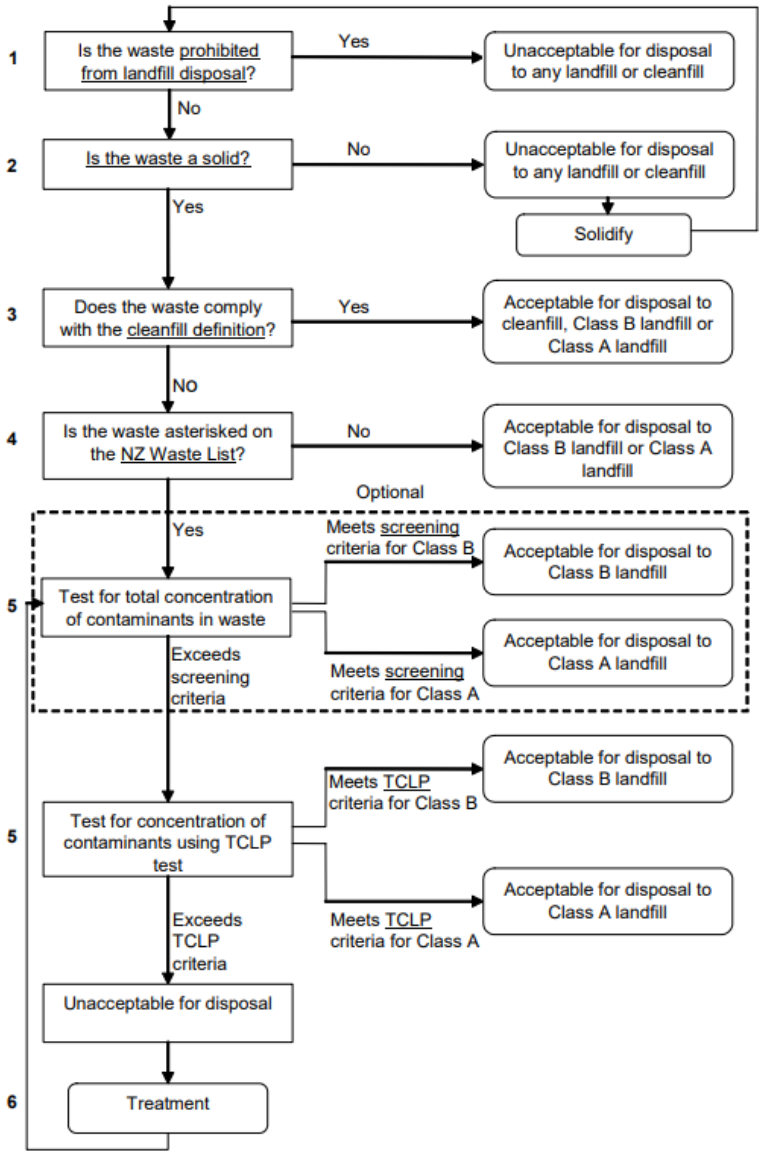
The guidelines also specifically enable the disposal of waste containing asbestos, if it is labelled, packaged, and disposed of in accordance with the requirements laid out in the Asbestos Regulations 1998. They also allow disposal of small quantities of waste products containing potentially hazardous components that are not likely to have adverse effects on the environment and can be reasonably expected to be contained in the municipal waste stream.

The waste acceptance decision process outlined in the Module 2: Hazardous Waste Guidelines is set out in **Figure 12** below. The reference to class A landfill in the diagram is corresponds with a class 1 landfill.

The proposed landfill will not accept wastes that do not meet the Module 2: Hazardous Waste Guidelines - Class A leachability criteria. Consistent with those guidelines, the landfill will also not accept the following wastes:

- Liquid wastes, with the exception of landfill leachate. For wastes to be considered non-liquid they are to have a solid content of at least 20% and liberate no free liquids when transported or have no free liquids when tested in accordance with the US EPA Point Filler Liquids Test[27], and liberate no free liquids when transported.
- Wastes or substances classified as explosive, flammable, oxidising or corrosive under the Hazardous Substances and New Organisms Act 1996.

Figure 12 – Ministry for the Environment Module 2: Hazardous Waste Guidelines – Waste Acceptance Decision Process.



[27] US Environmental Protection Agency Method 9095A 1996.

8.4.2 Waste Acceptance Procedures

Before waste can be accepted at the landfill, the operator will confirm that the waste meets the class 1 waste acceptance criteria outlined above. Implementation of procedures will occur to detect and deter the inappropriate disposal of material, and ensure unacceptable wastes are easily identified, segregated, and rejected.

The WasteMINZ guidelines recommended a tiered approach be implemented, covering the following:

1. Completion of a formal **waste disposal application** by the disposer to deposit waste prior to becoming a user of a landfill, or in the case of regular deliveries, before there is a change to the nature or mass of the waste being disposed of at a landfill. The disclosure of the nature of the waste allows the operator to evaluate if the waste meets the waste acceptance criteria and require the disposer to perform any additional tests needed to characterise the waste.
2. 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. For a class 1 landfill accepting municipal solid waste, sampling is required for all potentially hazardous materials against the leachability criteria.
3. The operator **evaluating waste disposal applications** 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.
4. Confirmation of a **waste acceptance agreement** between the operator and disposer of waste. The agreement contains details of sanctions available to the operator should the disposer breach the terms of the agreement to accept waste. It also sets out the rights of the landfill operator to inspect, challenge, sample, test and, if necessary, reject waste brought to the landfill for disposal.
5. **Notification of alternative facilities** for the storage or disposal of waste where a waste disposal application is refused.

Once a waste acceptance agreement is in place, operators are recommended to undertake verification and monitoring of incoming wastes. Procedures are recommended for:

1. 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. For a class 1 landfill accepting municipal solid waste, load inspections are recommended for 1 in every 50 loads.
2. **Supervision of the tipping face** at all times when wastes are received to ensure the accountability of those depositing wastes and identify inappropriate loads before they are covered and incorporated into the waste mass.
3. **Notification of regulatory authorities** if any waste contravenes the waste acceptance criteria, or list of prohibited wastes. If the waste is identified as unacceptable while in the possession of the transporter, the load is to be rejected. If unacceptable waste is identified

after unloading, then immediate steps are to be taken to separate and secure the waste, and a plan for removal or treatment actioned as quickly as practicable.

4. **Keeping records of waste accepted** at the landfill, load inspections, and operational activities. Information on waste accepted includes the quantity, and where possible, classification of wastes. Information on load inspections includes observations made, violations, and notifications made to regulatory authorities. Information on operational activities includes records of disposal locations and training.
5. **Recording disposal locations** for wastes requiring special handling procedures, such as treated hazardous wastes. Information recorded includes the type, quantity, location, and depth of waste.

The landfill will operate in accordance with the above waste acceptance procedures. The landfill will only receive waste from commercial or bulk disposers who have applied for and obtained a Waste Acceptance Agreement from the operator. The landfill will not be open to the general public and will be securely fenced and gated to avoid indiscriminate dumping outside of the landfill opening hours.

Trucks arriving at the site will pass through a main gate and travel to a weighbridge inside the gate. Incoming waste will be weighed, and random loads inspected for compliance with the waste acceptance criteria at a minimum rate of 1 in 50 loads. Unacceptable loads will be rejected, and the ORC notified. Accepted loads will then progress to the active landfill operational area for disposal of waste, where all tipping will be supervised to identify any inappropriate loads prior to covering. Immediate steps will be taken to separate, secure, remove, or treat waste unacceptable waste that has been unloaded. Detailed records will be kept of quantities and types of waste accepted at the landfill, load inspections, and disposal locations.

8.4.3 Waste Acceptance Management Measures

Based on the above assessment, measures are proposed to be incorporated as conditions and LMP objectives within the ORC consent to discharge of waste/hazardous waste, and leachate to land to ensure the above waste acceptance criteria and procedures are adopted and any adverse effects to the receiving environment and human health and safety are avoided, remedied, or mitigated. The conditions have been developed to align with those recommended in section 7 of the Ministry for the Environment *Module 2: Hazardous Waste Guidelines (2004)* for a Class A landfill.

The proposed conditions and draft LMP objectives are included in **Appendix 17** and for the purposes of waste acceptance require:

- All persons delivering waste holding a valid Waste Acceptance Agreement.
- No waste, other than municipal solid waste (MSW) and hazardous wastes that meet the Ministry for the Environment Module 2: Hazardous Waste Guidelines – Class A being accepted for disposal.
- Random inspections of loads, and supervision of all waste tipping.
- Keeping records of the quantities of waste accepted, and load inspections.
- Notifying ORC of rejection of any waste delivery from the landfill.

- Ensuring the final LMP addresses waste acceptance criteria and procedures, record keeping, prevention of the disposal of hazardous substances, and secure waste transport.

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 and no more than minor on the environment, and on any persons.

8.5 Water Quantity Effects

The construction, operation, and aftercare of the landfill will modify groundwater and surface water flows and levels within the site and the downstream receiving environment. Such effects are relevant to the consideration of the applications to ORC to take, use, dam, and divert water; and place and use structures within and alter the beds of wetlands/rivers.

Potential effects on water flows and levels include:

- Loss of infiltration through the landfill liner and resulting loss of recharge to the shallow groundwater system, and deep groundwater system.
- Interception of groundwater beneath the landfill liner by the groundwater collection system, and discharge downstream to the Ōtokia Creek, or abstraction for non-potable water supply.
- Interception of surface runoff by areas of the exposed landfill liner, open areas of waste, infiltration to the completed landfill, and increased evapotranspiration over the landfill cap.
- Increased rate of surface runoff flows across the landfill cap and attenuation of flows by the attenuation basin prior to discharge downstream.
- ~~Diversion of surface runoff from 9000 m^2 of the site to Open Stream (Flax Stream catchment).~~

The Groundwater Report contained in **Appendix 8**, and Surface Water Assessment Report contained in **Appendix 9** have addressed the effects of the project on groundwater and surface water flows and levels, taking into account the existing hydrogeology and hydrology described in those reports.

8.5.1 Catchment Water Balance

The assessment of potential effects to groundwater and surface water flows and levels has been informed by using the Hydrologic Evaluation of Landfill Performance (HELP) software to predict average run-off, evapotranspiration, leachate generation and leakage during the phases of landfill operation and aftercare. The HELP model provides analytical estimation of water movement and prediction of a water balance for the landfill. Landfill design, material properties and location specific weather data were used in developing the model.

The designated landfill site is approximately 177.8 ha in area, of which 69.2 ha ~~forms the catchment that will report to the proposed landfill attenuation basin at the toe of the landfill~~is within the catchment of the Ōtokia Creek. That catchment includes the entire ~~44.5~~18.6 ha landfill footprint, gullies upslope of the basin, and the landfill facilities area. With the landfill proposed to

occupy ~~44.5~~18.6 ha of the catchment, the remaining ~~24.7~~50.6 ha will continue to contribute groundwater recharge and surface runoff at the same rate as under the existing environment.

During landfill operation, the worst case scenario for reduction in groundwater recharge and surface runoff will occur ~~during stage 5 where~~after the landfill footprint is fully occupied, but sections of exposed liner and open waste are present in the final stage of development which report all runoff ~~where runoff instead reports to~~ the leachate collection system. A comparison of the predicted water balance of the existing environment with the worst case landfill scenario, and after landfill closure for the entire 69.2 ha catchment ~~reporting to the attenuation basin~~ is outlined in **Table 13** below.

Table 13 – Landfill Catchment Water Balance (Updated May 2021)

	Existing Environment	**Worst Case During Landfill Operation**	**Landfill Closure**
Inputs (m^3/year)			
Rainfall	560,200		
Outputs (m^3/year)			
Evapotranspiration	~~218,400~~218,300	~~285,700~~241,200	~~290,600~~246,100
Runoff	~~334,600~~335,900	~~173,600~~268,300	~~177,600~~271,100
Shallow Groundwater System	~~3,600~~3,000	~~1,200~~2,200	~~1,200~~2,200
Deep Groundwater System	~~3,600~~3,000	~~1,200~~2,200	~~1,200~~2,200
Leachate Collection System	-	~~98,500~~46,300	~~89,600~~38,600
Leachate Leakage	-	~~3.0~~0.26	~~1.9~~0.26

Total rainfall over the ~~proposed landfill attenuation basin~~ Ōtokia Creek catchment area (69.2 ha) is predicted to be approximately 560,200 m^3/year when based on an annual average of 809 mm (calculated by the weather generator model (WGEN) in HELP). Actual evapotranspiration and runoff for the existing environment has been predicted to be approximately ~~218,400~~ 218,300 m^3/year and ~~334,600~~335,900 m^3/year, respectively.

The existing groundwater flow from the localised shallow groundwater system within the 69.2 ha catchment at the site is calculated to be approximately ~~3,600~~3,000 m^3/year. This indicates that flow through the shallow groundwater system is less than 1% of the total rainfall over the catchment area. Allowing a component of loss to the deeper groundwater system of less than that flowing to the shallow system (given significantly lower permeability and muted response to seasonal changes in rainfall), total recharge of groundwater across the site is expected to be less than 2% of total rainfall.

8.5.2 Effects to Groundwater and Surface Water Flows

Based on the above predicted water balance, the effects of potential changes to groundwater and surface water levels and flows, considered in the Groundwater and Surface Water Report, and Stormwater Report, are summarised in **Table 14** below.

Table 14 – Assessment of Water Quantity Effects (Updated May 2021)

Potential changes to groundwater and surface water levels and flows	**Assessment of Effects**
The landfill footprint will result in the loss of infiltration and recharge to the shallow groundwater system. This will affect levels, flows, and gradients within the shallow groundwater system, and result in decreased baseflow to the Ōtokia Creek, and the subsequent movement of the ephemeral/perennial flow transition further downstream.	Following the placement of the 44.518.6 ha landfill footprint, there will be no further recharge to the shallow groundwater system from rainfall infiltration over the area of the landfill, which is anticipated to resulting in a reduction in recharge to the shallow groundwater systemŌtokia Creek catchment by approximately 6727%, and reduce groundwater flow through the valley floor from approximately 3,6003,000 m^3/year to approximately 1,2002,200 m^3/year. Groundwater levels in the shallow groundwater system are predicted to reduce by approximately 2 – 3less than 1m m in the immediate vicinity of the landfill. The implications of this will likely be a reduction in groundwater discharge to the Ōtokia Creek, a potential shift downstream where the stream transitions from an ephemeral to perennial stream flow, and potential impact on water levels in any wetlands located immediately downstream of the landfill. The predicted reduction in groundwater levels is anticipated to move the location where the stream transitions from an ephemeral to perennial stream up to 50 45 m further downstream from its current location although this will also be mitigated by the contribution of groundwater from the wider catchment downstream of the attenuation basin. The attenuation basin has been designed with no lining in the base, which will to allow infiltration of stormwater to the underlying groundwater system. Excavation of the attenuation forebay into aAlluvium and colluvium in the gully floor will is expected to promote soakage. The forebay capacity (designed to hold 1% AEP) attenuation basin capacities provides the means to capture a significantly greater volume of stormwater for soakage than is estimated to presently recharge the shallow groundwater system (approximately 3,6003,000 m^3/year). This is expected to provide a net increase in groundwater flow through the valley floor. This recharge is anticipated to provide sufficient soakage to mitigate the majority of the loss of groundwater recharge to the Ōtokia Creek system, potential shift downstream where the stream transitions

Potential changes to groundwater and surface water levels and flows	Assessment of Effects
	from an ephemeral to perennial stream flow, and potential impact on water levels in any wetlands located immediately downstream of the landfill. While the catchment is expected to see changes in where groundwater recharge occurs, the influence of the landfill on groundwater levels and flow in the shallow aquifer is therefore expected to be less than minor and more likely to be beneficial to groundwater flow through the valley floor towards the Ōtokia Creek.
The groundwater collection system beneath the landfill will intercept groundwater and abstract it for non-potable water supply in the facilities area. This will affect levels, flows, and gradients within the shallow groundwater system, and result in decreased baseflow to the Ōtokia Creek.	Placement of the groundwater collection system to ensure dewatered conditions beneath the landfill are not expected to intercept groundwater in the southern extent of the footprint, where groundwater has been encountered at relatively deep levels. However, in the northern section of the landfill footprint, near the toe of the landfill, there is potential for interception of groundwater within the shallow groundwater system. Although sub-soil drainage may provide some initial lowering of groundwater levels within the localised shallow groundwater system, it is anticipated that this will be for a relatively short period of time as groundwater levels are expected to be reduced below the elevation of the drains due to loss of recharge with placement of the landfill liner. ~~Given that groundwater levels are expected to be reduced below the landfill, s~~ Significant volumes of groundwater are not anticipated to be abstracted through the groundwater collection system over the life of the landfill. The maximum estimated discharge is expected to be in the order of ~~4~~ 87 m^3/day (approximately ~~0.05~~1 l/s).
The landfill footprint will result in the loss of infiltration and recharge to the deep groundwater system. The loss of recharge to the deep groundwater system has the potential to affect baseflow to streams and groundwater takes of other users.	Any change in groundwater levels due to reduced recharge will have a negligible impact on the deep groundwater system, which does not support any groundwater takes or provide baseflow to any streams. All valleys in the vicinity of the site that host ephemeral streams are anticipated to have their own localised shallow system. With an estimated average horizontal permeability of 1x10-8 m/s in the deep groundwater system of the Henley Breccia, and a distance of approximately 2.6 km from the south eastern edge of the site, it would take groundwater an average of 8,245 years to reach the Pacific Ocean along a direct flow path. The deep groundwater system therefore contributes negligible discharge to the Pacific Ocean.

Potential changes to groundwater and surface water levels and flows	Assessment of Effects
	The reduction in recharge due to placement of the landfill is therefore likely to have a less than minor impact to the deep groundwater system.
Surface runoff will be intercepted by areas of the exposed landfill liner, open waste, and infiltration into the landfill which report to the leachate collection system, and greater evapotranspiration over the landfill cap due to ~~an~~ a relative increase in water infiltration, soil moisture retention in surface soils, and good grass cover. There will also be an increased rate of surface flows across the less permeable nature of the landfill cap and attenuation of flows by the attenuation basin. The interception of surface runoff, more evapotranspiration, and attenuation of flows by the attenuation basin will result in less surface runoff/ changes in flows to the Ōtokia Creek.	The site is located at the head of the catchment and very little flow of runoff from above the site occurs. Furthermore, any surface runoff from above or within the site only occurs during and immediately after periods of high or persistent rainfall. During landfill operation, the worst case scenario for reduced surface runoff will occur during stage ~~5~~ 4 where the ~~44.5~~18.6 ha landfill footprint is fully occupied, but sections of exposed liner and open waste are still present which reports runoff to the leachate collection system. After placement of the ~~intermediate and~~ final ~~caps~~capping layer, and the majority of the intermediate capping layers, all runoff will be directed to the attenuation basin before discharge. During the worst case scenario, a minimum of approximately ~~12.7~~12% of rainfall runoff is predicted to report to the attenuation basin, with the remainder either entering or infiltrating the landfill or undergoing evapotranspiration. After landfill closure, the predicted percentage of rainfall that reports to the attenuation basin increases to approximately ~~13.8~~14%. This equates to between approximately ~~45,000~~18,000 m^3/year to ~~49,000~~21,000 m^3/year of runoff from the ~~44.5~~18.6 ha landfill area before and after closure, respectively. With the landfill proposed to occupy ~~44.5~~18.6 ha of the catchment, the remaining ~~24.7~~50.6 ha of the catchment will continue to contribute runoff at the same rate as under the existing environment. The worst case predicted combined runoff to the ~~attenuation basin~~catchment from both the ~~44.5~~18.6 ha landfill and the remaining ~~24.7~~50.6 ha of the catchment is likely to be a minimum of ~~173,600~~268,300 m^3/year (refer **Table 13** above). This is a reduction of ~~nearly~~ approximately 20~~50~~% from the existing environment runoff of ~~334,500~~335,900 m^3/day. After closure, the entire landfill will contribute runoff, which is predicted to increase to 271,100 m3/year. While there will be an overall ~~50~~20% reduction in surface water flows to the Ōtokia Creek, the site is estimated to currently contribute no more than 1.6% of flood flows to the catchment, and consequently no significant impacts are anticipated on flows and levels in the wider catchment beyond the immediate vicinity of the site. Flows immediately downstream of the site are already

Potential changes to groundwater and surface water levels and flows	Assessment of Effects
	intermittent in nature and the effects of the changes in flows will also be relatively less important downstream as recharge occurs from other tributaries (e.g. East Gully) and as the relative proportion of the catchment affected by the landfill decreases. It is also likely that during existing conditions that rainfall events result in the majority of runoff flowing directly to the Ōtokia Creek, which is quickly flushed downstream. Although total runoff is predicted to reduce due to placement of the landfill, diversion of stormwater to the ~~unlined forebay of the~~ attenuation basin will infiltrate in-situ to recharge the shallow groundwater system and will provide a more consistent source of groundwater recharge and baseflow for the Ōtokia Creek, as well as providing regular surface water discharges to the Ōtokia Creek during rainfall, as discussed above. As outlined in **section 4.5.4**, schedule 9 of the Regional Plan: Water, identifies the Lower Ōtokia Creek Marsh, adjacent to McColl Creek approximately 7.6 km north east of the site at Brighton, as a regionally significant wetland. The Lower Ōtokia Creek Marsh is located towards the bottom of the catchment. At this location the contribution to surface water flows from the landfill site is very small and no significant impacts are likely associated with creek hydrology at this location.
~~The landfill will result in the diversion of rainfall surface runoff from 9000m^2 of the site to the Open Stream (Flax Stream catchment). This will/has the potential to affect levels and flows in that stream.~~	~~The majority of surface flows from the site will report to the attenuation basin, with the exception of an approximately 9000 m^2 area of the site adjacent to Big Stone Road, where surface flows will be diverted to the Open Stream (Flax Stream catchment), via a catchpit and culvert beneath Big Stone Road. The culvert will be sized to accommodate the 1% AEP storm event.~~ ~~The anticipated flow rates from the 9000 m^2 area are 67 l/s for the 10% AEP storm event, and 101 l/s for the 1% AEP. The Open Stream catchment is comparatively large (at least 6 km^2) and the additional diversion catchment of 9,000 m^2 is predicted to make a very minor additional contribution (less than 0.01%), which will be readily assimilated into the catchment and stream.~~

8.5.3 Water Quantity Management Measures

Based on the above assessment, measures are proposed to be incorporated as conditions and LMP objectives within the ORC consent for the take, use, damming, and diversion of groundwater and surface, to avoid, remedy and mitigate any adverse effects on groundwater and surface water flows and levels; and place and use structures within, and alter the beds of wetlands/rivers.

The proposed conditions and draft LMP objectives are included in **Appendix 17** and for the purposes of water quantity require:

- Supervision of design and certification of completed works by a suitably experienced registered engineer.
- Directing all stormwater to the attenuation basin for infiltration to ground, and discharge to the Ōtokia Creek, except for stormwater collected by stage 1, which will be discharged via a SRP through the toe bund to the Ōtokia Creek.
- The take of groundwater from the groundwater collection system for non-potable water supply not exceeding ~~8~~ 50 m^3/day~~, and which provides flexibility for higher abstraction above the predicted 4 m^3/day of water collected by the sub-liner groundwater collection system~~.
- Recording of water taken from the groundwater collection system, and leachate collection system.
- Designing and constructing all permanent stormwater infrastructure to manage a 1% AEP storm event.
- Ensuring the final LMP addresses: stormwater ingress into the landfill, and extreme events.

Overall, with these measures, the adverse effects of the project on groundwater and surface water flows will be appropriately managed and no more than minor on the environment, and on any persons.

8.6 Water Quality Effects

The construction, operation, and aftercare of the landfill will result in the generation of leachate, and stormwater containing sediment and other contaminant runoff which has the potential to enter the downstream receiving environment. Construction of the roading upgrades will also generate stormwater containing sediment runoff with the potential to enter adjacent waterways. Such effects are relevant to the consideration of the applications to ORC to discharge waste/hazardous waste and leachate to land; and stormwater and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers.

Potential effects on water quality include:

- Leakage of leachate through the landfill liner entering groundwater and connected surface water.
- Waste contaminated surface runoff.
- Accidental spillage of leachate from conveyance, storage, and load out facilities.

- Uncontained sediment and oil from the wheel wash and vehicle wash bay.
- Sediment runoff from construction of the landfill, site access, and road upgrades.
- Sediment runoff from sealed and unsealed areas of the landfill during operation.
- Erosion of the final landfill cap and resulting sediment runoff.

The Groundwater Report contained in **Appendix 8** and Surface Water Assessment Report in **Appendix 9** has addressed the effects of the project on groundwater and surface water quality, taking into account the existing hydrogeology, hydrology, and water quality described in those reports.

8.6.1 Effects of Leachate Leakage

Leachate from a class 1 landfill is generated due to the interaction of waste with infiltrating water and the release of liquids directly from the waste. Leachate can have varying quality, dependent upon the relative proportion of different waste types, landfill design, age of the landfill and local environmental setting.

Typically, contaminant concentrations in leachate are highest when waste is exposed ~~in an operating cell,~~during operation and decrease with closure and as the landfill ages. Decomposition of putrescible material and the transition of the landfill waste over time from an aerobic to anaerobic state, and the generation of organic acids, ~~over time~~ also plays a key role in determining leachate quality, influencing microbial reactions, solubility and physiochemical reactions of leachate constituents.

Decomposition of putrescible waste and the leachate generating environment is often defined to occur in three stages:

1. Aerobic degradation, generating heat and producing organic compounds and carbon dioxide.
2. Anaerobic degradation where large organic molecules are broken down into simple compounds such as hydrogen, ammonia, water, carbon dioxide and organic acids.
3. Methanogenic degradation where organic acids break down to form methane gas and other products.

Table 15 outlines an upper quartile for the highest leachate constituent concentrations of eight New Zealand landfills, provided in the Centre for Advanced Engineering Landfill Guidelines 2000.

Table 15 – Upper Quartile of the Highest Leachate Constituent Concentrations

Parameter	Upper Quartile Concentration – Class 1 Landfills (mg/L excluding pH)[28]
Aluminium	7.9
Ammoniacal Nitrogen	705

[28] Upper quartile of the highest leachate concentrations recorded in eight consented municipal solid waste (MSW) Class 1 Landfills in New Zealand (CAA, 2000[28]). Note some landfills did not provide concentrations for all parameters.

Arsenic	0.17
Boron	12.3
Cadmium	0.0063
Calcium	378
Chloride	1730
Chromium	0.17
Dissolved Reactive Phosphorus	3.4
Iron	183
Lead	0.13
Magnesium	193
Manganese	5.4
Nickel	0.19
Nitrate Nitrogen	0.86
pH	8.1 pH Units
Potassium	630
Silica	36
Sodium	1165
Sulphate	292
Total Kjeldahl Nitrogen	1220
Zinc	1.2
Total VOC	6.5
Total SVOC	4.4

Rates of leachate generation are highest during operation where waste is being placed. On completion of the landfill and application of the low permeability cap, leachate flows will be greatly attenuated such that the design flow will approach the average annual percolation rates. In order to minimise the volume of leachate generated, the following measures will be incorporated in the final LMP and implemented during the construction, operation, and aftercare of the landfill:

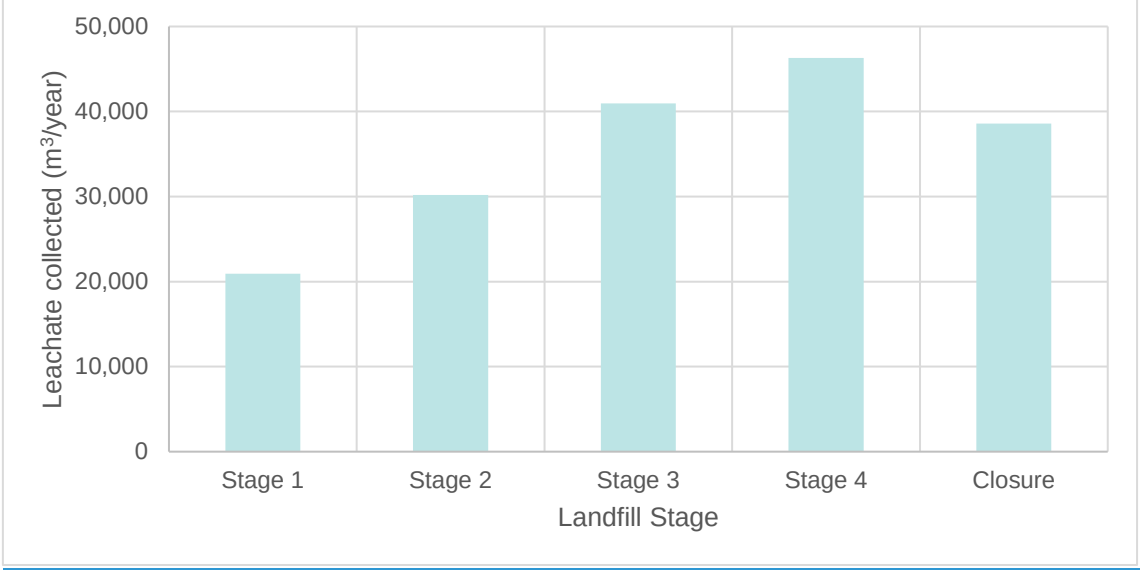
- Preventing clean upslope surface water from entering the placed waste mass and the leachate collection system.

- Minimising the size of the active waste tipping area where waste is exposed to rainfall.
- Covering areas with intermediate cover or final capping as soon as is practicable so that as much water as possible is ~~shed~~ diverted ~~in~~to the stormwater collection system~~s~~ and to further ~~minimising~~prevent ~~percolation of~~ water ingress to placed waste~~through these layers into the underlying waste~~.
- Providing well managed stormwater systems to separate all stormwater flow from areas where waste is placed, and ensuring all site stormwater is diverted away from waste.

The Hydrologic Evaluation of Landfill Performance (HELP) model has been used to predict leachate generation during different phases of landfill operation and aftercare. **Figure 13** below presents a summary of the leachate predicted to be collected in the leachate collection system~~s~~ during operation and after stage closure. ~~As noted in **section 5.5**, two leachate collection systems are proposed, which separate the leachate collection in Stages 1 and 2 from leachate collection in Stages 3, 4 and 5. The predicted leachate volumes reporting to the collection systems during operation will not occur concurrently as each landfill stage will be closed before the next one is opened.~~

As with surface runoff described in **section 8.5**, the worst case for leachate generation occurs during stage ~~5~~ 4 where the landfill footprint is fully occupied, but sections of exposed liner and open waste are present where runoff instead reports to the leachate collection system. The total predicted leachate volumes during stage ~~5~~ 4 is approximately ~~99,000~~46,310 m³/year ~~for the whole landfill (worst case for stages 3, 4 and 5 combined with closed stages 1 and 2)~~. After complete landfill closure, the total leachate predicted ~~from all five stages~~to be collected is approximately ~~90,000~~ 38,584m³/year.

Figure 13 – Predicted Leachate Volumes Collected by Leachate Collection System (Updated May 2021)



Leachate that reports to the leachate collection systems, will flow through pipework and drainage media to accumulate in the leachate sump~~s~~ at the base of the landfill where submersible pumps will extract and deliver the leachate to above ground holding tanks for removal off site. The leachate pump system will have multiple pump riser pumps designed with one pump in

redundancy. An emergency power supply will be installed at the facilities area to power the pumps should there be a loss of network supply.

The leachate collection system for the landfill has been designed to accommodate the calculated peak flow condition to prevent the discharge of leachate to the environment. The calculated critical leachate flows for the leachate collection system infrastructure are outlined **Table 16** below. The system has been designed to manage the 10% AEP storm event where leachate discharge is contained in other devices, and the 1% AEP storm event where there are no secondary devices that would otherwise contain leachate discharge.

Table 16 – Critical Leachate Storage Volumes (Updated May 2021)

Infrastructure	Storm return period (AEP)	Unit	Required capacity	Design capacity
Leachate collection pipework	10% (TC 10 min)	l/s	151	150
Leachate sump storage	10% (TC 2 hr)	m^3	~~267~~266~~**~~	~~240~~360
Emergency in waste storage (additional to the sump storage)	1% (TC 2 hr)	m^3	214	790
Total storage in landfill cell		m^3	481	1,030
Leachate storage tanks (Stages 1 - ~~5~~ 4 = 3 x 450 m^3 tanks)	10% (2 days)	m^3	1255	1350
Additional (to above tank storage) leachate storage in emergency bund for leachate tanks. Based on bund base of 21 m wide x 55 m long and 1.5 m bund height	1% (2 days)	m^3	~~862~~842	~~992~~1,144

Notes and assumptions

- ~~** The apparent discrepancy of the required storage over the actual storage in the leachate sump is not significant as the more than adequate additional capacity exists in the voids in the waste.~~
- *Leachate collection pipework is 2 x 200 mm slotted HDPE @ 4% grade, providing a flow rate of 75 litres per second per pipe.*
- *Leachate drainage media will provide~~s~~ flow additional to pipe flow*
- *Porosity in leachate sump aggregate assumed as 30%*
- *Porosity in waste assumed as 30%*
- *Leachate pumps are assumed to be EPG Companies - SurePump™ Wheeled Sump Drainer Series 95 or similar with a 30 l/s flow capacity for each pump*

- *Leachate storage in the in-cell sump provides for 10% AEP event with the greater of 2 hours storage assuming pumps are not working, or the peak short storm duration flow (with pumps working).*
- ~~*With combined cells (1 + 2 and 3 + 4 + 5) the in-cell leachate sump capacity is doubled as there are 2 sumps for each combined cell.*~~

Leachate head within the landfill will be limited to 300 mm above the liner by pumping during normal operational conditions as per the WasteMINZ guidelines. However, during low frequency/high intensity rainfall events the in-cell leachate sumps will provide storage for 10% AEP rain events through the voids within open graded aggregate that fill the sumps. Additional storage for 1% AEP weather events is provided in the waste. Under such conditions, the leachate level will be allowed to rise into the waste up to 1 m above the liner to allow for emergency short term storage.

~~The stage 1 sump will be separated from the stage 2 sump with a clay berm that extends up the interface of the base of the stage 1 / 2 cells. The same will apply to stages 3 / 4. The berm overlies the continuous landfill liner so that complications in the construction of the liner are avoided. The berm will be constructed to 2.5 m above the nominal liner level at the sump and 1 m above the liner at the interface between stages 1 / 2 and stages 3 / 4 to provide the required in-waste leachate storage volume and separation of leachate from surface water from the as yet undeveloped landfill footprint.~~

The leachate storage at the tanks in the facilities area will accommodate a 10% AEP storm event. The critical leachate flow event is related to the temporary condition in the landfill development where the liner of a cell extension is installed and before waste is placed over this liner. Therefore, there is no attenuation of the flow that waste would otherwise provide. As this condition exists at all stages of the landfill development, the storage tanks farm will be constructed in its entirety at commencement of the landfill operation.

The landfill liner will contain leachate within the landfill and prevent it from entering the underlying soils or groundwater. As discussed in **section 5.5**, the WasteMINZ Guidelines prescribe the use of either a Type 1 or Type liner for Class 1 landfills. While the concept design has been based on adopting a Type 2 lining system, both liner options provide an equivalent level of containment, and either option may be utilised for the proposed landfill. The option to be used will be determined at the time of detailed design~~, based on further permeability testing of the on-site loess material to confirm the effect of lime or bentonite stabilisation~~.

All components of the lining system work together to contain leachate within the landfill and minimise leachate seepage. The landfill liner will extend to the level of the landfill toe embankment (some 10 m above the base of the landfill), which will practically eliminate the risk of leachate loss to surface water as leachate would need to saturate the waste for a depth of 10m before being able to over top the embankment, which is unlikely.

The primary containment layer in both the Type 1 and Type 2 liner systems is the HDPE geomembrane (FML). Individual sheets will be welded together, and all welds tested for potential leaks. The HDPE geomembrane is practically impermeable and strict quality control measures will be used to ~~promote liner~~ensure its integrity during placement. However, in all landfills some leachate leakage through the membrane occurs, albeit very slow, through downwards vertical percolation of leachate, and pinhole imperfections in the liner. In a Type 1 liner system this leakage is mitigated by the underlying compacted clay layer, whereas in a Type 2 liner system,

the next layer of containment is provided by the GCL. For both liner systems, the underlying low permeability clay layer is expected to significantly restrict rates of onward leachate migration. ~~For the Type 2 liner system this leakage is mitigated through intimate contact with the underlying GCL or for Type 1 by the compacted clay layer.~~

The predicted potential leachate leakage through the landfill liner during operation and after stage closure is presented in **Figure 14** below. ~~As with leachate generation, the leachate leakage during landfill operation will not occur concurrently due to sequential stage construction.~~ The maximum leachate leakage is likely to occur during operation of stage ~~5~~4 and after landfill closure, with a predicted leakage rate of ~~3.0~~0.26 m^3/year. The reduction in leachate leakage as the landfill progresses from stage 1 to stage 2 is due to the progressive capping of the low gradient central landfill area, and placement of waste on higher gradient slopes. This is because greater leachate leakage occurs over low gradient sections of liner, where the head of leachate above the liner is greater than across higher gradient slopes.~~(generated from operational stage 5 and closed stages 1, 2, 3 and 4). The predicted total leachate leakage from all stages after landfill closure is approximately 1.9 m^3/year.~~

Figure 14 – Predicted Leachate Leakage through the Landfill Liner (Updated May 2021)

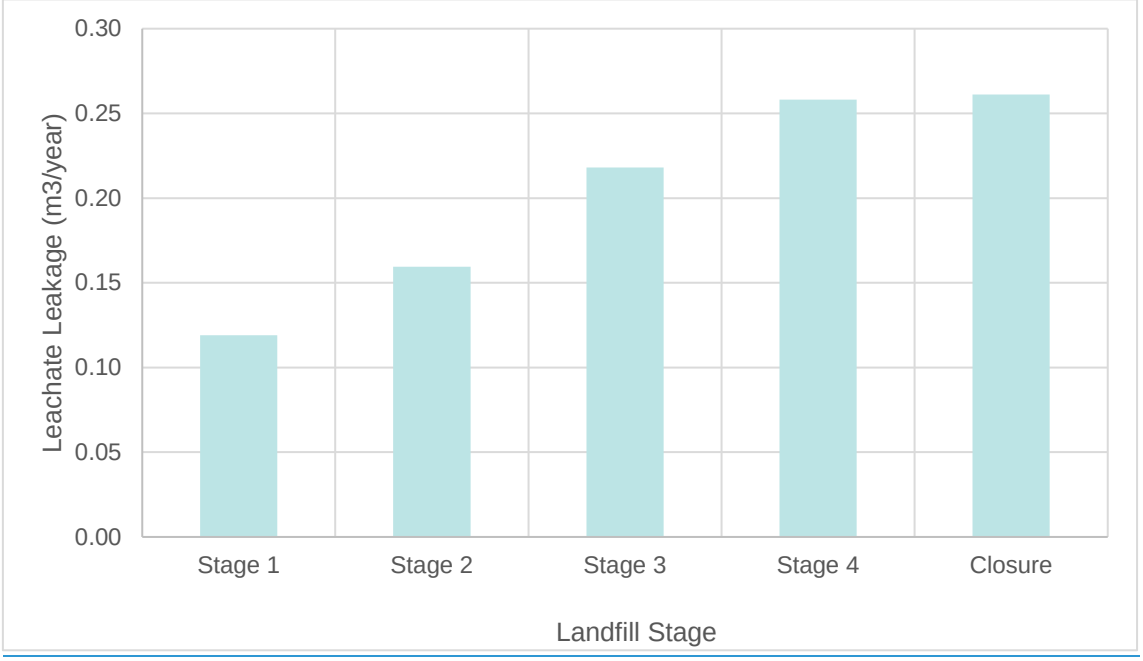


Table 17 presents the estimated contaminant flux in the shallow groundwater system under existing conditions for both the landfill sub-catchment and the full 69.2 ha landfill site catchment of the Ōtokia Creek, and also resulting from ~~potential~~ the maximum predicted rate of leachate leakage, and following mixing of leachate with the shallow ground system downgradient of the landfill~~for the worst case and closed landfill scenarios~~. This provides an indication of the potential for long-term adverse effects on groundwater and surface water quality. The closed landfill scenario is an appropriate comparison for the existing situation, owing to the significant time involved with broad scale catchment water mixing compared to the temporary nature of the operational scenarios, and because it reflects the maximum landfill footprint, and predicted leachate leakage.

Table 17 – Predicted Changes in Groundwater Quality (Updated May 2021)

Parameter	Flux (kg/year excluding pH)			
	Existing shallow groundwater system in landfill sub-catchment (800 m²/year)	Existing shallow groundwater system (69.2 ha Ōtokia Creek catchment – 3,000 m²/year)	Leachate leakage (closed landfill – 0.26 m²/year)	Predicted shallow groundwater system down-gradient of landfill (2,200 m²/year)
Aluminium	-	-	0.0021	-
Arsenic	0.00025	0.00092	0.000045	0.00072
Boron	-	-	0.0032	-
Cadmium	0.000035	0.00013	0.0000016	0.000098
Calcium	111.5	422.6	0.10	311.2
Chloride	94.0	355.9	0.45	262.3
Chromium	0.00008	0.00032	0.000046	0.00028
Iron	0.026	0.097	0.048	0.12
Lead	0.000021	0.000080	0.000034	0.000093
Magnesium	36.3	137.6	0.051	101.4
Manganese	0.25	0.94	0.0014	0.69
Nickel	0.0038	0.014	0.000050	0.011
pH	7.40 pH Units	7.40 pH Units	8.08 pH Units	7.41 pH Units
Potassium	4.6	17.2	0.16	12.8
Silica	-	-	0.0094	-
Sodium	66.0	249.3	0.30	183.6
Sulphate	128.6	488.4	0.076	359.9
Zinc	0.0046	0.018	0.00032	0.013
Total VOC	-	-	0.0017	-
Total SVOC	-	-	0.0012	-

Total Kjeldahl Nitrogen	0.35	1.3	0.32	1.3
Dissolved Reactive Phosphorus	0.00088	0.0033	0.00090	0.0033
Ammoniacal Nitrogen	0.012	0.045	0.18	0.22
Nitrate Nitrogen	11.3	43.0	0.00022	31.7
Total Inorganic Nitrogen	11.3	43.0	0.18	31.9

The results indicate that for the majority of parameters contaminant flux is predicted to reduce significantly following construction of the landfill~~, with the exception of ammoniacal nitrogen~~. This is the result of the reduction in the existing groundwater flows and the small amount of potential leachate leakage anticipated. ~~Nutrient transformation between nitrogen species, nitrate and ammoniacal nitrogen, is dependent upon a variety of environmental conditions, therefore total inorganic nitrogen represents a better measure for comparing nitrogen nutrient flux for the existing and landfill scenarios. Following placement of the landfill, total inorganic nitrogen (comprising both ammoniacal nitrogen and nitrate nitrogen) is estimated to significantly reduce from the existing flux, from approximately 73 kg/year to less than 2 kg/year.~~ Increases in contaminant flux are however predicted for iron, lead, dissolved reactive phosphorus (DRP) and ammoniacal nitrogen following construction of the landfill. The predicted flux for a number of key parameters has been converted to concentration within the shallow groundwater system down-gradient of the landfill within **Table 18** below and compared against adopted water quality criteria. The indicated concentrations are considered conservative in that geochemical equilibrium reactions and adsorption have not been considered. These remove contaminant mass through precipitation of minerals and binding to aquifer materials respectively.

The predicated concentrations within the shallow groundwater are also considered representative of surface water quality on occasion when, surface water is sufficiently elevated to provide base flow to the ephemeral stream to the north of the landfill; and when rainfall runoff is not occurring (anticipated to potentially provide dilution in the surface water system).

Table 18 – Predicted Contaminant Concentration within Shallow Groundwater System Downgradient of Landfill (May 2021)

Parameter	**Water Quality Criteria (mg/L)**	**Predicted concentration (mg/L)**
Iron	-	0.054
Lead	0.0034 (1)	0.000042
Cadmium	0.0002 (1)	0.000045

Chromium	0.001 (1)	0.00013
Nickel	0.011 (1)	0.0049
Zinc	0.008 (1)	0.0061
Dissolved reactive phosphorus	0.035 (2)	0.0015
Nitrate	1.0 (2)	14.5
Ammoniacal Nitrogen	0.2 (2)	0.10

Notes

1 ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Default criteria values for freshwater – protection: 95% of species.

2 ORC (2016). Otago Regional Council. Regional Plan: Water for Otago. Schedule 16A: Discharge Thresholds for Discharge Threshold Area 2.

The flux of lead, DRP, ammoniacal nitrogen and iron are predicted to increase following construction of the landfill. However, the predicted concentrations of lead, DRP and ammoniacal nitrogen within the shallow groundwater system down gradient of the landfill are not anticipated to exceed the adopted water quality criteria presented in **Table 18**. No applicable criteria is available for iron, however this parameter is not considered to be of concern given concentrations greater than the predicted concentration were recorded in nine of the 14 samples collected from the shallow groundwater system, to a maximum of 4.69 mg/L.

Nutrient transformation between nitrogen species, nitrate and ammoniacal nitrogen, is dependent upon a variety of environmental conditions, therefore total inorganic nitrogen is considered to represent a better measure for comparing nitrogen nutrient flux for the existing and landfill scenarios. This indicates that following placement of the landfill, total inorganic nitrogen (comprising both ammoniacal nitrogen and nitrate nitrogen) is estimated to reduce within the shallow groundwater system from approximately 43 kg/year to 32 kg/year.

Under the existing environment, the influence of current and historical site activities is reflected in the quality of the shallow and deep groundwater, particularly in the form of nutrients, which are readily leached from soils. As outlined in **section 8.5**, placement of the proposed landfill precludes recharge to the shallow groundwater system beneath the landfill footprint from these existing sources. Potential predicted long term leachate leakage through the liner of ~~1.9~~0.26 m^3/year (~~43~~ 14 L/ha/year) is expected to reflect the only recharge to groundwater across the landfill footprint area. Widely distributed infiltration, low leakage rates and a significant thickness of unsaturated material below the liner is expected to significantly retard the rate of leachate percolation to groundwater, providing the opportunity for significant attenuation of contaminants.

On reaching and mixing with the ~~underlying~~ shallow groundwater, migration of contaminant constituents will occur with groundwater flow. The rate of groundwater flow through the shallow aquifer is expected to be low, as a function of moderate permeability and a loss of driving head (a function of reduced groundwater recharge). Travel times for migration of groundwater ~~through the shallow aquifer to the toe of the landfill~~ are correspondingly expected to be protracted and

potential for further attenuation of contaminant concentrations exists prior to influenced groundwater moving beyond the landfill ~~footprint~~site.

The impacts of potential leachate leakage on groundwater quality down gradient of the landfill are expected to be limited in the context of the existing groundwater quality, with mixing with groundwater down gradient of the ~~beneath the~~ landfill footprint alone expected to provide greater than 1000-fold dilution. In addition, ~~significant~~ dilution is expected to occur from the significant volumes of catchment stormwater (~~173,600~~268,000 m^3/year) predicted to discharge to the 69.2 ha Ōtokia Creek catchment ~~soak to ground~~ from the attenuation basin which will further dilute groundwater with any residual landfill leachate influence by approximately three-fold.

Considering the reduction in contaminant flux and the levels of dilution predicted the effects to groundwater and connected surface water quality in the immediate vicinity of the site from potential leakage of leachate are expected to be negligible. The impact on the surface water quality in the downstream Ōtokia Creek receiving environment is anticipated to be less as the landfill groundwater will be further diluted by groundwater seepage from the wider catchment in the surface water flow.

8.6.2 Effects from Other Contaminant Sources

The effects from waste contaminated and sediment runoff considered in the Surface Water Assessment Report are summarised in **Table ~~18~~ 19** below.

Table ~~18~~ 19 – Assessment of Water Quality Effects (Updated May 2021)

Potential changes to groundwater and surface water quality	**Assessment of Effects**
Waste contaminated surface runoff has the potential effect on water quality in the downstream Ōtokia Creek receiving environment.	Surface runoff over open sections of the landfill where waste is placed will be separated from surface runoff and stormwater systems over the remainder of the landfill footprint. Open sections of the landfill will instead report to the landfill leachate collection system. ~~As noted in **section 8.6.1**, at the commencement of the Stage 1 landfilling, a low bund will be installed at the interface of Stages 1 and 2 which will separate and direct leachate to the leachate collection sump, and surface water from earthworks to the sediment retention pond. This will be repeated for the interface between Stages 3 and 4.~~ Temporary stormwater drains and grades will also be provided on the landfill operational surfaces, as required for the stage of operation, that diverts runoff from areas that could be potentially contaminated with waste to the leachate collection system, and clean stormwater to the landfill perimeter drain. Intermediate cover will be placed where waste will not be overlaid with fresh waste for more than 3 months. This will include most of

Potential changes to groundwater and surface water quality	Assessment of Effects
	stage 1. The intermediate cover will consist of low-grade organic soils, or low permeability loess stripped from subsequent landfill stages or stockpiles and placed in compacted layers not less than 300 mm thick and hydroseed applied. Areas of intermediate cover will be graded to the landfill perimeter drain where possible to allow runoff of uncontaminated water and reduction in leachate generation. Intermediate cover will then be stripped before placement of fresh waste. The final landfill cap will be similarly graded to the land perimeter drain.
Accidental spillage of leachate from conveyance, storage, and load out facilities has the potential to affect water quality in the downstream Ōtokia Creek receiving environment.	A sudden leachate discharge to the environment could occur as the result of a number of events: • Failure of the leachate rising main between the landfill and the storage tanks. • A leachate tank and bunding failure. • Spillage from a tanker during filling or transport through the site. The leachate riser pipes will be butt-welded PE and are resilient to movement and impact. The leachate storage tanks will be contained in a lined depression to accommodate 150% volume of a ruptured tank and provide additional storage for a 1% AEP storm event. The leachate loading bay will be provided with emergency containment to accommodate the storage capacity of a tanker. The landfill and the ~~facilities area~~leachate storage and load out facilities gravitates to the stormwater system that reports all flows to the attenuation basin. Any leachate discharged to the environment from equipment failure would ultimately enter the attenuation basin. The low flow discharge outlet from the basin will be fitted with stop valves to allow stormwater to be contained, monitored, and contaminated stormwater diverted to the leachate management system for disposal. Any spillage that occurs from a tanker on the landfill site access or public roads will be managed by implementing environmental spill response procedures.

Potential changes to groundwater and surface water quality	Assessment of Effects
Used water from the wheel wash and vehicle wash bay in the facilities area may contain sediment and oil residues that has the potential to affect water quality in the downstream Ōtokia Creek receiving environment.	The vehicle wash bay will have concrete pad directing water to sumps with oil and sediment traps to remove contaminants. The wheel wash will comprise a pressure underbody spray wash with rumble bars through which vehicles will drive. Dirty water from the wheel wash will pass through coarse sediment traps and further treated in flocculation ponds to remove contaminants before being recycled back to the wheel wash. Discharges of excess water from the wheel wash recycle system are expected to be minimal and only occur during periods of heavy rainfall. Discharges of water from the wheel wash recycle system ~~and vehicle wash bay~~ will be directed via the landfill stormwater system to the attenuation basin for further treatment, prior to discharge to the Ōtokia Creek receiving environment. Discharges from the vehicle wash bay will be directed via the lower facilities area sediment retention pond (SRP), prior to discharge.
Surface runoff during construction of the landfill, site access from McLaren Gully Road, and road upgrades to McLaren Gully Road and Big Stone Road has the potential to result in erosion and sedimentation of downstream waterways. Surface runoff over unsealed and sealed areas during operation of the landfill, and the final landfill cap has the potential to result in erosion and sedimentation of the downstream Ōtokia Creek receiving environment.	Development and operation of the landfill has the potential to generate sediment loads during rainfall events. Erosion and sedimentation during landfill construction works and operation, will be minimised by implementing the following measures: • The area of soil surfaces exposed at any one time being minimised. • Installing temporary cut-off drains upslope of exposed soil surfaces to intercept stormwater and minimise flow over exposed soil. • Directing all stormwater from exposed soil surfaces within each landfill stage to sediment ~~control~~retention ponds (SRP) constructed at the commencement of the stage, to provide primary treatment to remove sediment. The ~~sediment control ponds~~SRP's will remain in operation for the life of that stage until subsequent stage works require its removal. A sediment control pond will then be installed for the subsequent development stage. Consistent with the WasteMINZ guidelines, the ponds will be designed to accommodate a 10% AEP storm event. • Directing treated stormwater from the landfill ~~sediment control ponds~~SRP's to the attenuation basin which will provide additional water polishing prior to discharge to the Ōtokia Creek receiving environment. This is except for

Potential changes to groundwater and surface water quality	Assessment of Effects
	stage 1, where treated stormwater will be discharged from the SRP via pipes though the landfill toe bund directly to the Ōtokia Creek receiving environment, until which time stage 1 is completed. • Installing temporary measures such as silt fences and sediment traps where practicable to minimise the transport of sediment from exposed soil surfaces. • Stabilising earthworked areas with vegetation or other means as soon as practicable. This may take the form of grassing /hydroseeding or the use of protective matting. Stockpiles within ~~the dedicated soil stockpile area located to the east of the landfill~~eastern stockpile 1, and western stockpile 2, will be track rolled and trimmed to regular shapes and those not expected to be reworked within 1 month will have mulch or hydroseeding applied. The stockpile areas will also incorporate control measures including stabilisation, silt fences, ~~sediment retention ponds~~SRP's, and cut off drains to ensure sediment is retained and does runoff into gullies, and ultimately downstream to the Ōtokia Creek. Road upgrade works will be undertaken in a way that minimises the areas of exposed soil surfaces and utilises localised sediment control measures such as filter socks, and temporary silt dams in channels. The sealing of the road is will result in a long term reduction in sediment runoff. Design and implementation of sediment control measures will take into account site specific conditions, and be in accordance with best practice guidelines, including Auckland Council GD05 - *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region – June 2016,* and the Environment Canterbury *Erosion and Sediment Control Toolbox*. The final cap will be placed as the final waste level in any area is reached. The final cap will meet the WasteMINZ guidelines and include not less than 150 mm of topsoil, over not less than 300mm growth media layer, followed by at least 600 mm (and up to 1000 mm) of compacted cohesive soils with a permeability less than $1x10^{-7}$ m/s ~~over 600 mm of clay with a permeability less than $1x10^{-7}$ m/s, overlaying a minimum of 500 mm of intermediate cover.~~ The final cap will be graded to flow to the landfill perimeter drain. Where final cap slopes exceed 1V:~~10H~~5H, permanent contour

Potential changes to groundwater and surface water quality	Assessment of Effects
	drains discharging to the perimeter swale drains will be installed ~~every 50 metres~~upslope to control flows. Grass and other shallow rooted vegetation will then be established.

Overall, the measures proposed will ensure waste contaminated and sediment runoff is appropriately managed and minimised to ensure low effects on water quality. The long-term effects of the landfill in terms of sediment management may also be largely beneficial as the sediment discharge from the final cap and swale drains will be reduced compared to the existing forestry operations during periods of cutting, clearing and replanting/re-establishment.

8.6.3 Water Quality Monitoring

Monitoring of groundwater, the discharge from the groundwater drainage system, and surface water discharges will be undertaken before, and during operation and aftercare of the landfill. This will enable the existing baseline environment to be further characterised, and for potential water quality impacts from the landfill to be monitored. In particular, it will enable monitoring for leachate leakage and detection of any more significant failure of the landfill liner, confirm leachate is not mixing with surface waters, and confirm the effectiveness of sediment management measures.

Six groundwater monitoring bores will be installed downgradient of the proposed landfill, which will be sealed to prevent the ingress of contaminants.

Proposed monitoring locations, frequency, and parameters to be monitored are set out in **Table ~~19~~ 20** below:

Table ~~19~~ 20 – Proposed Water Quality Monitoring

Monitoring Point	Frequency	Parameters
Sub-liner groundwater drainage system prior to discharge to the Ōtokia Creek or abstraction for non-potable water supply.	Continuous	• Electrical conductivity • pH • Ammonia
	Monthly	As set out in section **Table 15, Section 8.6.1** above.
Groundwater monitoring wells as GW1 – GW6 on drawing 51-12506381-C309.	Quarterly.	As set out in section **Table 15, Section 8.6.1** above.
Sediment retention pond within stage 1 prior to discharge to the Ōtokia Creek	Continuous (when flows occur)	• Electrical conductivity • pH • Ammonia

Surface water monitoring points shown as SW1 – SW6 on Drawing 51-12506381-C309. Surface water monitoring point shown as SW7 on Drawing 51-12506381-C309 (located at the Ōtokia Creek culvert).	~~Monthly~~ Weekly (when flows occur). If continued periods of surface water discharge occur, then monitoring will occur weekly.	As set out in section **Table 15, Section 8.6.1** above. In addition, the following will be monitored: • Flow rate • Suspended solids • Turbidity The sediment load being discharged from the site will be compared to the calculated sediment load at SW7 to determine whether the landfill site is contributing on a proportional basis more sediment than the immediate catchment.
Tributary of the Ōtokia Creek immediately downstream of the landfill northern site boundary.	Daily visual inspection (when flows occur)	Visual inspection of water clarity and colour.

Baseline data for all monitoring parameters will be collected prior to construction of the landfill commencing. Groundwater monitoring will commence at least 18 months prior to waste being accepted, and surface water monitoring will commence at least ~~12~~ 36 months prior to construction. The higher 36-month timeframe for surface water baseline monitoring recognises the rare and unpredictable nature of ephemeral surface water flows at the site. This will inform development of specific trigger levels for each of the parameters, and contingency actions to be implemented where those trigger levels are exceeded. Trigger levels and contingency actions will be incorporated in the final LMP. Potential contingency actions will include:

- Closing the low flow outlet pipe from the attenuation basin in the event that leachate contaminated ~~groundwater or~~ stormwater is flowing from the basin to the Ōtokia Creek. This will enable containment and removal of the stormwater off site.
- Closing the ~~manhole~~ outlet from the groundwater collection system, and/or sediment retention pond for stage 1 in the event that leachate contaminated groundwater is flowing to the Ōtokia Creek. This will enable containment and redirection of the groundwater to the leachate collection system.
- Notifying Te Rūnanga o Ōtākou and downstream groundwater and surface water abstractors of any exceedance.
- An investigation is undertaken into potential causes, and a report provided to Te Rūnanga o Ōtākou and ORC outlining actions to be taken to prevent further contamination, including follow up monitoring.
- Revision of sediment controls if the site is shown to be contributing a disproportionate sediment load downstream in comparison to the immediate catchment above McLaren Gully Road.

8.6.4 Water Quality Management Measures

Based on the above assessment, measures are proposed to be incorporated as conditions and LMP objectives within the ORC consent to discharge waste/hazardous waste and leachate to land; and stormwater and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers, to avoid, remedy and mitigate any adverse water quality effects.

The proposed conditions and draft LMP objectives are included in **Appendix 17** and for the purposes of water quality require:

- Supervision of design and certification of completed works by a suitably experienced registered engineer.
- Construction of a landfill liner and leachate collection system that meets the WasteMINZ guidelines.
- Construction of a groundwater collection system to ensure effective sub-liner drainage.
- Installation of monitoring bores, with groundwater and ~~downstream~~ surface water monitoring to detect leachate leakage, and associated contingency actions where leakage is detected.
- Treating dirty water from the vehicle wash bay and wheel wash.
- Implementing stormwater, erosion, and sediment control management measures, designed and implemented in accordance with applicable technical publications.
- Ensuring the final LMP addresses: leachate generation, containment, and transport from the site; separation of waste contaminated stormwater; sediment runoff; erosion of the landfill cap; and extreme events.

Overall with these measures, the adverse effects of the project on water quality will be appropriately managed and no more than minor on the environment, and on any persons.

8.7 Air Quality Effects

The construction, operation, and aftercare of the landfill will result in the generation of odour, dust, landfill gas, and combustion emissions from the flaring of landfill gas, which have the potential to affect air quality in the receiving environment. Such effects are relevant to the consideration of the application to ORC to discharge contaminants to air.

Construction of the roading upgrades also have the potential to generate dust, however the discharge of dust to air from construction activity is a permitted activity under rule 16.3.14.1 of the Air Plan. Furthermore, operation of backup diesel generators of up to 5MW heat generation capacity is a permitted activity under rule 16.3.4. ~~the Air Plan,~~ The effects of these emissions have ~~and~~ therefore has not been further considered.

Potential effects on air quality include:

- Odour from the disposal of waste to land, including highly malodorous waste, leachate storage, and landfill gas.

- Dust from construction earthworks for the landfill, stockpiling of material, disturbance of soils on unsealed landfill operational surfaces (e.g. internal roads), and placement of the landfill cap.
- The lateral escape of landfill gas to air from the landfill.
- The combustion of collected landfill gas by way of flaring.

The Air Quality Assessment Report contained in **Appendix 10** has addressed the effects of the project on air quality, informed by meteorological modelling of the local wind conditions. Effects on air quality from landfill gas have also been addressed in the Landfill Gas Report attached as Appendix A to the Landfill Concept Design Report in **Appendix 3**.

8.7.1 Meteorological Modelling

The closest long established meteorological station relative to the landfill site is located at Dunedin airport, approximately 4.5 km away, which is unlikely to be representative of onsite conditions as it is located in the wide Taieri Plain valley. ~~As suitable local meteorological data has been unable to be sourced, metrological modelling has been completed to better understand local weather conditions.~~ Due to the lack of local meteorological data, an Automatic Weather Station (AWS) ~~weather station~~ was installed at the site in ~~June 2020.~~ July 2020 and records wind speed and direction, temperature, relative humidity and rainfall. To date insufficient data had been collected to allow meaningful correlation with observations and records at Dunedin airport. As suitable local meteorological data has been unable to be sourced, metrological modelling has been completed to better understand local weather conditions.

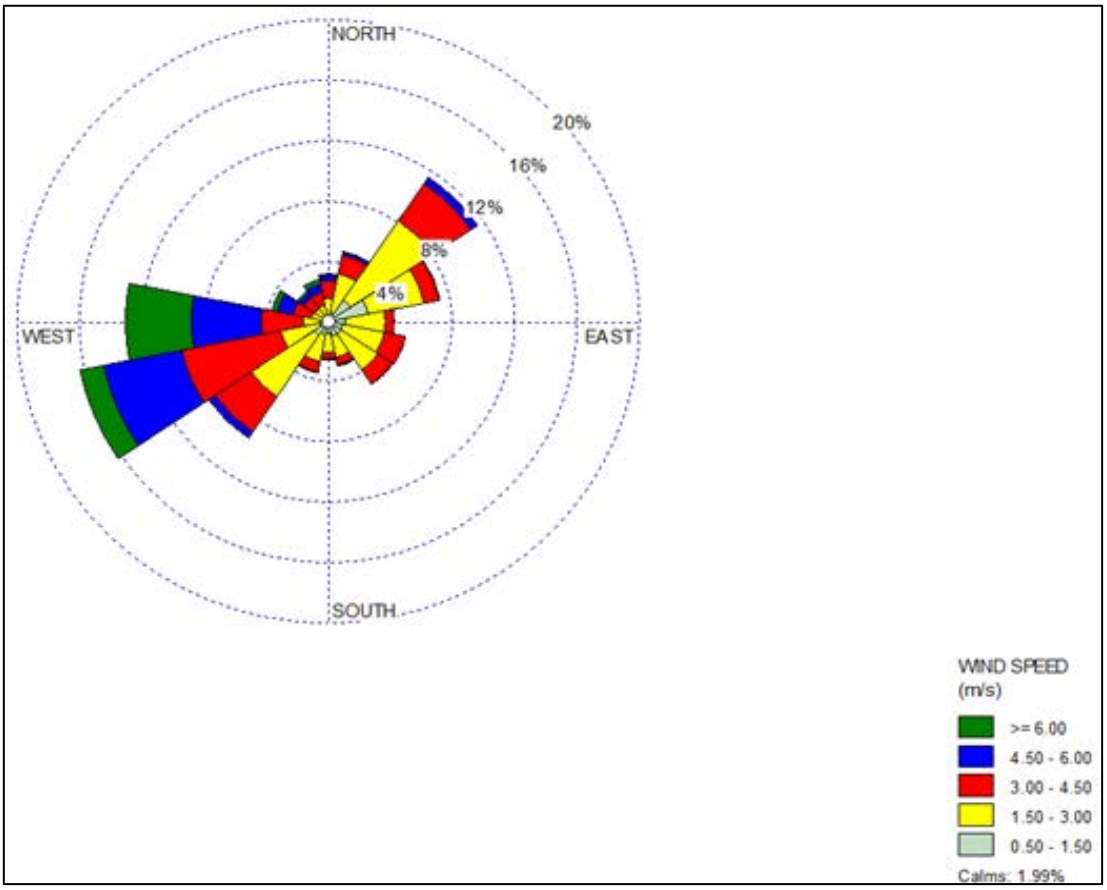
A site specific, three-dimensional meteorological data set was developed using the CALMET (v7) diagnostic meteorological model, using the following key model inputs:

- Surface meteorological observations from Dunedin Airport Automatic Weather Station (AWS).
- Upper air data derived from The Air Pollution Model (TAPM) (v4), utilised as an initial guess field in the Hybrid mode configuration.
- Land use and terrain data.

A three-year modelling period (2017-2019) was selected which includes the most recent available surface observations from the Dunedin Airport AWS. The three-year model period selected suitably captures both El Niño and La Niña phases of the El Niño-Southern Oscillation (ENSO).

Wind direction and speed outputs from the CALMET model at the site location are shown as a wind rose (for 2017- 2019) in **Figure 15** below. The average wind speed at the site predicted by the model is 3.1 m/s.

Figure 15 – CAMLET Model Output Wind Rose at Landfill Site 2017 – 2019



A review of the meteorological model outputs as well as surface observations at Dunedin Airport indicates that local and regional wind fields at the site are influenced by topographical features. Wind fields observed within the Taieri Plain valley which the Dunedin Airport is located in are strongly aligned with the valley orientation and model predicted wind speeds within the valley as significantly greater in comparison to the elevated site location.

Model predicted wind patterns at the site are less aligned with the valley orientation but are suggested to be more well aligned with wind patterns above the valley (>100 m above sea level). Analysis of the local wind field predicted some local topographical influences during periods of light winds and stable atmospheric conditions. Most notably so is apparent drainage of wind flow into the major gully north of the site. During the infrequently predicted southerly or south-easterly winds, flows moving from site follow this pattern into the low points within the valley.

Atmospheric stability substantially affects the capacity of pollutants such as gas, particulate matter or odour to disperse into the surrounding atmosphere and is a measure of the amount of turbulent energy in the atmosphere. There are six Pasquill-Gifford classes (A-F) used to describe atmospheric stability outlined in **Table ~~20~~ 21** below, and these classes are grouped into three categories; stable (classes E-F), neutral (class D), and unstable (classes A-C). The climate parameters of wind speed, cloud cover and insolation (solar radiation) are used to define the stability category. As these parameters vary from day to night, there is a corresponding variation in the occurrence of each stability category.

Table ~~20~~ 21 - Pasquill-Gifford Atmospheric Stability Class Descriptions

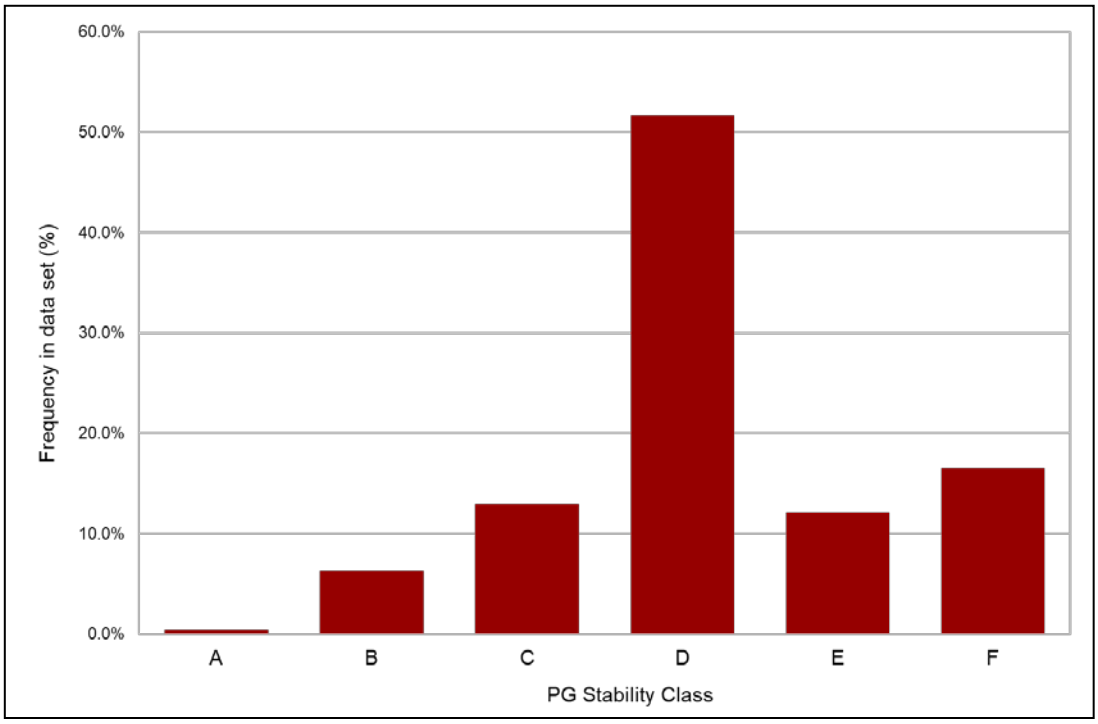
Stability Category	Wind Speed Range (m/s)	Stability Characteristics
A	0 – 2.8	Extremely unstable atmospheric conditions, occurring near the middle of day, with very light winds, no significant cloud
B	2.9 – 4.8	Moderately unstable atmospheric conditions occurring during mid-morning/mid-afternoon with light winds or very light winds with significant cloud
C	4.9 – 5.9	Slightly unstable atmospheric conditions occurring during early morning/late afternoon with moderate winds or lighter winds with significant cloud
D	≥ 6	Neutral atmospheric conditions. These occur during the day or night with stronger winds, during periods of total cloud cover or during the twilight period
E	3.4 – 5.4	Slightly stable atmospheric conditions occurring during the night-time with significant cloud and/or moderate winds
F	0 – 3.3	Moderately stable atmospheric conditions occurring during the night-time with no significant cloud and light winds

Notes:

- Data sourced from the Turner's Key to the P-G Stability Categories, assuming a Net Radiation Index of +4 for daytime conditions (between 10:00 am and 6:00 pm) and –2 for night-time conditions (between 6:00 pm and 10:00 am)
- E and F class stability classes assumed to only occur at night, during Net Radiation Index categories of –2.

Figure 16 shows the frequency of stability class at the site for all hours of the model generated dataset. Neutral atmosphere conditions (class D) are the dominant stability state of the atmosphere occurring approximately 50 per cent of the time. Stable conditions (classes E and F) occur approximately 30 per cent of the time. Unstable atmospheres (classes A, B and C) occur approximately 20 per cent of the time.

Figure 16 – CALMET Model Distribution of Atmospheric Stability Classes



8.7.2 Separation Distances and Sensitive Receptors

The primary concern with odour and dust is its ability to cause an effect that could be considered 'offensive or objectionable'. Separation distance between sensitive neighbours, particularly residential dwellings, and odour/dust-generating activities is important when assessing the likely impacts of an activity. By having a suitable separation distance, odour/dust emissions can be dispersed, diluted and deposited to such an extent that their effects at sensitive locations should be minimised to an acceptable level.

The Auckland Council (AC) discussion document on Separation Distances for Industry[29] recommends a separation distance of 1,000 m and ~~In the absence of separation distance guidelines for dust/odour discharges in New Zealand,~~ the Environment Protection Authority Victoria (EPA Victoria) separation distance guidelines recommend a distance of 500 m for Type 2 landfill[30] such as Smooth Hill. ~~have been used in New Zealand. Based on the EPA Victoria guidance the Smooth Hill Landfill is a Type 2 landfill.[31] and recommends a buffer distance of 500 m from buildings or structures.~~ Separation distances in the guidance however are indicative, not absolute criteria, and ~~The guidance is generic and~~ does not take account of site specific factors~~, of emission and how they are dispersed. The Ministry for the Environment (MfE) considers that separation distances are indicative, not absolute criteria, and may be adjusted having regard to specific site circumstances.~~ Accordingly, specific analysis has been completed to better understand the potential for odour nuisance, particularly those receptors located within 1000 m of the landfill.

[29] Emission Impossible 2012. Separation Distances for Industry – A discussion document. Prepared for Auckland Council 9 July 2012.
[30] ; a landfill receiving municipal (putrescible) waste
~~[31] a landfill receiving municipal (putrescible) waste~~

The proposed landfill will be a modern lined landfill with an efficient LFG collection system. This is compared with Green Island which is unlined. Consequently, there will be much better control of fugitive LFG and less potential for off-site odour. Unlike Green Island, no composting activities will be undertaken at the site, further reducing the potential for odour. The site will also incorporate a range of best practice mitigation measures to reduce off-site odour. These factors combined with favourable meteorological conditions, lessen the primacy of the factors which support ~~a 500 m~~these separation distances.

There are a number of existing sensitive receptors located in the area surrounding the proposed landfill, that may be susceptible to changes in abiotic factors as a consequence of odours from the landfill, and dust. These existing sensitive receptors are shown in **Figure 17** below and summarised in **Table ~~21~~22**.

Figure 17 – Location of Sensitive Receptors

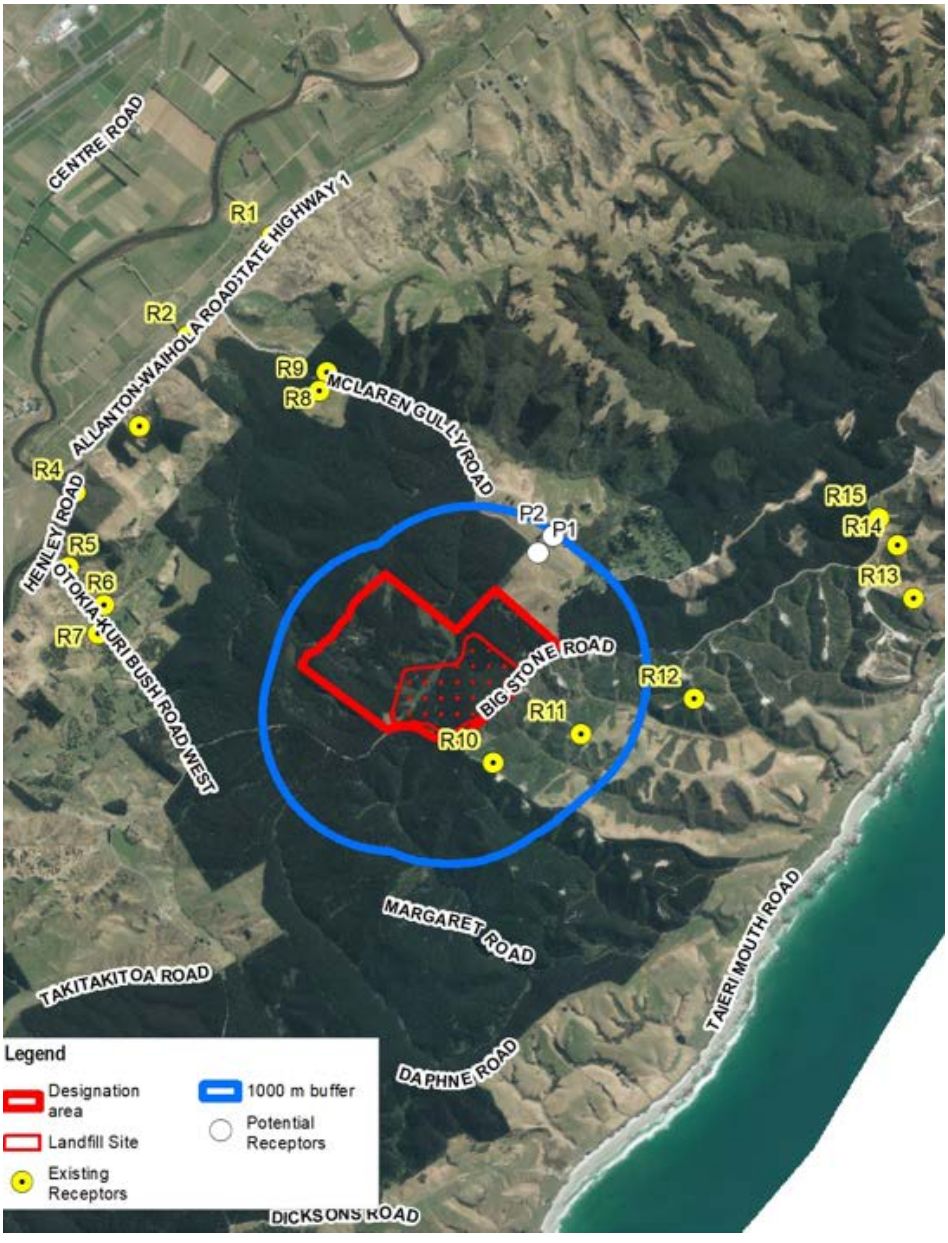


Table ~~21~~ 22 – Summary of Sensitive Receptors

Receptor ID	Type of Receptor	Distance (m)	Direction from the centre of the site
R1	Commercial	3,456	North northwest
R2	Commercial	3,200	North northwest
R3	Residential	2,800	Northwest
R4	Commercial	2.920	Northwest
R5	Residential	2.720	West northwest
R6	Residential	2.375	West
R7	Residential	2.380	West
R8	Residential	2,328	North northwest
R9	Residential	2.230	North northwest
R10	Residential	380	Southeast
R11	Residential	605	East southeast
R12	Residential	1,380	East
R13	Residential	3.060	East northeast
R14	Residential	3110	Northeast
R15	Residential	3,090	Northeast
P1	Potential future receptor	970	Northeast
P2	Potential future receptor	810	Northeast

There are currently a number of rural residential properties northwest of the site between 1.5 and 2.5 km from the landfill footprint. Three rural residences (R10, R11, and R12) are also located southeast of the site, within 1 km from the landfill footprint. The nearest sensitive residential receptor is 731 Big Stone Road (R10), located approximately 380 m from the landfill footprint. This is within the recommended EPA Victoria separation guideline and consequently has the greatest potential to be affected.

Additional sensitive residential activities could establish within the surrounding area as a permitted activity under the 2GP rural zoning where they comply with minimum density and separation distance performance standards. Those standards require a site of a minimum of 15 ha to establish a residential activity, or 80 ha for a second residential activity on a site (rule 16.5.2). Furthermore, they require new residential buildings to be located at least 150 m from existing, lawfully established landfills.

The sites containing residential receptors R10 and R11 are of an insufficient size to enable additional residential activities to be constructed as a permitted activity. The rest of the surrounding environment predominantly comprises plantation forestry on large sites owned by commercial forestry interests. Recently harvested forests have been replanted and therefore it is considered there is a low likelihood of additional residential activities establishing on these properties in the reasonably foreseeable future.

There are however two open properties to the northwest of the landfill site, currently used for pastoral farming where there is a credible opportunity for additional residential activities to establish. Likely locations for residences have been identified on these properties as P1 and P2 on **Figure 16** based on topography, ease of access, and the 2GP requirement to be set back a minimum of 150 m from the landfill site.

8.7.3 Odour Effects

Odours associated with landfill operations (refuse, leachate and LFG) are generally accepted by the majority of the population to be unpleasant. In order to minimise offsite odours, the following measures will be incorporated within the final LMP and implemented during the operation of the landfill. Operational practices are based on those currently used at Green Island Landfill and amended to represent best practice operation standards for landfills in New Zealand. The measures include:

- Implementing protocols to forewarn of the arrival of odorous wastes (e.g. biosolids and offal) so that preparations can be made to cover waste as soon as its placed.
- Transporting refuse to the site in sealed truck and trailer units or bins.
- Treating wastewater biosolids (stabilised with lime or equivalent treatment) prior to arriving at the site.
- Training weighbridge staff to identify and hold unexpected highly odorous deliveries until such time as measures are in place to place and cover the waste.
- Implementing and maintaining good housekeeping standards on the site.
- Keeping the size of the landfill working face to a minimum.
- Locating the refuse tip head close to the refuse placement area to avoid pushing the refuse a long distance that would increase odour potential.
- Landfill cells will be filled from the base of the valley based on the sequence set out **section 5.3**.
- Covering waste at the end of each working day so no refuse is exposed overnight.
- Mowing landfill surfaces that are grassed to allow effective surface emission monitoring.
- Undertaking instantaneous surface monitoring (ISM) on a regular basis to identify any areas of capping that need to be remediated.
- Scheduling activities such as extensive excavations into old waste (only undertaken under exceptional circumstances) to days when wind direction is away from sensitive receptors.

- 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.
- Implementing systems for identifying areas for improvement and recording corrective actions.
- Maintaining a log of all odour complaints, identifying the source, actions taken to minimise odour emissions, and feedback to the complainant.

Additional measures could also be implemented if these measures prove insufficient to control offsite odour to acceptable levels, such as using odour neutralising sprays, and implementing additional procedures for highly odorous wastes. This may include timing deliveries of highly odorous waste to times of the days which provide better odour dispersion conditions, prioritising their delivery to the tip face, and locating placement areas as far as practicable from sensitive receptors.

Investigation of any odour complaints will also be undertaken to determine the contributing factors and identification of improvements to odour control procedures. If it is determined that all odour mitigation measures were being implemented effectively at the time of the complaint and that the complaint is directly attributed to the placement of highly odorous waste, then waste from this customer will no longer be accepted until it can be demonstrated that the level of odour from the waste has reduced to acceptable levels.

Should excessive odour be generated by the landfill from abnormal operation then measures will be implemented as a staged approach to identifying and remediating the cause of odour, including:

- Identifying and covering odorous waste.
- Stop further deliveries from any identified source of the odorous waste.
- Redistribute odour sprayers.
- Alter the odour spray chemical dose rate.
- Repair obvious leaks in gas system.
- Repair obvious deficiencies in the landfill cover.
- Move the tipping to a remote area until wind is favourable.
- Undertake surface emissions survey.

In order to assess whether an odour event has the potential to be offensive or objectionable, MfE recommends that the qualitative FIDOL (frequency, intensity, duration, offensiveness and location) factors are considered. The qualitative FIDOL assessment tool has been used to determine the potential for odours from the landfill to be considered offensive or objectionable by off-site receptors, taking into account the CAMLET modelled wind direction and speeds.

Odour dispersion modelling was also carried out for one expected worst-case scenario. The odour dispersion modelling utilised publicly available odour emission rate measurements from a New Zealand landfill to predict peak odour concentrations at the nearest sensitive receptor. The worst-case scenario placed key odour generating sources at the boundary of the site closest to the nearest sensitive receptor.

The FIDOL assessment has determined:

- Light winds with speeds less than 3 m/s have the greatest potential to carry odour off-site as mechanical mixing is higher within increasing wind speed. Based on the predicted CAMLET modelling wind speeds and direction, there is a low frequency of light/calm wind speeds (required to carry undiluted odour) blowing from the site towards receptors. It is expected that receptors R14, R15, P1 and P2 will experience light winds from the site for approximately 6% of the year and the nearest receptors R10, R11 and R12 are expected to receive light winds from the site between 1% and 2% of the year.
- Light winds will tend to follow the contour of the valley (valley drainage flows). These drainage flows will keep odours close to ground level, and therefore odours are unlikely to migrate up valley walls to reach receptors. The nearest receptors (R10 and R11) are on ridgelines, which means that they are less likely to be impacted by landfill odours, as odour will typically stay close to the surface and migrate down the sides of the ridgeline to lower lying areas.
- There are no receptors downwind of the valley drainage flow (travelling from south or south-easterly toward the north of the valley).
- Receptors R10, R11 and R12 have the greatest potential to experience off-site odour, particularly if mitigation measures are not appropriately implemented while refuse is being placed in the south-eastern areas of the landfill.

While there is the potential for nearby sensitive receptors to experience odour from the landfill from time-to-time, it is considered unlikely that any odours detected at the nearby receptors will be considered offensive or objectionable given: receptors are not predicted to be downwind of the landfill for significant periods of time; nearby receptors are not located down-valley; the landfill will be constructed in accordance with best practice engineering designs and, a range of appropriate mitigation measures will be implemented. The FIDOL assessment is also supported by the findings of the odour dispersion modelling assessment which predicted odour concentrations to be below the relevant assessment criteria at the nearest sensitive receptors locations. Consequently, odour impacts on nearby receptors will be not be significant.

The potential odour impact on road users of adjacent Big Stone Road is also considered to be low given the limited duration that odour events will occur and the ~~low~~ coincidence they will be present at the time a road user is driving past the landfill, and short the timeframe ~~they~~ that odour will be encountered and infrequency of ~~by~~ vehicles ~~driving past the landfill~~using Big Stone Road. This finding supported by the MfE, *Good Practice Guide for Assessing and Managing Odour in New Zealand, 2016* which considers road users as having a low sensitivity to odour with the reasoning that "…*Roads users will typically be exposed to adverse effects from air discharges for only short periods of time"*.

8.7.4 Dust Effects

Dust emissions from the construction and operation of the site are expected to predominantly consist of coarse particles, which are typically greater than 20 microns in diameter. The most common concerns relating to coarse dust discharges are impacts on amenity, visibility and effects on structures (nuisance), however with mitigation these impacts are typically localised to within

100m of the source. The following mitigation measures will be incorporated in the final LMP and implemented on site to minimise the potential for off-site dust emissions, as far as practicable:

Construction

- Carrying out visual dust inspections on a regular basis throughout the day.
- Using watercarts or fixed sprinklers to control dust generated from haul roads.
- Increasing the intensity of dust control measures (e.g. increased suppression watering rate) where visual inspections find instances of dust leaving the boundary of the site.
- Delaying/reducing the rate of works and/or further increase the rate of watering during high-wind speeds (wind speeds above 5 m/s). Data collected by the on-site AWS will be used to inform site staff if wind speeds are above 5 m/s.
- Establishing vehicle speed limits (typically less than 15 km/hour) to reduce wheel generated dust emissions.
- Where practicable, keeping those parts of the site that are paved clean and free from waste and dust through regular sweeping and/or hosing down.
- Regularly carrying out street sweeping on paved roads and at the site entrance/exit.
- Placing excavated material directly into trucks where possible.
- Where material being excavated is very dry, using water sprays to increase surface moisture.
- Where material is placed in temporary stockpiles, using water in dry windy conditions to control the dust potential or cover, if practicable, prior to re-use or long-term storage.
- Limiting the height of uncovered stockpiles to reduce wind entrainment.
- Covering long term stockpiles to avoid dust generation.
- Taking account of daily weather forecast wind speed, wind direction and spoil conditions before commencing dust generating activities.

Operation

- Apply maximum speed limit of 30 km/hr in all areas of the site.
- Use of the wheel wash to prevent mud/dirt from being tracked along the access road on to public roads.
- Using water-carts on both sealed and unsealed roads as required during dry periods.
- Properly maintaining and grading temporary roads on the landfill.
- Treating dust generating wastes as a special waste, requiring customers to dampen down the load prior to delivery to site, implementing special controls at the disposal point, e.g. water sprays, waste pit, etc.

Dust nuisance requires winds greater than 5 m/s to travel beyond the site boundary and with appropriate mitigation these effects will be localised to 100 m from the dust source. Based on the CAMLET wind direction and speed modelling, the site is predicted to experience high wind speeds (>5 m/s) blowing towards receptors 14% of the time. Nuisance dust effects are generally only

experienced within 300 m of unmitigated dust sources. Given the nearest sensitive receptor (R10) is 380 m from the landfill boundary, it is not expected that there will be any discernible dust at this location when appropriate dust mitigation measures are implemented. Based on the construction and operational activities of the landfill and FIDOL factors it is unlikely that dust emissions will cause any adverse effects beyond the site boundary.

8.7.5 Effects of Landfill Gas

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. During the anaerobic phase, when decomposition of biodegradable waste materials occurs in the absence of oxygen, methane and carbon dioxide are the major constituents of the LFG generated (although numerous other gases may also be present at low concentrations).

Landfill gas 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 three to twelve 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 an LFG collection and destruction system for a landfill that will exceed 1M tonnes of waste, and that the system be in operation before 200,000 tonnes of waste is placed. Based on the predicted waste stream of 90,000 tonnes / year, a LFG collection and destruction system will be installed and commissioned within ~~2~~ approximately 3 – 4 years of the commencement of landfilling at the site. Under the NESAQ, the system is required to ensure:

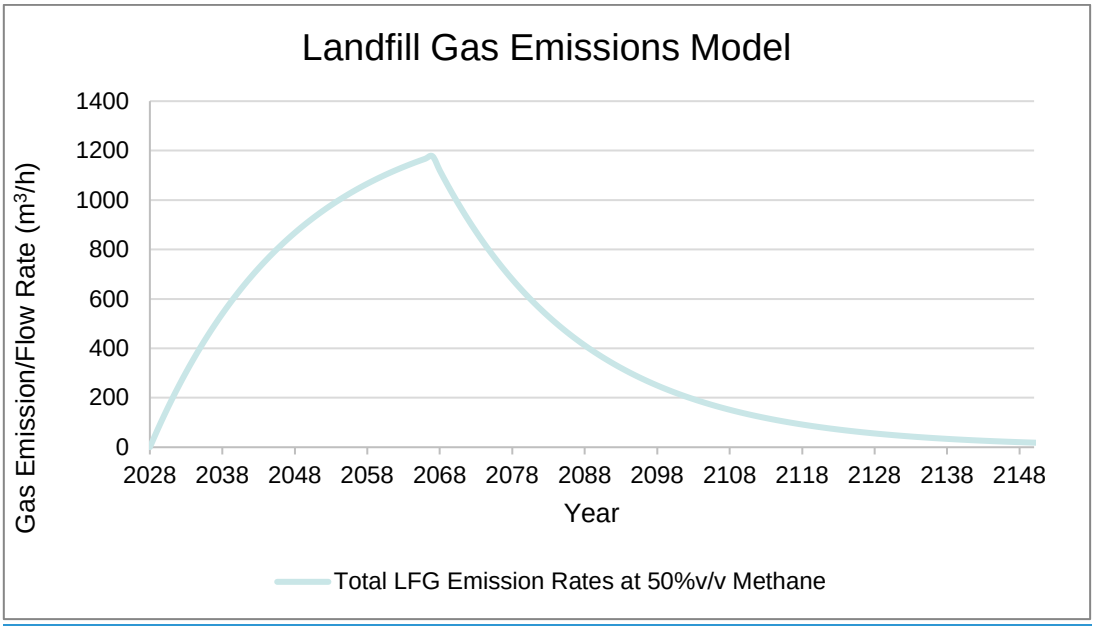
- the discharge of gas from the surface of the landfill does not exceed 5000 parts of methane per million parts of air; and
- the gas is flared or used as a fuel for generating electricity.

In order to develop an understanding of the potential magnitude of LFG emissions from the site over time, an LFG emission model has been developed for a landfilling period of ~~55~~ 40 years, which is consistent with the total design capacity of the site. The modelling approach and outcomes are discussed in the Landfill Gas Report, attached as Appendix A to the Landfill Concept Design Report in **Appendix 3**. The model used was the United States Environmental

Protection Agency (USEPA) (2005) Landfill Gas Emissions Model (LandGEM) Version 3.02, which is the most commonly used LFG emission model in New Zealand.

The estimated LFG emission rates for the model are shown in **Figure 18** below. The LandGem model presents the LFG emission rate outputs as m^3/LFG/year, and these rates have been converted into m^3/LFG/h for consistency with typical industry practice.

Figure 18 – Landfill Gas Emission Model Outputs



This shows the following:

- The proposed landfill is expected to start generating LFG in ~~2023~~ 2028 and will continue to do so for many years after landfilling of waste has ceased in ~~2078~~2066.
- The LFG emission rate at the proposed site will peak in ~~2078~~ 2067 at ~~1,927~~ 1,177 m^3/LFG/h and will steadily decrease every year post ~~2078~~2067.
- The LFG emission rate will be greater than 250 m^3/LFG/h (i.e. moderate to large generation rates [32]) between ~~2026~~ 2033 and ~~2118~~ 2097 (~~93~~ 65 years).
- The LFG generation rates will be greater than 100 m^3/LFG/h at 50% v/v methane (i.e. theoretically sufficient to operate a flare from ~~2024~~ 2030 to ~~2137~~ 2116 (~~114~~ 87 years) +

A preliminary landfill gas risk assessment (LFGRA) has been completed to assist with understanding potential LFG related risks at the site, and what management measures should be implemented. The assessment is detailed in the Landfill Gas Report. The risk assessment has considered the potential sources of LFG, potential emission pathways, and receptors of LFG emitted from the site. As identified in **section 8.7.2**, the nearest off site sensitive receptor for LFG emissions is the existing residence at 731 Big Stone Road, located approximately 380 m from the landfill footprint. It is unlikely that any other residential dwellings will be constructed closer than 380 m, given the 2GP planning framework, existing land use, and topography.

[32] According to EPA Victoria (Australia) (2015) *BPEM, Siting, design, operation and rehabilitation of landfills*, Section 6.7.1 on page 35

A preliminary assessment of the potentially complete source-pathway-receptor linkages and potential impacts to receptors with consideration of the LFG emission mode has been completed, which has identified the following key risks associated with LFG at the site:

- Impact upon on-site workers and visitors.
- Impact upon on-site buildings and structures.
- Impact upon future on-site subsurface services.

Risks presented to other potential receptors are considered to be of a lower significance. Given these key risks and the magnitude and longevity of the estimated emission rates, a range of LFG management measures will be required at the site to appropriately manage the LFG emitted. These include active LFG management (i.e. collection and combustion), regular monitoring and appropriate waste covering and containment systems. The proposed LFG management measures that will be implemented include:

- Installation of a low permeability lining system which will reduce the likelihood of subsurface LFG emissions.
- Installation of a leachate collection system, with leachate pumping systems to be designed and operated in accordance with relevant standards in relation to LFG as applicable (e.g. AS/NZS 2381.1.1:2005).
- Regular covering of waste with appropriate daily and intermediate cover materials. Cover will be applied at the end of each day's waste placement and intermediate cover will be placed on areas where further waste will not be placed for one month.
- Progressive capping and rehabilitation of the site with a low permeability landfill cap over the site's lifetime that meets the WasteMINZ Guidelines for a Class 1 landfill.
- Progressive installation, operation and monitoring of an active LFG collection and treatment system (gas wells, pipework, manifolds, flares) that is suitable for the quantity of LFG emitted by the site as development progresses.
- Appropriate design, installation and validation of buildings and structures and subsurface services on-site to prevent LFG entering and/or accumulating within them.
- Design, installation and implementation of an appropriate LFG monitoring network and program (described in **section 8.7.6** below). This network and program will be reviewed and updated on an ongoing basis as conditions change at/adjacent to the site over time.
- Completion of a detailed landfill gas risk assessment (LFGRA) prior to waste filling occurring and on-going review and update of that document as conditions change at/adjacent to the site over time. This detailed LFGRA will further consider / investigate organic mudstone / lignite as a potential source of ground gas at the site.
- Development and implementation of appropriate work, health and safety procedures for on-site workers who may be at risk of being exposed to LFG emissions.

8.7.6 Landfill Gas Monitoring

Monitoring of LFG will be undertaken during and after operation of the landfill. An LFG monitoring bore network will be installed around the perimeter of the landfill prior to the commencement of landfilling to intercept any LFG escaping laterally from the landfill site and enabling identification

of its location. Monitoring will confirm the effectiveness of the landfill gas collection system and enable detection of any LFG escape that may present a hazard or nuisance to sensitive receptors, including those identified in the LFGRA.

A concept design for a preliminary perimeter LFG monitoring bore network for the site has been developed as described in the Landfill Gas Report and shown on the application plans. The design has been developed with consideration of the guidance provided in EPA Victoria (2015) Best Practice Environmental Management: Siting, design, operation and rehabilitation of landfills (BPEM).

Two concept layouts have been developed, one based on the BPEM, and a refined network taking into account the findings of the preliminary LFGRA. The BPEM bore network would require a total of ~~63~~ 54 monitoring bores to be installed around the site. Based on the findings of the LFRGA, this has been reduced to ~~32~~ 46 bores. This reduction recognises that an increased bore spacing is appropriate on the northern, western, south-western, and south-eastern boundaries due to a lack of current and perceived future LFG receptors within 250 m of the landfill footprint.

While 32 bores are considered to be appropriate based on the risk assessment, the final number and configuration will be subject to detailed design, including completion of a detailed LFGRA prior to waste filling occurring. The LFG bore network will be installed and monitored at least 6 months prior to the commencement of landfilling in order to obtain background ground gas data for the site prior to filling. The LFGRA will also be reviewed every 5 years, potentially resulting in the need for expansion of the bore network based on the monitoring results obtained, and/or changes to location of potential receptors.

In addition to the monitoring bores, regular surface monitoring of methane emissions from the landfill cap will be undertaken, and visual inspection to identify any areas of the landfill cap that require remediation.

8.7.7 Effects of Landfill Gas Flare Emissions

It is proposed that LFG will be flared, however in the future it may be used for electricity generation. The combustion of LFG in the flares will emit various air pollutants including NO_2, CO, SO_2, PM_{10} and $PM_{2.5}$ and small amounts of volatile organic compounds (VOC).

LFG will primarily be combusted in the enclosed ground flare, however if the flare develops a fault or is taken off-line for maintenance a backup candle stick flare will be used. The flares will be designed to meet the requirements of the NESAQ. Specifically, by ensuring that the flare has minimum gas retention time of 0.5 seconds and that the minimum temperature in the flare is greater than 750 °C, the destruction efficiency of the flare will be very high, typically greater than 99.7%. The flare will also be at least 8 m high which, combined with the hot buoyant gas being discharged, will ensure that emissions of VOC and unburnt methane will be at trace levels and therefore it is very unlikely for theses pollutants to cause adverse off-site effects.

Pollutant emissions from the flare at the sensitive receptor locations identified in **Section 8.7.2** have been modelled using the CALPUFF atmospheric dispersion model (Version 7). CALPUFF is extensively in New Zealand and Australia and is a recommended by MfE for sites surrounded by complex terrain and where sea-breeze conditions can occur. 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 2005.

Based on the order of priority outlined above the relevant air quality assessment criteria are set out in **Table ~~22~~23**.

Table ~~22~~ 23 – Pollutant Emission Assessment Criteria

Pollutant	Threshold Concentration (µg/m³)	Averaging Period	Source of Assessment Criteria
NO_2	200	1-hour	NESAQ
NO_2	100	24-hour	NZAAQG
CO	30,000	1-hour	NZAAQG
CO	10,000	8-hour	NESAQ
SO_2	570	1-hour	NESAQ
SO_2	350	1-hour	NESAQ
SO_2	120	24-hour	NZAAQG
PM_{10}	50	24-hour	NESAQ
PM_{10}	20	Annual	NZAAQG
$PM_{2.5}$	25	24-hr	WHO
$PM_{2.5}$	10	Annual	WHO

The results of the modelling identified the concentrations of NO_2, CO, SO_2, $PM_{10,}$ and SO_2, in combination with existing background concentrations, are predicted to be well below the relevant health-effect based assessment criteria at all off-site locations. Consequently, there is limited potential for adverse off-site air quality effects associated with the flare discharges.

No other combustion emissions are proposed with the exception of a 300kV backup diesel generator, to power the leachate pump system and LFG flare system in the event of the loss of network supply. The size of this generator falls well within the maximum 5MW heat capacity limit and will have a stack height of 8.5m that complies with permitted activity rule rule 16.3.4 of the Air Plan.

8.7.8 Air Quality Management Measures

Based on the above assessment, measures are proposed to be incorporated within the conditions and LMP objectives for the ORC consent to discharge contaminants to air, to avoid, remedy and mitigate any adverse air quality effects.

The proposed conditions and draft LMP objectives are included in **Appendix 17** and for the purposes of air quality require:

- Supervision of design and certification of completed works by a suitably experienced registered engineer.
- Continued provision of an automatic weather station which records wind speed and direction, temperature, relative humidity, and rainfall.
- No composting activity to occur on site.

Odour

- Waste being accepted only if transported to the site being in sealed truck and trailer units.
- Delivery of highly odorous loads being pre-booked to enable site preparations and cover as soon as practicable.
- Daily and intermediate cover of waste.
- Sealed leachate conveyance and storage facilities.

Landfill Gas

- Completion of a detailed LGRA prior to construction, and regularly reviewed.
- Construction of a landfill liner, leachate collection system, and landfill cap which meets the WasteMINZ guidelines.
- Construction of a landfill gas collection and destruction system which meets the WasteMINZ guidelines and NESAQ.
- Installation of a landfill gas monitoring bore network, with LFG monitoring to detect fugitive emissions, and associated contingency actions where emissions are detected.

Complaints

- Maintenance of a complaints management, investigation, and reporting system.

LMP

- Ensuring the final LMP addresses: the size of the landfill working face; identification of odorous deliveries; waste cover; LFG escape, control and destruction; erosion of the landfill cap; health and safety; and extreme events.

Overall with these measures, the adverse effects of the project on air quality will be appropriately managed and no more than minor on the environment, and on any persons.

8.8 Terrestrial and Freshwater Ecology

The construction, operation, and aftercare of the landfill and road upgrades will modify the existing terrestrial and freshwater habitats within the site and the downstream receiving environment. Such effects are relevant to the consideration of the application to ORC to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. They are also relevant to the DCC consents for the road upgrade, ~~and wetland creation/enhancement~~ outside the designation.

The effects are also relevant to the consideration of the future application for an outline plan of works to construct and operate the landfill within the designated site. While not relevant to the current applications, management of effects within the designation are discussed to inform the community and decision makers as to how such effects will be managed.

Potential effects on ecological values include:

- Vegetation removal or disturbance, and associated loss of threatened or at risk flora species, and weed encroachment and introduction.
- Vegetation removal, and associated loss of bird and lizard habitat.
- Construction and operational activities disturbing or displacing birds and resulting in increased bird mortality.
- Operational activities attracting increased abundances of birds, and associated risk of bird strike with aircraft.
- Construction activities displacing lizards into unsuitable habitat or resulting in lizard mortality.
- Reduction in surface water flows, and discharge of sediment and contaminants to the downstream environment, resulting in loss of wetland vegetation and habitat, and changes to freshwater indigenous fish, aquatic invertebrates, or indigenous aquatic plants.

The Ecological Impact Assessment Report contained in **Appendix 11** has addressed the effects of the project on vegetation communities, avifauna, herpetofauna and freshwater ecology. The assessment on freshwater ecology has taken into account the changes in surface water flows described in the Groundwater Report contained in **Appendix 8,** and Surface Water Assessment report in **Appendix 9**. The assessment of effects on ecological values has been undertaken in accordance with the Environment Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment (EcIA) Guidelines, with the magnitude of effects being described on a scale of very high – very low effects, or net gain for positive effects.[33] The assessed level of effect has then guided the extent and nature of measures required to avoid, remedy, mitigate, offset, or compensate for the loss of ecology values.

The potential changes to vegetation, habitats, or communities, and their effects considered in the Ecological Impact Assessment Report, are summarised in **Table ~~23~~ 24** below.

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

Table ~~23~~ 24 – Assessment of Ecological Effects (Updated May 2021)

Potential Changes to Vegetation, Habitats, or Communities	**Assessment of Effects**
Construction of the landfill and road upgrades will result in vegetation removal or disturbance, result in loss of threatened flora species, and potentially result in exotic weed encroachment and introduction.	Construction of the landfill requires large-scale vegetation clearance and earthworks across a range of habitat types within the designation site. These vegetation communities and habitats sit on a spectrum with respect to the level of modification and the diversity and dominance of indigenous species, ranging from highly modified communities with no or few indigenous species, to less modified indigenous-dominated communities. The construction of the landfill and road upgrades will require large-scale clearance and disturbance of the vegetation communities described in **section 4.5.1** totalling ~~55.65~~38.18 ha in area. This includes the clearance of the following areas of ~~**low** to~~ **moderate** ecological value: • ~~0.72 ha~~0.0014ha (13.8m^2) of (Pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland~~(Pūrei - rautahi – Yorkshire fog) – cocksfoot / watercress – floating sweetgrass grassland~~ of **moderate** ecological value, located ~~at the base of West Gully 4, the swamp wetland, and~~ along McLaren Gully Road. ~~• 0.10 ha of (Large-leaved pohuehue) / (Himalayan honeysuckle) – gorse scrub of **moderate** ecological value, located in the swamp wetland.~~ ~~• 0.08 ha of Harakeke – gorse / (rautahi – pūrei) flaxland of **moderate** ecological value, located in the swamp wetland and along McLaren Gully Road.~~ ~~• 4.52 ha of [Large-leaved pohuehue] / [makomako – kōtukutuku] / Himalayan honeysuckle treeland of **low** ecological value, located in West Gully 4, and along Big Stone Road.~~ • ~~4.73~~3.15 ha of (Yorkshire fog) - cocksfoot grassland of **moderate** ecological value, located within the site, and along McLaren Gully Road. • ~~0.19~~0.00027 ha (2.7m^2) of [Pūrei] – wīwī / rautahi – exotic grass rushland ~~(Pūrei) – wiwi / cocksfoot rushland~~ of **moderate** ecological value, located along McLaren Gully Road.

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	~~These vegetation communities that will be lost all frequently occur in nearby areas or the wider ecological district (ED), or are otherwise small/degraded. In particular:~~ The extent of the (Pūrei) / (Yorkshire fog – cocksfoot) – rautahi sedgeland that will be lost adjacent to McLaren Gully Road amounts to just 13.8m^2, or 0.0014ha. The clearance would likely affect a small number of plants comprising, exotic grass, rush, and herb species, and some rautahi sedges and wīwī rush which are extremely common and widespread Not Threatened species. Modification would be confined to very narrow margins at the already modified edge of substantial (i.e. multi hectare) wetland features. No meaningful hydrological changes (and subsequent indirect wetland loss or gain) to these wetland areas are expected to occur because, the existing road already acts to impound surface water flows from tributary valleys. A minor expansion in the road footprint may not appreciably alter this process except perhaps to enhance it. Surface runoff from a sealed road would may also contain less sediment. In terms of nearby areas and the wider Tokomairiro ED, gully wetlands supporting habitats such as this (in a similar or better condition to what is present in the designation site) frequently occur in poorly draining gullies / valley floors within plantation forestry, regenerating native forest and farmland. • ~~Gully wetlands supporting swamp habitats such as the (Pūrei - rautahi – Yorkshire fog) – cocksfoot / watercress – floating sweetgrass grassland, and Harakeke – gorse / (pūrei – rautahi) flaxland, frequently occur in poorly draining gullies / valley floors within plantation forestry, regenerating native forest and farmland. The indigenous species that would be cleared are common and widespread.~~ • ~~Weedy scrub areas with scarce indigenous species such as those found in the (Large-leaved pohuehue) / (Himalayan honeysuckle) – gorse scrub are extensive in the immediate and wider area.~~ • ~~The [Large-leaved pohuehue] / [makomako – kōtukutuku] / Himalayan honeysuckle treeland is a relatively small and degraded example of regenerating indigenous forest. The indigenous species present are common and widespread.~~

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	~~Nearby much larger areas of vegetation with similar species composition are present in areas with statutory protection, and other similar or more intact patches are present in nearby gullies in adjacent catchments.~~ The extent of the (Yorkshire fog) - cocksfoot grassland that will be lost within the site and adjacent to McLaren Gully Road amounts to 3.15ha. Exotic rank grassland is common in fallow pasture or on disturbed habitat edges and is extensive in the immediate and wider area. The extent of the [Pūrei] – wīwī / rautahi – exotic grass rushland that will be lost adjacent to McLaren Gully Road amounts to just 2.7m^2 or 0.00027 ha ~~(pūrei) – wiwi / cocksfoot rushland wetland vegetation alongside McLaren Gully road~~The vegetation has likely been induced by vegetation clearance and grazing, and extensive similar areas of permanently or periodically wet pastures occur in the local and wider (ED) area. The loss of these vegetation communities will have a ~~low or~~ **very low** level of ecological effect. All other areas to be cleared comprise vegetation communities of negligible ecological value. ~~Notwithstanding this, further design work following the lodgement of these applications is proposed to refine the upgrades to McLaren Gully Road to avoid the roadside wetlands to the extent it is possible.~~ ~~A small number of *Threatened* k~~It is probable that a small number of Kānuka seedlings or low stature kānuka occur in areas affected by the proposal, however this species largely or exclusively occurs in areas of the site that are outside the landfill footprint. Kānuka has a threat status of 'Threatened – Nationally Vulnerable'. ~~trees will be lost in the [Large-leaved pohuehue] / [makomako – kōtukutuku] / Himalayan honeysuckle treeland in West Gully 4. However, t~~This threat status has been precautionarily assigned due to the possible and, as yet, poorly understood threat of myrtle rust to indigenous myrtle species (which includes kānuka). Kānuka is however an extremely common species at the level of the ED and nationwide. Vegetation clearance and earthworks may create further opportunities for weed invasion, and other potentially problematic weeds could be accidentally introduced on machinery, material or waste brought to site. However, in the context of the existing level of modification, the potential magnitude of ecological effect on all

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	vegetation types not subject to clearance at the site due to weed encroachment or weed introduction will be **very low**.
Construction of the landfill will result in the permanent loss of habitat for avifauna, including regenerating native treeland, macrocarpa forest, and re-planted radiata pine plantation, which provides habitats variously used by the At Risk eastern falcon for foraging, roosting and nesting.	Given that ~~only a small proportion of~~none of the native gully habitat on site will be lost, that ~~all of these~~ the lost re-planted radiata pine habitat type~~s are~~ is very abundant in the surrounding landscape, and that falcon are highly mobile species, habitat loss for falcon will have a **very low** level of ecological effect. Other native Not Threatened birds will also be able to disperse and utilise the areas of native habitat that will remain on site as well as native gully habitats present in the surrounding environment. As such, habitat loss for Not Threatened birds will also result in a **very low** level of ecological effect.
The noise and activities associated with construction and operation of the landfill, and road upgrades, may disturb foraging, roosting and nesting activities of local birds and potentially displace them from the site and nearby areas. Increased rodent populations may result in increased bird mortality.	Construction activities occurring during the falcon breeding season (i.e. between the start of September and the end of February) when birds are nesting on the site, could disturb and displace nesting adults and compromise the survival of eggs and / or chicks. This risk can be managed by avoiding construction activities during the falcon breeding season, or conducting a pre-construction nesting falcon survey and establishing construction-free exclusion zones around nests until nesting activities are completed. Outside of the falcon breeding season (i.e. between the start of ~~March~~ June and end of ~~August~~July), it is expected that At Risk eastern falcon, which are a highly mobile species, will disperse and utilise other areas of their extensive home ranges. Subject to construction management measures during the breeding season being implemented, any disturbance of falcon will result in a **very low or low** level of ecological effect. For native Not Threatened species, the effect of disturbance will also have a **very low** level of ecological effect. Most of the habitat they utilise on site will remain, and if displaced there is other habitat nearby that they can disperse to and utilise. Increased food supplies at landfills can attract rodents and increase local rodent populations, which can have a negative effect on local bird populations. Vermin numbers can be controlled by prompt compaction and application of cover soil, and trapping and poisoning rodents. With the implementation of these actions any increased predation by rodents in the surrounding area will have a **Very Low** level of ecological effect on avifauna.

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
Operation of the landfill will attract increased abundances of birds, and potentially result in strike with aircraft within the Dunedin airport approach/departure circuit.	As outlined in **section 4.5.2**, birds that pose a strike risk to aircraft (and as such are at risk themselves from strike) are already currently common in the local and wider landscape surrounding Dunedin Airport. The landfill site is approximately 4.5 km south-west of Dunedin Airport. Normal aircraft flight patterns are north / south along the Taieri Plains, however, during strong westerly winds commercial aircraft prefer to fly east rather than west of Dunedin airport over, or near, the landfill site. Smaller aircraft fly over the area if the cloud base is at least approximately 150m above the terrain. Landfills attract birds, particularly scavenging species, some of which are at risk from strike with aircraft if a landfill is located near an airport. The landfill site provides habitat for a diversity of bird species, however, no species are present at the site that are both attracted to landfills and are at risk from strike with aircraft. Gull species, especially black-backed gulls, are of particular concern in New Zealand. Black-backed gulls are the species most attracted to landfills and because they are large birds that often soar at high elevations (between 1000 - 3000 feet (approximately 305 - 914 m above ground level) where they may potentially encounter aircraft, and they are at risk from aircraft strike. Seven black-backed gulls were observed traversing the site during surveys. Good landfill operational practises are crucial and if effectively maintained can keep bird numbers at low levels. The most effective operational practise to prevent birds from establishing at a landfill is to exclude or reduce as much as possible putrescible (organic) waste from the waste stream as this denies birds a food source. Other important operational practises~~, and~~ include: • Good litter control; • Separating putrescible and general waste streams (if possible); • Transporting waste to the landfill in sealed containerised trucks (if possible); • Minimising the uncovered working face; • Prompt and thorough compaction of waste; • Covering waste at the end of the day; • Special handling of highly organic waste; and

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	• Minimising areas of exposed earthworks and related shallow pools and puddles of water. • Maintaining long grass cover at the site. • ~~Bird management measures~~Deterrence and bird management methods, including scaring, and shooting non-protected species. Experiences at landfill's elsewhere in New Zealand (including Green Island), has highlighted the following practices as being most effective at reducing the attractiveness of landfills to birds and keeping bird numbers low, include: • Providing daily, plentiful cover of the waste in the open tip face. This denies birds a food source and as such does not provide a foraging opportunity. • Scaring birds using gas-powered bird scarers (gas guns) and shooting them using shot guns. These methods should both be used as birds can become habituated to one type of method, reducing its effectiveness over time. With good, sanitary and effective operational procedures as well as reducing the proportion of organic waste in the waste stream, good bird monitoring, management and control, bird numbers (particularly black-backed gulls) at the landfill can be kept to very low numbers and therefore result in negligible additional strike risk with aircraft, and a **very low** level of ecological effect. Waterfowl and shags are also present in high abundances in the wider landscape, and may be attracted to areas of open water in the site. These species are also at risk of strike with aircraft. The landfill attenuation basin will at times hold water following rain events, however will typically be dry, and will be planted so open water will not be present. It is therefore not expected bird strike risk will increase relative to the risk in the wider area that already exists from the extensive number of waterfowl utilising the Taieri Plain wetland complex. As a result, there will be negligible additional risk of strike risk for waterfowl and shags with aircraft, resulting in a **very low** level ecological effect.

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
Construction of the landfill and road upgrades will result in the loss of habitat for lizards, and disturbance and displacement of lizards into unsuitable habitat, or result in lizard mortality.	The potential lizard habitats within the designation site and on roadsides are of generally low quality and are expected to house low numbers of lizards (if any). However, At Risk lizard species may be present within the site with **High** ecological value, and all native lizards are protected under the Wildlife Act. Where practicable, clearance of areas of lizard habitat (particularly ~~regenerating native treeland (large-leaved pohuehue) / (Himalayan honeysuckle) – gorse scrub community); and~~ areas of (Yorkshire fog) - cocksfoot grassland (within or surrounding radiata pine – gorse / (cocksfoot – Yorkshire fog) shrubland) should be avoided. Where the removal of lizard habitat cannot be avoided, risks to lizards can be managed by the pre-construction salvage and relocation of lizards and implementing measures for incidental discovery of lizards during construction. Revegetation within the designation site which incorporates a species mix can also provide habitat and food resources (e.g. *Muehlenbeckia complexa*). Wooden debris can also be included, providing suitable refugia for lizards (as well as invertebrates). With appropriate salvage plan and habitat enhancement, the effects on the wider populations is likely to have a **low level** of ecological effect.
Construction and operation will result in the reduction in groundwater and surface water flows, and discharge of sediment and contaminants to the downstream environment, resulting in loss of wetland habitat, and changes to freshwater indigenous fish, aquatic invertebrates, or indigenous aquatic plants.	As outlined in **section 8.5.2**, the landfill is likely to lead to a worst case ~~50~~20% reduction in surface water flows to the downstream valley floor marsh wetland, and groundwater levels in the shallow groundwater system at the bottom of the site are predicted to reduce by approximately ~~2 – 3~~1 m in the immediate vicinity of the landfill. This change in annual runoff could lead to a “down-valley” shift in the perennial flow transition (i.e. the point at which the system shifts from valley floor marsh wetland system to a permanently flowing waterway system). Groundwater infiltration from the proposed stormwater attenuation basin is however anticipated to provide sufficient soakage to mitigate the loss of groundwater recharge, and the alteration to downstream water flows is expected to result in only a slight change. It is anticipated that any changes in downstream water quantity are likely to be only slight changes and limited to 300 m of waterway section between the swamp wetland within the designation site and the large pond downstream of the site. Furthermore, ~~E~~ecological effects of any alternation to downstream ~~the altered~~ water supply

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	will become relatively far less important downstream of the swamp wetland as recharge of the valley floor marsh wetland occurs from other tributaries (e.g. East Gully) and as the relative proportion of the overall catchment affected by the landfill decreases. A reduction in water supply may lead to a slightly altered composition of wetland vegetation in the swamp wetland and the valley floor marsh wetland. Based on the anticipated slight changes in the surface water and shallow groundwater system, it is expected the swamp wetland and valley floor marsh wetland will persist as wetland features. At worst, some individual obligate wetland plants may disappear from some areas, being most likely nearest the designation site, and such an effect would likely be associated with an expansion of the surrounding facultative wetland plant species. The main obligate wetland species that are most vulnerable to an altered (reduced) water supply, in terms of cover, are exotic species (sweetgrass and watercress) and as such are not considered to have intrinsic ecological value in terms of ecological effects assessment. Pūrei, which could possibly reduce in extent, is a Not Threatened indigenous species that is extremely common in the surrounding area and at the level of the ED. The continuous overall wetland feature (within and below the designation site) has a number of hydrological influences that will alter with time irrespective of the landfill proposal (including climate change effects, and land use changes in other tributaries, i.e. ongoing maturation of adjacent pine forest and regeneration of native forest in gullies). Such factors render it difficult to assess the likelihood or extent of possible wetland changes. For example, it is likely that ongoing plantation forestry at the site would have negative effects on the swamp wetland (e.g. reduced water supply as pines mature, and introduction of weeds and sediment especially during harvest cycles). In this context, the impacts of an alteration in land use (the landfill) may be similar or perhaps better. This applies also to the valley floor marsh wetland, but this area is likely better buffered (in terms of water supply) by the existing large deep pool surrounded by pūrei approximately 300 m below the designation site. It is likely to be important for the hydrology of the valley floor marsh wetland overall by buffering the water supply both upstream and downstream (by impounding flows and retaining water upstream, and by releasing water slowly downstream in dry periods). It is unlikely that the seasonal rainfall / runoff retained by

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	this system (and water contributions downstream in turn) would diminish due to the influence of the landfill. Taking into account the uncertainties and assumptions, the worst case effect of the landfill, in terms of potential habitat changes (change in wetland species composition) is assessed as a **Low** level of ecological effect for the swamp wetland and a **Very low** level of ecological effect for the better-buffered valley floor marsh wetland below. No hydrological effects of the landfill proposal on the wetland vegetation at the base of West Gully 3 and 4 upstream of the swamp wetland are expected because of the non-existent and insignificant contribution (respectively) of the proposed landfill footprint to the catchment for this narrow area. ~~result in the contraction or disappearance of permanently wet area and resultant swamp vegetation, most likely nearest the designation site. The surrounding marsh vegetation may expand to occupy this area but may do so at the expense of a loss at the existing marsh edges, because the permanently and periodically wetted soil width may contract overall.~~ ~~The precise magnitude of effect is unclear, because the wetland has a number of hydrological influences that will alter with time (including other tributaries, maturation of adjacent pine forest), and because it cannot be predicted with confidence the extent to which soil moisture conditions may be reduced to the point that wetland plant species are excluded.~~ ~~The valley floor marsh wetland covers approximately 2.0 ha, of which approximately 0.8 ha is immediately downstream of the site and upstream of the East Gully confluence. At the severe end of the spectrum, the potential near-total loss of wetland vegetation above the East Gully confluence could occur if water runoff from the landfill site is insufficient to retain permanent water in the large pool at this location.~~ ~~This area comprises a mix of largely exotic species and indigenous wetland plant species that are all common in the area and the wider (ED) landscape, but the entirety of the wetland, and in particular its large length, is likely to be of importance in buffering runoff and sediment flows downstream. In this context, the potential loss of 0.8 ha of wetland would amount to a **low** to **moderate** level of ecological effect, with this range reflecting the uncertainty regarding the effects of reduced wetland water supply.~~

Potential Changes to Vegetation, Habitats, or Communities	Assessment of Effects
	The landfill construction and operation could result in the disturbance and mobilisation of soils into stormwater and into the downstream receiving environment if sediment control measures are not established. Elevated turbidity can adversely affect the growth of aquatic plants and algae. Feeding activity and foraging success for macroinvertebrates can be reduced by elevated turbidity, and it can limit the ability of visually foraging fish to feed (e.g. trout) and result in avoidance behaviour of indigenous species such as banded kokopu. High loads of suspended sediments can also damage fish gills and make them more susceptible to disease, or even result in mortality. The proposed stormwater management system should capture any sediment laden water and ensure that fine materials are not discharged downstream. The tributary currently receives runoff and stormwater from the pine plantation. Based on the proposed management system, there could be an overall positive effect,~~Sediment discharges to the tributary may be~~ or only a very slight change from the existing baseline condition due to the landfill proposal, ~~or could be better than currently occurs,~~ resulting in a **very low** level of ecological effect. Discharge of leachate to the receiving environment would likely be toxic and may kill freshwater flora and fauna. The proposed leachate management system will intercept and collect potential leachate to avoid it leaking / discharging into the downstream receiving environment. Down gradient monitoring wells are also proposed to be installed, to provide advance warning of any leachate leakage before it reaches the downstream receiving environment. With this management system in place, there will be a **very low** level of ecological effect. As outlined in **section 8.6.1**, there is predicted to be a reduction in contaminant flux downstream as a consequence of the landfill. It cannot be predicted with confidence what effect an overall reduced contaminant flux will have on downstream wetland vegetation, however overall changes to surface water quality due to the landfill proposal are most likely to be an overall positive effect. ~~the effect may be positive.~~

8.8.1 Ecological Management Measures

Overall, the construction and operation of the landfill, and road upgrades are expected to have a low or very low level of ecological effects. ~~Effects on wetlands downstream of the site however are uncertain and may constitute a moderate level of ecological effects, due primarily to a reduction in surface runoff from the landfill site.~~ ~~Furthermore~~However, as noted in **section 4.5.1**, some of the vegetation types that will be lost comprise areas of significant indigenous vegetation or habitats for the purposes of section 6(c) of the RMA, as determined by assessment against the PRPS and 2GP criteria.

The policy framework of the PRPS and 2GP overall require that adverse effects on wetlands and other significant indigenous vegetation types are to be avoided; and if avoidance is not practicable, the applicant must ensure that there is 'no net loss' and preferably a net gain in the indigenous biodiversity values of the area. Consequently, vegetation types / habitats (including wetlands) that have been identified as significant~~, including wetlands,~~ that are to be cleared or otherwise negatively affected are required to be avoided, remedied, mitigated, offset, or compensated for to ensure that there is no net loss of the significant ecological values in those vegetation types. These requirements are irrespective of the ecological value, magnitude of impact, and overall level of ecological effect identified above, which describes the effect of the proposal in relation to the existing environment rather than its significance in terms of the PRPS / 2GP.

Based on the recommendations of the Ecological Impact Assessment, **Table ~~24~~ 25** below outlines the management measures proposed to avoid, remedy, mitigate, or offset any adverse effects of construction and operation of the landfill, and road upgrades. It also describes the residual impact with the management measures implemented for adverse ecological effects, with emphasis on steps required to effect 'no net loss' for significant habitats and/or levels of effect that are greater than 'very low.'

Table ~~24~~ 25 – Summary of Predicted Effects, Proposed Mitigation, and Residual Effects after the implementation of Avoidance, Minimisation and Mitigation Measures (Updated May 2021).

Subject or Location of Impact	Predicted Impact Without Management Measures	Summary of Management Measures	Residual Effects After Implementation of Management Measures
Terrestrial and Wetland Ecosystems and Habitats			
~~Loss of wetland habitat in the swamp wetland and West Gully 4.~~	~~Loss of at least 0.45 ha of grassland and flaxland wetland habitat in these areas constitutes a low level of ecological effect, but these habitats are significant under RPS criteria and no net loss, or net gain, is required.~~	~~A Wetland Restoration Plan, which outlines steps to enhance or create wetland habitat of an equivalent overall area, will be prepared and implemented. This Plan will include fencing, planting, weed and pest control, and monitoring.~~ ~~Expansion of wetland will take place near the site of impact (in~~	~~The habitat types lost are degraded by weeds and pests, and implementation of a Wetland Restoration Plan would result in no net loss or net gain (a positive effect) in wetland habitat in the vicinity of the landfill.~~

Subject or Location of Impact	Predicted Impact Without Management Measures	Summary of Management Measures	Residual Effects After Implementation of Management Measures
		~~West Gully 3, around stormwater attenuation basin) or within the designation site (East Gully).~~	
Loss of significant wetland habitat adjacent to roadsides.	Loss of ~~at least 0.53~~0.0017 ha of wetland (sedgeland~~grassland,~~ and rushland~~) and flaxland~~ habitat in these areas constitutes a very low level of ecological effect, but these habitats are significant under RPS and 2GP criteria and no net loss, or net gain, is required.	A ~~Wetland~~ Vegetation Restoration Management Plan, which outlines steps to enhance wetland habitat in ~~remaining~~ a nearby wetland area~~s~~, will be prepared and implemented. This Plan will include fencing, planting, weed control, and monitoring. Enhancement of wetland ~~will occur in the same wetlands affected by road widening. If landowner permission cannot be obtained, then~~will occur in an area of existing wetland vegetation within the landfill site at the base of West Gully 3, and West Gully 4 (comprising 0.49 ha in total)~~ an offset at another site will be considered (e.g. East Gully, or gullies within land owned by the DCC outside of the designation to the west)~~.	Implementation of a Vegetation ~~Wetland~~ Restoration Management Plan (including fencing, plantings, and weeding across 0.49 ha of higher quality wetland) would result in a substantial net gain ~~no net loss or net gain (a positive effect)~~ in wetland habitat ~~in the vicinity of the roads~~.
Downstream effects on significant wetlands below the ~~designation site~~landfill.	~~A reduction in~~Altered groundwater and runoff from the ~~site~~ landfill footprint may affect the 0.47ha swamp wetland. ~~valley floor marsh wetland. The degree to which reduced water supply might reduce wetland extent is highly uncertain.~~ Possibly, changes to vegetation structure, with loss of some indigenous	A Vegetation ~~Wetland~~ Restoration Management Plan, which outlines steps to enhance and improve the integrity of the ~~existing~~ swamp wetland ~~habitat, in downstream / nearby wetland areas,~~ will be prepared and implemented. This Plan will include fencing, planting, weed control, and monitoring. Enhancement would occur within the swamp wetland itself. ~~Adaptive management will be applied to monitor wetland loss (if any) and ensure wetland~~	Implementation of a Vegetation Restoration Management Plan (including fencing, infill planting and weeding across the currently degraded 0.47 ha wetland, including planting of an 0.4 ha buffer of indigenous dryland vegetation around the wetland) would result in a net gain (a positive effect) to the swamp wetland. ~~Monitoring of wetland loss (if any) and~~

Subject or Location of Impact	Predicted Impact Without Management Measures	Summary of Management Measures	Residual Effects After Implementation of Management Measures
	wetland species that generally favour wetter conditions (pūrei), would occur. ~~Wetland loss / changes cannot be predicted with confidence~~. A low ~~to moderate~~ level of ecological effect is possible. No net loss, or net gain, is required.	~~enhancement is adequate to account for the as-yet unknown impact on the valley floor marsh wetland.~~ ~~Enhancement of wetland will occur within the valley floor marsh wetland, most likely downstream of the site where enough water supply to support wetland vegetation is likely to persist, or an offset at another site provided (e.g. East Gully, or gullies within land owned by the DCC outside of the designation to the west~~.	~~subsequent implementation of an appropriate Wetland Restoration Plan (if required) would result in enhancement of indigenous biodiversity in remaining wetland areas and would result in no net loss or net gain (a positive effect) in indigenous biodiversity in the remaining wetland habitat.~~
~~Treeland vegetation in West Gully 4 and in scattered small areas elsewhere (along roads).~~	~~Loss of 4.52 ha of treeland habitat in West Gully 4 constitutes a low level of ecological effect, but these habitats are significant under RPS criteria and no net loss, or net gain, is required.~~	~~A Terrestrial Vegetation Restoration Plan, which outlines steps to enhance and create habitat, will be prepared and implemented prior to clearance of vegetation during landfill stage 4-5. This Plan will include require fencing, planting, weed and pest control, and monitoring.~~ ~~Expansion and enhancement of treeland will occur between West Gully 2 and 3 to link existing indigenous forest patches and take into account natural spread of native seedlings.~~	~~The habitat types lost are degraded by weeds and pests, and implementation of an appropriate Terrestrial Vegetation Restoration Plan would result in no net loss or net gain (a positive effect) in treeland / forest habitat in the vicinity of the landfill, and represents an opportunity to introduce tree species lost from the area but which would have been historically present (also a net gain / positive effect).~~
Avifauna			
Eastern Falcon	Disturbance, displacement and mortality[34] of falcon during the breeding season (construction)	A Falcon Management Plan will be prepared and implemented. This plan will include~~, but is not limited to,~~ details regarding the time of year to avoid~~ing~~ construction during the falcon	There will be negligible /low residual effects after correct implementation of the Falcon Management Plan.

[34] There is only a potential mortality risk if falcon are nesting on site.

Subject or Location of Impact	Predicted Impact Without Management Measures	Summary of Management Measures	Residual Effects After Implementation of Management Measures
		breeding season, and if this is not practicable, measures to minimise effects on potentially nesting birds (e.g. pre-construction falcon surveys and establishing construction exclusion zones around any identified nests until nesting activities are completed.	
Herpetofauna			
Southern grass skink and other indigenous herpetofauna	Indigenous lizard species may be present in the landfill site, most likely Southern grass skink (At Risk – Declining). ~~Some areas of~~3.15ha of grassland vegetation that ~~are~~ is proposed to be cleared for landfill construction and road upgrades represent ~~typical~~low quality habitat for this species. All native lizard species are absolutely protected under the Wildlife Act 1953.	A Lizard Management Plan will be prepared and implemented. This plan will manage effects on lizards primarily by salvage and translocation away from the site of impact, and through predator control efforts as part of the plant and animal pest controls detailed in the LMP. ~~Pest Management Programme~~. It will also outline a range of measures to enhance and protect a potential lizard release site via fencing and planting. ~~Whether~~ The extent of lizard translocation / habitat enhancement ~~is~~ required is dependent upon the as-yet unknown population size and current locations of lizards. The Forest and Westland Restoration Plan includes a range of measures to enhance and protect a potential lizard release site at West Gully 2 across an approximately 5.8 ha area.	There will be negligible residual effects after correct implementation of the Lizard Management Plan.

Subject or Location of Impact	Predicted Impact Without Management Measures	Summary of Management Measures	Residual Effects After Implementation of Management Measures
Freshwater ecology			
Downstream effects on the Ōtokia Creek Tributary below the designation site	A reduction in groundwater and surface water / runoff from the designation site may reduce the perennial extent of the waterway. The degree to which reduced water supply might reduce the extent of the perennial reaches is likely to be limited to 200-300 m downstream of the designation (and upstream of the large pond). Changes to perennial reaches would result in a slight change to poor quality freshwater habitat. The large pond, which supports two species of indigenous fish, is unlikely to be affected. This constitutes to a very low level of ecological effect.~~A reduction in groundwater and surface water / runoff from the landfill site may reduce the perennial extent of the waterway. The degree to which reduced water supply might reduce the extent of the~~	Impact measures such as best practice erosion and sediment control measures, implementation of attenuation basin, etc. are already assumed. The Vegetation Restoration Management Plan is also required as mitigation for the potential changes to the 0.47 ha swamp wetland which sits within the tributary. No additional mitigation for freshwater is required. Mitigation will occur within the swamp wetland itself. ~~Adaptive management will be applied to monitor loss of freshwater habitat (if any) and ensure enhancement is adequate to account for an as-yet unknown impact on the freshwater ecology values downstream.~~ ~~Enhancement of freshwater habitat will occur within the valley floor marsh wetland / Ōtokia Creek Tributary downstream of the site where enough water supply is found to create perennial flows, or an offset at another site will be provided (e.g. East Gully, or gullies within land owned by DCC outside of the designation to the west).~~	~~Monitoring of loss / shift of perennial reaches (if any) and subsequent implementation of appropriate mitigation/offset.~~ Implementation of an appropriate Vegetation Restoration Management Plan will result in a net gain (a positive effect) to the swamp wetland. This will result in improvement of freshwater habitat downstream, resulting in a positive effect, or a very low level of residual effect.

Subject or Location of Impact	Predicted Impact Without Management Measures	Summary of Management Measures	Residual Effects After Implementation of Management Measures
	~~perennial reaches is highly uncertain.~~ ~~Changes to perennial reaches would result in a loss of habitat for freshwater species, potentially including freshwater fish and freshwater crayfish.~~		

A draft of the Vegetation Restoration Management Plan, Falcon Management Plan, and Lizard Management has been prepared and is contained within the draft LMP.

In addition, the following additional measures are proposed to be implemented:

- ~~Avoiding indigenous vegetation clearance in West Gully 3 (the kānuka forest and harakeke – gorse / (pūrei – rautahi) flaxland) and West Gully 2.~~
- Avoiding ~~as far as practicable indigenous vegetation clearance, earthworks, road widening, and~~ vehicle or machinery movements ~~in areas of indigenous vegetation and wetland~~ outside the ultimate footprint of works. In particular, during road construction, contain vegetation clearance and construction effects to only the area within the final road widening design extent to avoid any further encroachment of wetland vegetation. ~~this regard, further design work following the lodgement of these applications is proposed to refine the upgrades to McLaren Gully Road to avoid the roadside wetlands to the extent it is possible.~~
- Avoiding further weed incursions by ensuring construction equipment is clean, and external sources of gravel, soil etc being bought to site are free from seeds or other viable plant material and managing the encroachment of weed species into vegetation communities within the site.
- Preparing and implementing a ~~Predator Control Programme~~Plant and Animal Pest Control Programme in order to mitigate adverse effects on vegetation, avifauna, and herpetofauna due to landfill construction; to enhance these ecological values; and to avert future losses associated with a potential influx in mammalian pests due to landfill operation. Plant and animal pest controls are detailed in the draft LMP.
- Implementing a Bird Management Plan to manage the risk of aircraft bird strike from avifauna attached to the site by the landfill operation, and in particularly black-backed gulls). A draft Bird Management Plan has been prepared and is ~~attached as **Appendix 17**~~included within the draft LMP. The plan is a dynamic document that will be reviewed at least annually and updated based on lessons learned (adaptive management), and the most effective bird management and control techniques. Ongoing liaison with Dunedin Airport will be part of the development and implementation of this plan.

~~Potential effects on the freshwater values of the downstream Ōtokia Creek tributary will be further considered and confirmed following further investigations of the existing freshwater ecology values, over the months of November to April (including to determine if freshwater fish and / or freshwater crayfish are present). Surveys for the presence of fish were due to be undertaken in the first quarter of 2020, however that did not occur due to Covid 19 travel restrictions. The outcomes of those investigations and any changes to the proposed management measures identified above, will be provided to Te Rūnanga o Ōtākou, and ORC and DCC as part of the consideration of the resource consent applications.~~

Based on the above assessment, measures are proposed to be incorporated within the conditions and LMP objectives for the ORC consent to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of rivers. Conditions are also proposed to be incorporated within the DCC conditions of consent for the road upgrade ~~and wetland creation/enhancement~~ outside of the designation.

The proposed conditions and draft LMP objectives are included in **Appendix 17** and for the purposes of ecology require:

- Avoiding clearance of indigenous vegetation in West Gullies ~~3 and 2~~1, 2, 3 and 4 and ensuring wetland clearance occurs only occurs to the extent necessary.
- ~~Preparation~~Finalisation, implementation, and review of Falcon, Lizard, ~~Wetland Restoration~~, and ~~Treeland~~ Vegetation Restoration, and Bird Management Plans in consultation with Te Rūnanga o Ōtākou, based on the draft plans.
- ~~Preparation, implementation, and review of the Bird Management Plan based on the *Draft Smooth Hill Bird Management Plan* prepared by Boffa Miskell Ltd,~~
- ~~Preparation~~ Finalisation and implementation of a ~~Predator~~ Plant and Animal Pest ~~C~~ Control Programme.
- Ensuring the final LMP addresses: protection of indigenous vegetation and wetlands outside of the operational footprint; and weed encroachment.

Overall with these measures, the adverse effects of the project on terrestrial and freshwater ecology will be appropriately managed and no more than minor on the environment, and any persons.

Other measures will also be later incorporated into the outline plan of works application to avoid, remedy, and mitigate the effects of the landfill construction and operational activities on terrestrial and freshwater ecology. Those measures are expected to largely mirror those proposed above to the extent to which they are relevant to the use of the site, including:

- Implementing the Falcon, Lizard, ~~Wetland, Terrestrial~~ Vegetation Restoration, and Bird Management Plans, and ~~Predator Control Programme~~Plant and Animal Pest Control Programme.
- Implementation of the Landfill Management Plan.

8.9 Natural Character, Landscape Character, and Visual Amenity

The construction, operation, and aftercare of the landfill and road upgrades will modify the existing landscape, natural character, and visual amenity within the site and surrounding area. Such effects are of broad relevance to the ORC consents to take, use dam, divert water; and discharge stormwater and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. They are also of relevance to the DCC consents for the road upgrade~~, and wetland creation/enhancement~~ outside the designation.

Landscape and visual effects will be primarily of relevance to the consideration of the future application for an outline plan of works to construct and operate the landfill within the designated site, including to address the designation condition 2 requirement for a landscape plan. While not relevant to the current applications, management of effects within the designation are discussed to inform the community and decision makers as to how such effects will be managed.

Potential effects on landscape and natural character values, and visual amenity include:

- Long term gradual modification of the landscape as the landfill is progressively constructed, operated, and closed.
- Reclamation of the ephemeral watercourses and swamp wetland within the site, and adjacent to the road upgrades, and the associated loss of landscape and natural character, and visual amenity.
- Reduction in visual amenity as viewed from surrounding public and private locations, including houses.

The Landscape and Visual Assessment Report contained in **Appendix 12** has addressed the effects of the project on landscape character, natural character, and visual amenity. The outcomes of that assessment are summarised in the following sections.

8.9.1 Landscape Effects

Construction of upgrades to McLaren Gully Road from its intersection with State Highway 1 to the access into the site along Big Stone Road will reveal a raw work appearance generating **moderate** adverse effects, but which do not appear uncharacteristic given their association with the existing rural road network. Once completed, the upgraded road corridor will maintain part of a wider rural road network which assimilates within this undulating rural ~~context~~ landscape resulting in **low** landscape effects.

Construction and operation of the landfill will substantially modify the existing folded landform to infill a gully ~~create an enclosed amphitheatre~~ as refuse is gradually deposited within the identified landfill extent. Such modification will contrast with surrounding rural based activity, however will be consistent with the effects anticipated by the underlying designation. Given this outcome, there will be moderate – high adverse physical landscape effects within the site during operation, but which remain largely internalised, and therefore generate **low** adverse effects from external areas outside the site. Once the landfill is fully completed the landform will be shaped to resemble a smoothed rounded form which will be maintained in pasture. It will remain contained in a broader productive rural landscape that can continue to be managed as productive forestry and enduring

areas of indigenous vegetation, including ecological mitigation within the balance of the site. There will be **low** adverse physical landscape effects following completion.

While the appearance of the site will continually change through sequences of bare ground, landfill operation, and reinstatement of pasture and surrounding vegetation, it will retain an inherent rural character both during and after the project. During landfill activity, movement of large machinery and earthworks will be evident and atypical of the normal day to day rural activities that currently prevail. The construction and operation of plant, soil stockpiles and drainage within the site will also generate some more distinctive rural-industrial influences, however these will remain subservient to surrounding rural land-use and will have limited visibility from beyond the site. Associated landscape effects will be further mitigated by perimeter trees consistent with surrounding areas of forestry (outlined in **section 5.9**) resulting in adverse landscape character effects remaining well contained, and external views continuing to be characterised by established areas of pine which are apparent in much of the surrounding landscape.

Given the relative containment of the site and the gradual and intermittent nature of the filling and earthworks activity, potential landscape character effects will be **moderate-low** adverse during operation which reduce to **low** adverse effects at completion.

8.9.2 Natural Character Effects

As outlined in **section 4.3.2**, the waterbodies on the site comprise ephemeral watercourses and a swamp wetland which form tributaries to Ōtokia Creek. Such waterbodies occur in the context of an existing modified rural environment which includes extensive areas of plantation forestry and express limited existing levels of natural character.

The proposed landfill will avoid the ephemeral streams and wetlands and preserve the limited levels of natural character expressed in these areas. Widening of the road as part of the upgrades will result in the removal of 17m^2 of wetlands. These waterbodies associated with the upgrade to McLaren Gully Road adjoin an established road corridor and surrounding rural landscape expressing a higher degree of modification and more limited natural character. Overall, the removal of 17m^2 of low-quality wetland will result in a very low level of effects. Providing substantial ecological planting throughout the designation site in accordance with the Vegetation Restoration Management Plan will in time result in low beneficial natural character effects.

~~Whilst the introduction of a landfill will represent a substantial modification of the site, this will remain localised and occur in the context of the existing wider modified working rural environment.~~

~~In addition to direct effects relating to the landfill, there may also be some indirect effects which include potential downstream effects, and loss of existing wetland areas associated with the proposed upgrade to McLaren Gully Road as identified in the ecological assessment in **section 8.8**. Such modification would occur in the context of an established road corridor and surrounding working rural landscape including plantation pine, expressive a higher degree of modification and more limited natural character. Implementation of the ecological mitigation, including the Wetland Restoration Plan will address any potential for significant natural character effect sin the context of ongoing rural activity.~~

8.9.3 Visual Amenity Effects

The site is visually confined within a sequence of hills and valleys which extend between the Taieri Plains and the South Taieri Coast. As such the visual catchment for all but the highest points of the site are very restricted. Within this context, the potential to observe the proposed landfill operation is largely contained within an internal amphitheatre with the potential viewing audience predominantly limited to adjoining areas including parts of McLaren Gully and Big Stone Roads.

The location and physical nature of the site, within a folded gully system, essentially contains and mitigates most visual effects of the landfill on the surrounding area. Views from dwellings are limited to long distance partial views from ~~the two closest dwellings southeast of the site~~three dwellings which are typically concealed by intervening plantation forest within a wider working rural landscape. Any partial and transient views will entail a foreground of productive plantation forestry and typically maintain a very distant backdrop of Maungatua beyond the Taieri Plains generating some short term **moderate adverse** effects, principally from adjoining roads. Once perimeter trees have established in accordance with the ~~staged~~ landscape mitigation (described in **section 5.9**), any visual effects generated along the boundary of the landfill will reduce to **low adverse** effects.

8.9.4 Landscape Management Measures

Based on the above assessment, no specific additional measures are proposed to be incorporated within the conditions and LMP objectives for the ORC consents to take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. Implementation of the proposed ecological mitigation measures addressed in **section 8.8.1**, will ensure there will be no potential for any significant residual adverse effects on natural character associated with waterbodies.

Measures are proposed to be incorporated within the DCC conditions of consent for the road upgrade ~~and wetland enhancement/creation~~ outside the site to avoid, remedy or mitigate adverse effects on landscape, natural character, and visual amenity. The proposed conditions are included in **Appendix 17** and require that where practicable completed road cut and fill batters to be hydroseeded with grass as soon as possible.

Overall with these measures, the adverse effects of the road upgrades on landscape and natural character, and visual amenity will be appropriately managed and be no more than minor on the environment, and on any persons.

Other measures will also be later incorporated in the outline plan of works application to avoid, remedy, and mitigate the effects of the landfill construction and operational activities within the existing designation on landscape and natural character, and visual amenity as recommended by the Landscape and Visual Assessment Report. This will include a finalised landscape mitigation plan to meet the requirements of designation condition 2, and which provides for:

- Perimeter planning comprising dense bands of pine, kanuka and totara along the eastern ridge and the Big Stone Road boundary. ~~The perimeter trees for stages 1 and 2 will be planted at the outset, with the balance of Stages 4 and 5 managed as productive forestry. Once Stage 3 is near completion (anticipated at 29 years), the forestry will be removed,~~

~~and the remaining permitter planting will be established as part of the development works for stages 4 & 5.~~

- Ongoing maintenance of the above planting to ensure successful establishment, along with weed control, rubbish removal, and replacement of failed/unhealthy plants.

8.10 Archaeological Values

The project has the potential to adverse effect archaeological values where known or unknown archaeological sites or material are damaged, modified, or destroyed by construction related earthworks or other activities. Such effects are relevant to the consideration of the applications to ORC consents to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of wetlands/rivers. They are also relevant to the DCC for the road upgrades~~, and wetland creation/enhancement~~ outside the designation.

The effects are also relevant to the consideration of the future application for an outline plan of works to construct and operate the landfill within the designated site. While not relevant to the current applications, management of effects within the designation are discussed to inform the community and decision makers as to how such effects will be managed.

The Archaeological Assessment Report completed by New Zealand Heritage Properties contained in **Appendix 13** has considered the effects of the project on the archaeological sites and values outlined in **section 4.8**. The archaeological sites that fall within the project area, the significance of their values, and how they are affected is summarised in **Table ~~25~~ 26** below.

Table ~~25~~ 26 – Archaeological Sites Affected by the Project

NZAA Site ID	Description	Archaeological Significance	Assessment of Effects
I45/71	1880s farmstead associated with the Flett family. Remnants of pre-1900 timber and roughcast building remain. The building is surrounded by Macrocarpa and Eucalyptus trees associated with pre-1900 occupation of the site.	Medium archaeological values.	The pre-1900 building falls outside the landfill operational footprint and will be unaffected. The margins of the archaeological site fall within the landfill operational footprint where there is the potential for other sub-surface archaeological remains to be encountered during works (e.g. foundations of outbuildings, rubbish pits). ~~The pre-1900 building falls within the landfill operational footprint and will be demolished. There is the potential for other sub-surface archaeological remains to be encountered during works (e.g.~~
I45/72	Likely pre-1880s farmstead associated with the Flett family. Foundations of pre-1900 earth walled building remain. The building remains are surrounded by Macrocarpa and Eucalyptus trees associated with pre-1900 occupation of the site.	Medium archaeological values.	

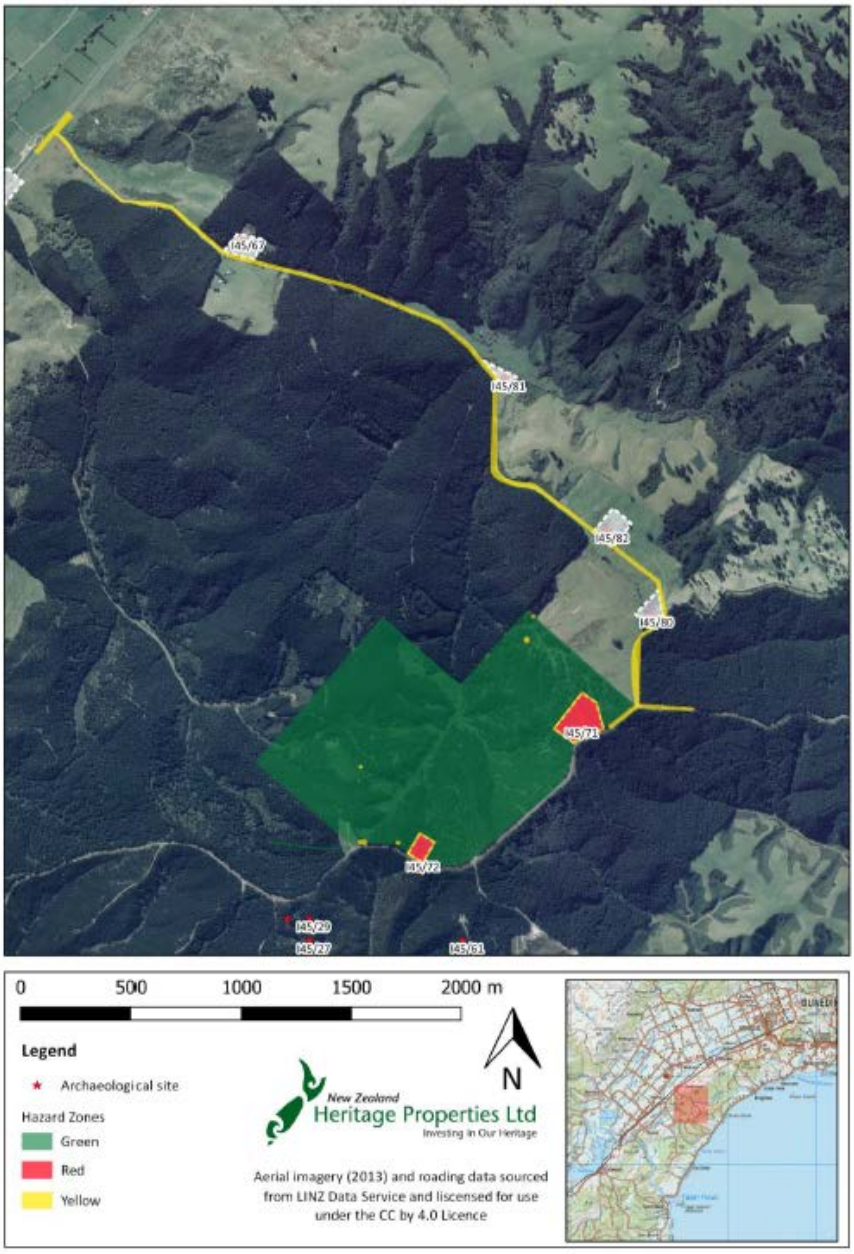
NZAA Site ID	Description	Archaeological Significance	Assessment of Effects
			~~foundations of outbuildings, rubbish pits).~~
I45/67	Farmstead associated with the Flett family from the 1860s. Pre-1900 building exists on the site. No other physical remains are evident on the site.	Medium-high archaeological values	The pre-1900 building falls outside the road upgrade corridor for the State Highway 1 intersection, McLaren Gully Road, and Big Stone Road and will be unaffected. There is the slight potential for other sub-surface archaeological remains to be encountered during road upgrade works (e.g. fence posts, rubbish pits).
145/79	Farmstead associated with the Palmer family from the 1860s. Pre-1900 building exists on the site. No other physical remains are evident on the site.	Medium archaeological values	~~The pre-1900 building falls outside the road upgrade corridor for McLaren Gully Road/Big Stone Road and will be unaffected. There is the slight potential for other sub-surface archaeological remains to be encountered during road upgrade works (e.g. fence posts, rubbish pits).~~
I45/80	Farmstead associated with the Riley family from the 1860s. No physical remains are evident.	Low-medium archaeological values.	
I45/81	Farmstead associated with the Guthrie family from the 1870s. No physical remains are evident.	Low-medium archaeological values.	
I45/82	Farmstead associated with the Souness family from the 1860s. No physical remains are evident.	Low-medium archaeological values.	

Overall, the proposed works will impact or have a high likelihood of impacting archaeological remains associated with sites I45/71 and I45/72~~, and particularly I45/72 which will be completely demolished by the construction of the landfill~~. It is less likely that archaeological remains associated with sites I45/67, 145/79, I45/80, I45/81, and I45/82 will be impacted by the proposed works. In addition to these identified archaeological sites, there remains the potential for other undiscovered archaeology to be encountered during the proposed works associated with European farming activities, and earlier Maori occupation of the area.

Hazard zones have been identified over the project area based on the risk of encountering archaeological features and materials (**Figure 19** below), specifically:

- The **red zone** represents a high risk of encountering archaeological features and materials. The zone covers sites I45/71 and I45/72.
- The **yellow zone** represents a moderate risk of encountering archaeological features and material. The zone covers the margins of sites I45/71, I45/72, I45/67, 145/79, I45/80, I45/81, I45/82, and other identified points of interest where there is the potential for encountering archaeological remains during work.
- The **green zone** represents a low risk of encountering archaeological features and materials.

Figure 19 – Archaeological Hazard Zones



Prior to the commencement of work, an archaeological site briefing will be delivered to all contractors undertaking earthworks that may affect archaeology. Within **red zones**, all works will be monitored by an archaeologist. Within **yellow or green zones**, where suspected archaeological material is encountered, work in the immediate area will cease (within 25 m for burials, 10 m for other finds) and an archaeologist alerted. All archaeological material will be recorded by an archaeologist prior to work recommencing. Where any suspected archaeological material is Maori in origin or where human remains are uncovered, HNZPT, Police and Te Rūnanga o Ōtākou through Aukaha will be notified to enable appropriate cultural procedure's and tikanga to be undertaken, and HNZPT Act/Protected Objects Act requirements to be met. Work will be able to recommence for Maori sites once confirmed by HNZPT and Aukaha, and for European sites once confirmed by HNZPT. A full report on any material found will be prepared and submitted to NZHPT within a year of the completion of works.

Given the risk of encountering archaeological features and materials, measures are proposed to be adopted within the ORC consent to discharge waste/hazardous waste, and leachate to land; take, use dam, divert water; and discharge stormwater, and contaminants to land and water; and place and use structures within, and alter the beds of rivers. Conditions are also proposed to be incorporated within the DCC conditions of consent for the road upgrade ~~and wetland creation/enhancement~~ outside the designation to avoid or mitigate adverse effects on archaeological values. The proposed conditions are included in **Appendix 17** and require implementation of an on-call protocol where suspected archaeological material is encountered.

Overall with these measures, the effects of the road upgrades on archaeological values will be appropriately managed and no more than minor on the environment, and on any persons.

Other measures will be later incorporated in the outline plan of works application to avoid, remedy, and mitigate the adverse effects of the landfill construction and operational activities within the existing designation on archaeological values (in particular for sites I45/71 and I45/72). As per the recommendations of the archaeological assessment, those measures will include:

- ~~For archaeological site I45/71, u~~Undertaking a baseline archaeology survey;
- ~~, and i~~Implementing protection measures in the form of fencing during construction.
- ~~The standing structures will be preserved~~Preserving the structures as a ruin with a protective covering approved by HNZPT, public interpretation provided, and a 10m buffer to landfill development established.
- Planting within 5m of the structure at site 145/72 occurs in a way that ensure root damage will not occur.
- ~~Prior to the demolition of archaeological site I45/72, undertake archaeology recording of the site. Hand excavation will be undertaken immediately around the footprint of the building remans to determine its extent and age, and to investigate construction methods and modifications.~~

8.11 Cultural Values

The Cultural Impact Assessment (CIA) prepared by Aukaha on behalf of Te Rūnanga o Ōtākou contained in **Appendix 14**, assesses the proposal against the cultural values identified by mana whenua, summarised in **section 4.9**.

Potential effects on mana whenua values from the CIA are summarised in the following sections and relate to:

- Wai Māori – effects on mauri, whakapapa
- Cultural Landscapes – effects on whakapapa
- Air, land, indigenous biodiversity, coast – effects on kaitiakitanga and mauri.
- Recognition of mana whenua; effects on mana, manaakitanga
- Haere Whakamua, Ki uta ki tai, Utu, Tikaka
- Hau

8.11.1 Effects on Wai Māori

Mana whenua have an association with Ōtokia Creek, a catchment that supports cultural values, as recognised in the Regional Plan: Water. Ōtokia Creek has become degraded over time, including due to farming runoff and nutrient pollution. Mana whenua consider that it is especially important that degraded environments are protected from further degradation.

Changes to hydrology and locating a landfill site in the headwaters of Ōtokia Creek where water is expected to be pristine will negatively affect the mauri of the catchment. Contaminants from leachate or sediment entering groundwater or surface water will also negatively affect the mauri of this water and water downstream, and all life within it and sustained by it. Leachate may have an effect on the microorganisms living in groundwater, and this may also affect the movement of water through the ground. In this regard mana whenua consider it preferable to prevent contaminants entering water rather than relying on dilution to manage water quality. Mana whenua ~~are also generally not supportive of~~also consider adaptive management approaches to managing water quality ~~as they rely on~~require robust monitoring to identify negative effects as soon as possible, and therefore consider it crucial that monitoring is fit for purpose.

All tributaries, including ephemeral waterways within the site, are part of the whakapapa of the catchment. Mana whenua consider water management from a ki uta ki tai / holistic perspective, acknowledging that what occurs in one part of the catchment affects the whole, especially in headwaters which are at the top of the catchment, so that effects occurring in the headwaters flow throughout the rest of the catchment downstream. Changes to hydrology, including changes in the source and quantity of water, and where it flows will affect the whakapapa of Ōtokia Creek, and the catchment. This ~~will inevitably~~has the potential to alter population composition of flora and fauna.

Mana whenua consider that if the potential effects described above were to occur, this would further degrade a waterbody which is currently in poor health~~an already degraded system~~. It is the aspiration and duty of mana whenua to enhance the health and wellbeing of all bodies of water as kaitiaki (guardians/stewards of the environment for future generations)~~., and f~~Further degradation would exacerbate existing problems waterbodies face in the catchment~~further compromise the numerous values that the waterbody supports~~. All areas of the ecosystem are connected and so too are the values that mana whenua hold for them.

8.11.2 Effects on Cultural Landscapes

Mana whenua view the site in the context of the wider Taieri ancestral landscape. While there have been no archaeological finds of Māori origin within the site, conceptually the site forms part of a highly valued and used wāhi tūpuna within the wider Taieri District.

The construction of a landfill will leave the landscape permanently modified and with it, the wāhi tūpuna values that mana whenua attribute to it. Mana whenua consider a facility that diminishes the mauri of the landscape through its functions as a depository for waste is inherently at odds with a valued cultural landscape. However, there is the opportunity through this project to enhance the whakapapa connection of mana whenua to this landscape, through measures such as adopting a planting palette which references the whakapapa of place and the historical presence of mana whenua in the area.

The archaeological assessment (described in **section 8.10** above) identified a cluster of early Māori archaeological remains within proximity of the site. Mana whenua require that there are robust measures taken to ensure that any early Māori archaeological remains that are uncovered are appropriately managed.

Mana whenua consider there are also opportunities to tell the Kai Tahu story of the broader Taieri cultural landscape through the educational facility that may be developed at the site. Restoring the footprints of the tribe to the landscape through interpretive information acknowledges the first peoples of the area and tells of their uses of the land and its resources.

8.11.3 Effects on Air, Land, Indigenous, Biodiversity, and Coast

Kaitiakitanga is an inherited responsibility, and whānau are conscious of leaving behind a landscape and resources that are in as good, if not better state for future generations to inherit. Of particular interest to mana whenua in the current proposal are taoka species that are at risk, and the enhancement of degraded areas. Mana whenua cannot carry out their duties as kaitiaki if the construction and operation of the proposed landfill results in adverse impacts on at risk species and degraded areas.

Wetlands support entire ecosystems and have long held historical, cultural, economic, and spiritual significance for mana whenua and Māori in general. Wetlands are the basis of matauraka (cultural knowledge) in the form of mahika kai practices that are still relevant to this day. As kaitiaki, mana whenua seek to enhance and restore degraded areas and preserve the knowledge and the resources that the area holds for generations to come. The Ōtokia Creek has also been identified as a significant fish spawning area as well as a significant area for the development of juvenile fish.

Mana whenua consider contamination and changes detrimental to the hydrological function of wetland areas will affect ecosystems and consequently mauri. It is important to ensure that any potential harm to Ōtokia Creek and its ecosystem is mitigated. Though the streams within the proposed site are ephemeral, this does not guarantee that there will be no runoff into the Ōtokia Creek further downstream. The swamp wetland and valley floor marsh wetland form part of the headwaters of the Ōtokia Creek catchment which may contain some surface water throughout the year.

Some vegetation areas that are proposed to be cleared for the construction of the landfill are typical habitats for southern grass skink (at risk – declining) of high ecological value and the Kārearea - Eastern Falcon (at risk – recovering), and which is considered to be taoka (treasures) by mana whenua, and there is concern that construction during the breeding season of Kārearea could result in adverse effects on Kārearea that are present at the time.

Mana whenua consider ~~it is impossible that~~ the mauri of the area will ~~not~~ experience short and long-term effects from the construction of the landfill. Establishing a facility where waste is stored and processed is already subjecting the mauri of the area to degradation. Further degradation of mauri would occur if elements of the design failed and contamination of water, air and land resulted. Leachate permeating through the site layers has one of the biggest potential impacts on mauri. Mana whenua apply an intergenerational perspective to all scenarios. There are no guarantees that the landfill would not yield detrimental effects in the long term, whether through leachate leakage or methane gas escaping because of waste decomposition. If this were to occur, the life supporting capacity, or the mauri of the area might diminish or cease to exist.

8.11.4 Recognition of Mana Whenua

Mana whenua consider mana can be upheld by the DCC recognising mana whenua as a Treaty partner in a responsive way, including by reflecting the concerns in the CIA in the application, and working with mana whenua on how recommendations may be dealt with.

Recognition of mana involves DCC committing to sustaining relationships over the long term. Parties must respect the knowledge, experience, and skills of each other if effective partnerships are to develop. Building in funding for ongoing mana whenua engagement throughout the life of this project, and for ongoing monitoring, should consents be granted, is critical. Meaningful engagement and involvement can help ensure cultural values are adequately and appropriately considered and incorporated into the landfill management over its lifespan.

Mana whenua consider any adverse effects resulting from the proposal would impact on the mana of the people of Ōtākou as it would compromise their ability to be effective kaitiaki in their takiwā. Degradation, or perception of poor water quality in the catchment, would undermine their ability to manaaki the city's residents and visitors by ensuring the city has clean beaches where swimming and recreational activities can be enjoyed without fear of pollution or contamination. Manaakitaka embodies showing hospitality or extending aroha (love) to others and is a recognition of the mana of the individual by mana whenua.

Leachate leakage beyond the 600mm compacted clay is a possibility that is concerning ~~not acceptable~~ to mana whenua. While the landfill would be designed and constructed to meet standards and specifications, all measures need to be undertaken that ensure leachate is contained within the layers. While groundwater will be monitored to provide advanced warnings of potential impacts to surface water quality, if these mechanisms were to fail and result in adverse impacts on any part of the immediate or surrounding environment, mana would be diminished as a consequence.

~~Leachate leakage that resulted in contamination of the surrounding waterbodies or wetlands which support taoka species would affect mana whenua values in these areas and diminish mauri. Mana whenua's ability to practice kaitiakitaka would also be compromised and in turn, their ability to express manaakitaka and therefore their mana.~~

8.11.5 Recognition of Ki uta ki tai, Harere whakamua, Uta and Tikaka

Mana whenua are concerned that the proposed landfill might become a liability for future generations in terms of residual risks of contamination and associated effects, highlighting the need for ongoing monitoring and maintenance requirements.

Mana whenua consider with the unprecedented environmental challenges that society faces, that it is vital now more than ever to seriously consider solutions to waste management that are outside the standard approach and which support the aspirations at all levels of government. This intent encapsulates the values of haere whakamua (future focus), utu (restoration of ecosystem imbalances) and tikaka (appropriate actions). As such, mana whenua support the aspirations and initiatives of the Dunedin City Council that are reflected in the Waste Futures programme and the overall movement to a more circular economy.

8.11.6 Hau

Hau covers all issues relating to air and the potential pollutants to it, including dust, carbon emissions, potential odours, and potential methane gas emissions. These could weaken the mauri and overall wellbeing of the landscape and in turn, adversely affect the ecosystems supported in the area should the effects of these elements not be sufficiently mitigated. Mana whenua consider on the basis of the mitigation measures in the air quality assessment (discussed in **section 8.7**), that the life supporting capacity and mauri of air and flora, fauna and mahika kai will be protected.

8.11.7 Cultural Recommendations

Overall the CIA has identified a number of key areas where the proposal has the potential to impact on cultural values, particularly in relation to:

- The involvement of Papatipu Runanga as kaitiaki and manawhenua.
- The protection and enhancement of waterbodies and indigenous biodiversity, including remnant wetlands, and the coast.
- The protection of archaeological and ancestral landscape values.

Mana whenua however support the changes to the proposal, in particular the reduction of its size/stages, and exclusion of the wetlands from the landfill footprint. Mana whenua also support the various enhancements proposed for the surrounding environment. While the potential impacts remain, mana whenua appreciate that the risk of these occuring are considerably less now as a result of the changes.

Recognising this, the CIA outlines a number of key messages and recommendations for dealing with potential remaining impacts. Those recommendations, and DCC's initial consideration of them are outlined in **Table ~~26~~ 27** below. DCC is committed to ongoing engagement with mana whenua to address these recommendations both during the resource consent process, and beyond.

Table ~~26~~ 27 – Cultural Recommendations

CIA Message / Recommendation	Response
Key Messages	
Mana whenua seek opportunities to exercise rakatirataka and kaitiakitaka in ongoing discussions with DCC regarding waste minimisation and waste management strategy and implementation in Dunedin.	DCC acknowledge that mana whenua has a key role to play as a Treaty partner in the delivery of the Waste Futures programme, as kaitiaki for Dunedin's natural environment and resources. DCC is committed to ongoing engagement to ensure rakatirataka and kaitiakitaka are exercised.
Mana whenua recognise the need for DCC to deal with waste in a pragmatic manner now, and as Dunedin's population grows. However, mana whenua question whether waste minimisation measures can be brought forward to reduce the need for waste to go to landfill beyond Stages 1 and 2 of the proposal.	The WMMP 2020 developed in consultation with mana whenua and the community sets achievable targets for waste minimisation and reduction of waste disposed to landfill by 2030. The success of these measures (and future measures beyond 2030) will determine the need for the use of the landfill beyond stage 2. However, it is possible there will remain a long term need for a landfill to dispose of residual waste that cannot otherwise be diverted.
Despite the mitigation measures set out to deal with surface and groundwater quality, concerns remain about the potential for leachate seepage within and beyond the site designation over the very long term. This concern extends to any impacts on the Ōtokia Creek.	Robust leachate containment and stormwater management measures, and operational, and monitoring practices are proposed that will persist beyond the ~~55~~40-year operational life of the landfill, and ensure impact on surface and groundwater quality, and the Ōtokia Creek will be avoided to the fullest extent possible. These ~~will~~ are in part ~~be further~~ detailed in the draft LMP and will be further developed prior to completion of the final LMP. The ~~creation and~~ enhancement of wetland/riparian habitat is proposed in the vicinity of the landfill, recognising the existing degraded habitats that exist, and the potential impacts of the landfill on their values. DCC will work with mana whenua following lodgement of the applications, and in the long term, to ensure its concerns are addressed, including to confirm landfill operational and monitoring measures in the final LMP, and identify wetland/waterway enhancement opportunities.
It is imperative that stormwater management systems are robust, actively monitored and addressed in the event of inefficiencies or failures.	
Mana whenua seek to protect and restore mahika kai values and wetlands. This includes the regionally significant wetlands of the Lower Ōtokia Creek Marsh at Brighton	
The inherent values of the permanent and ephemeral waterways must be safeguarded and enhanced.	

The effects of climate change, including extreme rain events, on the receiving environment should be accommodated in the design.	Climate change projections, including extreme rainfall, have been adopted within the design of the landfill, and will be further addressed through detailed design to ensure the long term stability of the landfill, and avoidance of effects on the receiving environment. This will be further detailed in the ~~draft~~ final LMP developed in collaboration with mana whenua.
Wai Māori	
That all practicable measures are taken to prevent discharges entering water, including preventing where possible leachate from entering groundwater and surface water.	As noted above, robust leachate containment and stormwater management measures, and operational, and monitoring practices are proposed that ensure impacts on surface and groundwater quality, and the Ōtokia Creek will be avoided to the fullest extent possible. ~~This~~ These are in part detailed in the draft LMP and will be further ~~detailed in the draft~~developed prior to completion of the final LMP ~~developed~~ in collaboration with mana whenua.
That stormwater quality is tested. If stormwater contains high concentrations of harmful leachate or contaminants, then it should not be allowed to infiltrate to groundwater or be discharged to the Ōtokia Creek.	The proposed monitoring includes monitoring of stormwater prior to entry to the attenuation basin, within the basin itself, and downstream. In addition, specific monitoring proposals are proposed for the discharge of stormwater from the stage 1 area downstream that bypasses the attenuation basin. Should leachate contamination be detected, stormwater will be diverted from entering the basin and directed to the leachate collection system for disposal off site. This will be further detailed in the draft LMP.
That effects on mauri and whakapapa from contaminants entering water and altering the existing hydrology are offset by mitigation measures such as 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 ~~negative~~ adverse effects on mauri, they will enhance the mauri of the area.	As noted above, the ~~creation and~~ enhancement of wetland/riparian habitat is proposed in the vicinity of the landfill, recognising the existing degraded habitats that exist, and the potential impacts of the landfill on their value. ~~Such wetland/riparian enhancement may however extend beyond same catchment.~~ A plant and animal pest ~~management~~ control programme will also be implemented. This will be further detailed in the ~~draft ecological management plans~~final LMP developed in collaboration with mana whenua.

That baseline monitoring is undertaken before any work can be undertaken. This will allow any effects to be identified and measured.	Extensive baseline monitoring, covering hydrogeology, water quality, ground gas, wetlands, eastern falcon, and lizards are proposed prior to landfill construction/operation. These are detailed in the draft conditions of consent and are in part detailed in the draft LMP. They will be further developed prior to completion of ~~and will be further detailed in the draft~~the final LMP and associated ecological management plans ~~developed~~ in collaboration with mana whenua.
That visual inspection monitoring, where proposed, forms part of an integrated water monitoring programme ~~is replaced with a more objective monitoring method~~.	Visual inspection is just one facet of a wider water and air quality monitoring measures which also include routine water and landfill gas sampling and assessment against trigger levels to detect adverse effects. Where it is proposed, visual monitoring provides another additional safeguard. Monitoring measures ~~will be further~~are in part detailed in the draft LMP and will be further developed prior to completion of the final LMP ~~detailed~~ in collaboration with mana whenua.
That additional groundwater and surface water monitoring sites are installed and monitored within the tributary to Ōtokia Creek outside of the designated site.	Groundwater and surface water monitoring sites have been selected that are suitable to detect any leachate and other contamination of the receiving environment. Monitoring measures will be further detailed in the LMP detailed in collaboration with mana whenua.
Kaitiakitaka and Mauri	
Any ecological management plans are developed prior to the granting of resource consent.	Draft ecological management plans have been developed as part of the draft LMP and will be developed ~~following the lodgement of these applications~~prior to completion of the final LMP in collaboration with mana whenua.
That any works are undertaken outside of the kārearea breeding season.	A draft Falcon Management Plan ~~will be~~has been developed in collaboration with mana whenua. Where kārearea have been identified as nesting on the site, works will be undertaken outside the breeding season where possible, and if not possible exclusion zones will be established to avoid or minimise any adverse effects on nesting birds.

~~That fish surveys are completed prior to any works being undertaken to confirm the species present in the nearby waterbodies. This could be undertaken as part of the baseline monitoring.~~	~~Fish surveys will be conducted between November 2020 and April 2021 to determine the presence of freshwater fish, and the outcomes shared with mana whenua to identify management responses.~~
Ensure landfill design elements and mitigation measures are controlled and regularly monitored so that degradation of the mauri of the ecosystem within, and beyond the site is avoided or eliminated.	Robust containment measures, and operational, and monitoring practices are proposed that will ensure impact on the receiving environment will be avoided to the fullest extent possible. These are in part detailed in the draft LMP and will further developed prior to completion of the ~~will be further detailed in the draft~~final LMP ~~developed~~ in collaboration with mana whenua.
Best practice erosion and sediment control guidelines are adopted for all works connected to the Smooth Hill Landfill project including design, construction maintenance, operation, and roading). Contractors undertaking the works should prepare an erosion and sediment control plan which details current best practice and confirms that the measures proposed are appropriate to the site	Best practice erosion and sediment control guidelines will be adopted for the construction and operation of the landfill and road upgrades. Control measures are in part detailed in the draft LMP and will be further developed prior to completion of the final LMP in collaboration with mana whenua.
Enhance water quality monitoring ~~system~~ outside of the designated area as it relates to the tributary of Ōtokia Creek, including visual inspection where surface discharges are occurring. ~~Mana whenua consider that visual inspection is insufficient.~~	As above, groundwater and surface water monitoring sites have been selected that are suitable to detect any leachate and other contamination of the receiving environment. Visual inspection is ~~just~~ one facet of a wider water quality monitoring measures. Monitoring measures are in part detailed in the draft LMP and will be further developed prior to completion of the final LMP in collaboration with mana whenua ~~and detailed in the LMP~~.
More information is required as to what measures are in place to mitigate mass leachate diffusion and subsequent influencing of ground and surface water in the Ōtokia Creek in the event of a natural hazard.	The site is a suitable location for a landfill in regard to land stability. Detailed design of the landfill will ensure natural hazard risks are appropriately addressed to ensure containment of waste and contaminants as a result of a hazard event. Contingency measures will be further detailed in the ~~draft~~ final LMP developed in collaboration with mana whenua.

Initiate wetlands and creek margins replanting programme.	As above, the ~~creation and~~ enhancement of wetland/riparian habitat is proposed in the vicinity of the landfill.
The applicant should consider a process of resourced and ongoing engagement with mana whenua, to enable input~~s~~ into and the exchange of information ~~exchange~~ regarding any Falcon, Lizard and Environmental Management Plans including water quality management, rehabilitation, heritage and biodiversity monitoring.	As above, the draft LMP and ~~draft~~ ecological management plans ~~will be~~have been developed and will be further developed prior to completion of the final LMP ~~following the lodgement of these applications~~ in collaboration with mana whenua.
The applicant ensures that thorough analysis of alternative solutions has been undertaken, documented and disseminated to mana whenua and stakeholders.	A thorough analysis of alternatives was undertaken as part of the 1992 site selection and designation process and reconfirmed through the Waste Futures programme. More information can be provided to mana whenua, and DCC remain open to considering design and operational alternatives suggested by mana whenua.
Recognition of mana whenua	
That DCC consider a process of resourced and ongoing engagement with Te Rūnanga o Ōtākou, with particular regard to input into and reporting on environmental and ecological management plans, water management, closure and rehabilitation, heritage, biodiversity and monitoring.	As above, the draft LMP and ~~draft~~ ecological management plans ~~will be~~have been developed and will be further developed prior to completion of the final LMP ~~following the lodgement of these applications~~ in collaboration with mana whenua.
Mana whenua should be given the opportunity to review and comment on the effectiveness of Environmental Management Plans.	Te Rūnanga o Ōtākou will have the opportunity to input into annual reviews into the effectiveness of the final LMP.
Mana whenua should be given the opportunity to undertake ongoing monitoring alongside other specialists.	Mana whenua will continue to be given the opportunity to join site visits undertaken by specialists for the purposes of environment monitoring.
Any Environmental Management Plans implemented must provide for ongoing monitoring to ensure the objectives of those management plans are being met.	The draft LMP and ecological management plans include in parr monitoring measures to enable the assessment of whether the objectives of the management are being met. These will be further development prior to completion of the final LMP in collaboration with mana whenua.

Haere whakamua, Tikaka, Utu	
Mana whenua request that the applicant develops, funds and adheres to an implementation strategy to enable an efficient shift to a zero waste future. This will require forward thinking, adaptability, innovation and accountability to the community to ensure that landfill solutions are phased out.	The WWMP 2020 includes implementation pathways aimed at achieving the Council's zero waste future, and targets for waste minimisation and reduction of waste disposed to landfill by 2030. Through the implementation of the plan, the Council will work closely with mana whenua as Treaty Partner and support their kaitiaki role.
The applicant ensures that thorough analysis of alternative solutions has been undertaken, documented and disemminated to mana whenua and stakeholders.	As above, a thorough analysis of alternatives was undertaken as part of the 1992 site selection and designation process and reconfirmed through the Waste Futures programme. More information can be provided to mana whenua, and DCC remain open to considering design and operational alternatives suggested by mana whenua.
Hau	
Ensure mitigation measures are monitored, controlled and regularly reviewed.	As above, robust containment measures, and operational, and monitoring practices are proposed that will ensure impact on the receiving environment will be avoided to the fullest extent possible. These are detailed in part in the draft LMP and will be further developed prior to completion of the final LMP ~~will be further detailed in the draft LMP developed~~ in collaboration with mana whenua.
Ensure residential properties in proximity to the site are engaged with.	As detailed in **section 11**, DCC has engaged with, and will continue to engage with adjacent residential properties.

Overall, it considered, that subject to further engagement with mana whenua, that the cultural key messages and recommendations can be addressed to ensure minor effects on the cultural environment, and on Te Rūnanga o Ōtākou.

8.12 Transportation Network

8.12.1 Road Network Effects

The project involves upgrading, widening, and sealing of McLaren Gully Road, its intersection with SH1, and Big Stone Road. The construction and operation of the landfill will also generate additional vehicle movements. These changes have the potential to adversely affect the safe,

effective, and efficient operation of the road network. Such effects are relevant to the consideration of the applications to DCC for the road upgrades.

The effects are also relevant to the consideration of the future application for an outline plan of works to construct and operate the landfill within the designated site. While not relevant to the current applications, management of effects related to the designation are discussed to inform the community and decision makers as to how such effects will be managed.

Potential effects on the road network include:

- The ability of the road network to cater for the expected additional vehicle movements.
- Whether the road upgrades will ensure the safe, effective, and efficient operation of the road network
- The temporary effects of road construction on the operation of the road network, and other road users.

The Integrated Transport Assessment Report contained in **Appendix 15** has considered the effects of the expected operational vehicle movements on the road network.

McLaren Gully Road and Big Stone Road will be significantly upgraded, regraded, widened, and sealed as far as the site access as part of the initial enabling works to ensure they can safety accommodate two-way traffic and increased traffic demands arising from the operation of the landfill. The upgrade will allow for two-way heavy vehicle movements, with a sealed 3.5 m wide lane in each direction, shoulders, and roadside drainage swales. Detailed design of the road upgrades will be in accordance with the DCC *Code of Subdivision and Development 2010.*

Landfill Construction activities will result in machinery, material delivery, and construction staff vehicle movements to and from the site. Construction of the initial enabling works for the landfill are expected to occur over at least two construction seasons (October to April/May) prior to the landfill accepting waste. Ongoing landfill construction works are then expected to reoccur every 3 to 10 years during the life of the landfill for stage/cell construction.

The temporary effects of road and landfill construction on the operation of the road network, and other road users will be managed through the preparation and implementation of a Construction Traffic Management Plan to ensure the safe and efficient interaction of construction traffic with other road users. The Plan will be approved by Waka Kotahi NZ Transport Agency (NZTA) and DCC prior to construction commencing.

Regular operational vehicle movements to and from the landfill site will include those for worker transport, delivery of waste/clean fill, leachate and water transport, commercial deliveries, and service vehicles. The projected heavy waste vehicle movements to the site during a typical day are outlined in **Table ~~27~~ 28** below, based on the projected waste disposal rate for the landfill of 90,000 tonnes/annum, and also conservatively assuming each waste vehicle is 80% full.

Table ~~27~~ 28 – Projected Waste Vehicle Movements (Updated May 2021)

Vehicle Type	% of Deliveries	Vehicle Capacity (tonnes)	Total Capacity (tonnes)	No Trucks if 100% full	No of Trucks is 80% full	No Daily Trips if 80% full
6 wheel truck	10%	10	2,654~~3,982~~	265~~398~~	332~~498~~	1

8 wheel truck	20%	15	7,964~~11,947~~	530~~796~~	664~~996~~	~~3~~2
Semi-trailer	30%	22	17,722~~26,283~~	796~~1,195~~	995~~1,493~~	~~4~~3
Truck and trailer	40%	30	31,860~~47,788~~	1,062~~1,593~~	1,327~~1,991~~	~~6~~4
Totals			**~~90~~60,000**	**2,653~~3,982~~**	**3,318~~4,978~~**	**~~14~~10**

The average number of heavy waste vehicle movements is expected to be approximately ~~14~~ 10 per day. In practice, the total number in any given day may fluctuate due to seasonality or operational requirements. There will also be up to ~~4~~ 5 additional heavy vehicle movements per day associated with leachate disposal, and 3 associated with water transport ~~(~~until dedicated pipelines are constructed to the site~~)~~, and other commercial deliveries. The total heavy vehicle movements from the site could therefore reach a maximum of approximately 25 per day. In addition, up to 25 light vehicle movements are expected per day for worker transport and other service vehicles.

Heavy vehicles, transporting waste and leachate will access the landfill via SH1. The majority (90%) of the waste is expected to be picked up from waste transfer stations in Dunedin, north of the landfill site, with some (10%) from the regions around Dunedin. It is therefore expected that the majority of vehicles will therefore be turning left (90%) into McLaren Gully Road from SH1 and right out of McLaren Gully Road onto SH1, to return to Dunedin.

The landfill will be open between Monday to Saturday 8.00am – 5.30pm, and Sunday 9.00am – 5.30pm. The peak weekday time for waste delivery movements to and from the landfill is expected to be between 7.00am – 9.00am. This recognises that waste delivery vehicles are typically filled the day prior and emptied when the landfill opens the next morning. Up to 10 heavy vehicles, and 8 light vehicles are expected to arrive during this time, with up to 6 heavy vehicles expected to depart the site within this time. Other waste deliveries are expected to occur across the balance of the day. Up to eight staff are expected to arrive at the site during the morning peak hour 7.00am – 8.00am.

Given the existing use of McLaren Gully Road and the current traffic volumes on SH1 (approximately 7,400 vehicles per day with 12% heavy vehicles), an increase of up to 25 heavy vehicles trips a day to and from the landfill is expected to have no noticeable effect on the operation of the receiving road environment. Furthermore, it is not anticipated that the increase in traffic volumes will impact the ability of residents on McLaren Gully Road or Big Stone Road to access driveways.

Performance of the existing SH1 / McLaren Gully Road intersection during the peak 7.00am – 9.00am peak period with the additional expected 10 heavy vehicle movements, and 8 staff movements has been modelled using SIDRA traffic modelling software. The modelling captures the performance of the intersection to 2050, taking into account forecast traffic growth over the duration of the initial resource consents. When modelled in SIDRA, turning movements from the state highway operate with an acceptable level of service (LOS) (between A and B). However, the right turn from McLaren Gully Road is expected to degrade over time and fall below an

acceptable level of service around the year 2040 for the existing intersection arrangement (i.e. LOS E is reached).

In order to mitigate this, the SH1 / McLaren Gully Road intersection, will be upgraded to provide:

- Flag lighting.
- 3.5 m wide right turn bay with 180 m taper.
- 3.5 m wide auxiliary left turn in lane with 180 m deceleration taper and painted separator.
- Localised shoulder widening for left turn out movement.

The above improvements have been discussed with NZTA and will address perceived and anticipated road safety concerns associated with increased demand on this intersection. There are secondary benefits associated with intersection efficiency and capacity. In recognition that this stretch of SH1 is used informally for passing, the auxiliary slip lane is required to provide improved driver visibility to and from McLaren Gully Road in line with the Safe System approach.

A Speed Management Assessment of the intersection has also been completed to determine whether a reduction in speed limit through the intersection is necessary due to the predicted increase of heavy vehicle turning movements associated with the proposed landfill. The assessment concluded that implementing an Intersection Speed Zone (ISZ) using Rural Intersection Activated Warning Signs (RIAWS) at this location would be suitable and provide an improvement on safety without having to permanently lower the speed limit in the area. The ISZ would be activated when a vehicle approaches SH1 from McLaren Gully Road, slowing oncoming traffic on the state highway to 80 km/h. When the intersection is not in use, a 100 km/h speed limit would be in effect. In this way, traffic on the state highway is only slowed when required.

Through consultation with NZTA, it was identified that the Allanton-Waihola Highway is being considered as part of an overall corridor speed management study. The study will consider the intersection and provide recommendations and determine whether an ISZ is implemented.

Based on the above assessment, measures are proposed to be adopted within the DCC conditions of consent for the road upgrade to avoid, remedy, and mitigate adverse effects on the safe, efficient, and effective operation of the road network. The proposed conditions are included in **Appendix 17** and require the detailed design of the road upgrades to be in accordance with appropriate road design standards; and the preparation, approval, and implementation of a Construction Traffic Management Plan during construction of the road upgrades.

Overall with these measures, the adverse effects of the road upgrade on the safe, effective, and efficient operation of the roading network will be no more than minor on the environment, and any persons.

Other measures will be later incorporated into the outline plan of works application to avoid, remedy, and mitigate the effects of the landfill construction and operational activities on the safe, efficient, and effective operation of the roading network. Those measures will include:

- Implementing construction traffic management during landfill construction.
- Providing a safe and effective vehicle access crossing into the site from Big Stone Road.
- Providing appropriate internal site parking, loading, and vehicle manoeuvring arrangements.

8.12.2 Airspace Safety

Operation of the landfill will attract increased abundances of birds and could increase the risk of bird strike with aircraft within the Dunedin airport approach/departure circuit. These risks, and the associated management of them has been discussed in **section 8.8** in addressing the potential effects of the project on avifauna. In summary, the increased risk of bird strike will be managed through the implementation of a Bird Management Plan, which reduces the attractiveness of the landfill to birds, and keeps bird numbers to very low levels. A draft of the Bird Management Plan is contained ~~in **Appendix 18**~~in the draft LMP. With these measures in place, adverse effects on air safety will be less than minor on the environment, and any persons.

8.13 Noise

The activities associated with the project will generate noise that has the potential to adversely affect the health and amenity of persons residing in noise sensitive activities, such as residential activities. Such effects are relevant to the consideration of the applications to DCC for the road upgrades.

The effects are also relevant to the consideration of the future application for an outline plan of works to construct and operate the landfill within the designated site, including to address the designation condition 3 noise limits. While not relevant to the current applications, management of effects within the designation are discussed to inform the community and decision makers as to how such effects will be managed.

Noise that will be generated by the project includes:

- Temporary construction noise from upgrading works to McLaren Gully Road (including its intersection with State Highway 1), and Big Stone Road.
- Periodic temporary construction noise associated with landfill development activities, including the initial enabling works, and the works for developing each of the landfill stages 1 – 5.
- Operational noise from landfill site activities, including vehicle movements, waste filling, compaction, cover, bird deterrence, and maintenance activities.
- Vehicle noise along McLaren Gully Road and Big Stone Road for worker transport, delivery of waste, leachate and water transport, and construction vehicles.

The Acoustic Assessment Report completed by GHD contained in **Appendix 16** has considered the adverse effects of the above noise sources on potential receptors in the surrounding area, based on whether the applicable 2GP noise limits will be met. The applicable noise limits are set out in **Table ~~28~~ 29** below.

~~There are no noise limits that apply to vehicles using State Highway 1, McLaren Gully Road, and Big Stone road to access the landfill. Specifically rule 9.3.6.7(h) of the 2GP provides that noise from vehicles operating on public roads are exempt from the noise limits of the District Plan.~~

Table ~~28~~ 29 – Relevant 2GP Noise Limits

<table>
<tr><th>2GP Provision / Noise Limits</th><th>Limit applicable to</th></tr>
<tr><td>Rule 4.5.4.1 Construction

Construction received at dwellings in rural zones and must not exceed the following noise limits:

<table>
<tr><th rowspan="3">Day</th><th rowspan="3">Time</th><th colspan="6">Duration of Work</th></tr>
<tr><th colspan="2">Typical</th><th colspan="2">Short Term</th><th colspan="2">Long Term</th></tr>
<tr><th>L_{eq}</th><th>L_{max}</th><th>L_{eq}</th><th>L_{max}</th><th>L_{eq}</th><th>L_{max}</th></tr>
<tr><td rowspan="4">Weekdays</td><td>0630-0730</td><td>60</td><td>75</td><td>65</td><td>75</td><td>55</td><td>75</td></tr>
<tr><td>0730-1800</td><td>75</td><td>90</td><td>80</td><td>95</td><td>70</td><td>85</td></tr>
<tr><td>1800-2000</td><td>70</td><td>85</td><td>75</td><td>90</td><td>65</td><td>80</td></tr>
<tr><td>2000-0630</td><td>45</td><td>75</td><td>45</td><td>75</td><td>45</td><td>75</td></tr>
<tr><td rowspan="2">Saturday</td><td>0730-1800</td><td>75</td><td>90</td><td>80</td><td>95</td><td>70</td><td>85</td></tr>
<tr><td>1800- 0730</td><td>45</td><td>75</td><td>45</td><td>75</td><td>45</td><td>75</td></tr>
<tr><td rowspan="2">Sunday, Public Holidays</td><td>0730-1800</td><td>55</td><td>85</td><td>55</td><td>85</td><td>55</td><td>85</td></tr>
<tr><td>1800-0730</td><td>45</td><td>75</td><td>45</td><td>75</td><td>45</td><td>75</td></tr>
</table>
</td><td>Noise from construction activities along the road upgrade corridor for State Highway 1, McLaren Gully Road, and Big Stone Road.

Note - "short-term duration" means construction work at any one location for up to 14 calendar days per project; "typical duration" means construction work at any one location for more than 14 calendar days but less than 20 weeks per project; and "long-term duration" means construction work at any one location with a duration exceeding 20 weeks per project.</td></tr>
<tr><td>A1.4 Designations – D659 Proposed Smooth Hill Landfill

Condition 3

Noise generated by any activity on the site shall comply with the following standards within 50 metres of the nearest house existing at the date on which the designation becomes operative - 55Dt/40Nt dBA. (NB These levels are subject to an adjustment of minus 5dBA for noise emissions having special audible characteristics)</td><td>Noise from construction activities and operational activities occurring within the existing Smooth Hill designation.

Note - the condition does not define the metric for the noise levels shown. The $L_{Aeq(15min)}$ metric has been used consistent with Rule 9.3.6 of the 2GP.</td></tr>
</table>

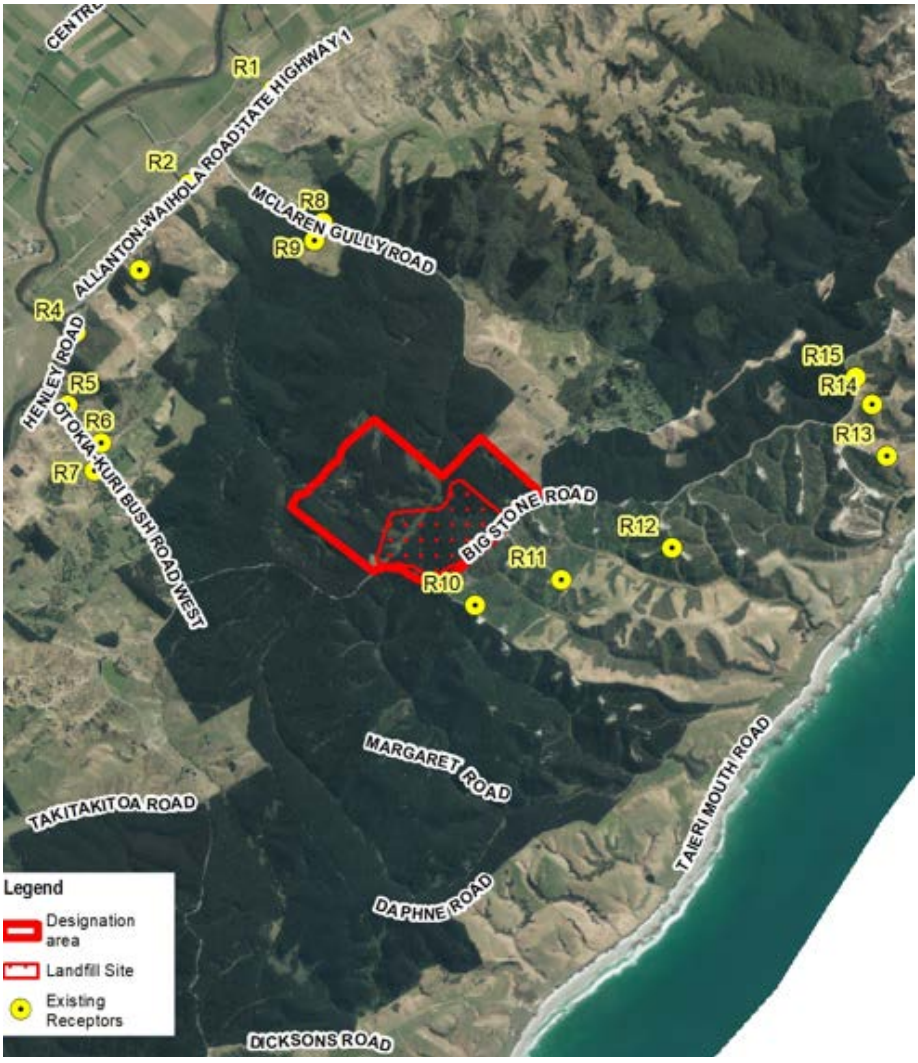
There are no noise limits that apply to vehicles using State Highway 1, McLaren Gully Road, and Big Stone R~~r~~oad to access the landfill. Specifically rule 9.3.6.7(h) of the 2GP provides that noise from vehicles operating on public roads are exempt from the noise limits of the District Plan. Policy 6.2.1.3 of the 2GP however provides that alterations to existing roads are only to be allowed where the location and design of the road, minimises, as far as practicable adverse noise and vibration effects on surrounding residential or other activities.

There are a number of existing noise sensitive receptors in the area surrounding the proposed landfill and road upgrades that may be subject to noise effects. The existing sensitive receptors are in **Figure 20** below, and include:

- Two existing residential activities (R8 and R9) located on opposite sides of McLaren Gully Road approximately 1km from the intersection with State Highway 1. The distance of the road carriageway to these receptors is approximately 65 m.
- Two existing residential activities (R10 and R11) located southeast of Big Stone Road and the proposed landfill.

The noise limits under designation condition 3 need only to be met at houses existing at the date upon which the 2GP designation became operative (December 2019). Noise from construction and operational activities occurring within the designation therefore do not need to meet the limits at any house constructed after this date.

Figure 20 – Existing Noise Sensitive Receptors



The proposed noise sources, closest existing and potential noise sensitive residential receptors, and compliance with the applicable 2GP noise limits is summarised in **Table ~~29~~ 30** below.

Table ~~29~~ 30 – Compliance with 2GP Noise Rules

Noise Source	Closest Existing or Potential Receptor	Compliance with Noise Rules
Temporary road upgrade works to State Highway 1, McLaren Gully Road, and Big Stone Road. Work received at a single receptor is likely to exceed 14 calendar days but be less than 20 weeks. The noisiest combination of equipment expected to operate simultaneously are an excavator and a dozer.	Residential activities R8 and R9, both located approximately 65 m from the existing McLaren Gully Road carriageway.	Compliance with the >14 work day typical duration 75dB $L_{Aeq(,}$ and 90dB LA_{max} construction noise limits in 2GP rule 4.5.4.1 will be achieved. This is subject to a 40 m setback to the dwellings being maintained, and works being limited to between 0730 - 1800 hours Monday to Saturday.
Periodic temporary construction noise associated with landfill development activities. Work is expected to exceed 20 weeks. The noisiest combination of equipment expected to operate simultaneously in stage 2 are two chainsaws, two excavators, two dozers and one vegetation chipper within Stage 2. The nosiest combination of equipment expected to operate simultaneously in Stage 3 are two excavators, two dozers and one motorscraper.	Residential activity R10, located approximately 400 m from landfill activity. Note that the designation noise limits only apply to the nearest house existing at the date on which the 2GP designation became operative (December 2019). Accordingly, the limits do not apply to future potential residential activities.	Condition 3 requires the noise limit to be complied with at a point 50 m from the nearest house. The shortest distance between the location of potential operational activity on the landfill and the façade of the closest receiver R10 is approximately 350 m. The highest noise level from construction predicted at R10 is 55dB L_{Aeq}. Compliance with the 55dB L_{Aeq} day time noise limit in designation condition 3 will be readily achieved at the closest existing house R10.
Operational noise from landfill site activities within the existing designation. The noisiest equipment likely to operate simultaneously are a excavator, dozer, and waste compactor.		Compliance with the 55dB L_{Aeq} day time noise limit in designation condition 3 will be achieved approximately 215 m from the equipment, and therefore will be readily achieved at the closest existing house R10
Vehicle noise along McLaren Gully Road and Big Stone Road associated with waste delivery trucks, leachate tankers, landfill staff movements, and construction traffic.	Residential activities R8 and R9, both located approximately 65 m from the existing McLaren Gully Road carriageway.	Under rule 9.3.6.7(h) of the 2GP, noise from vehicles operating on public roads are exempt from the any noise limits.

With regard to Policy 6.2.1.3 of the 2GP, noise levels from landfill traffic on McLaren Gully Road are expected to generate noise levels at the closest sensitive receptors R8 and R9 of between 43/44 – 47/48 $L_{Aeq(15min)}$, based on a maximum of two vehicle movements occurring at a speed of 50km/hr within a 15-minute period. The proposed sealing of McLaren Gully Road and Big Stone Road to the landfill site is expected to further reduce road traffic noise compared to the existing gravel surface. The expected noise levels present a low level of road traffic noise, and therefore adverse effects on residential activities will be minimised, consistent with policy 6.2.1.3.

Overall, the construction works and operational landfill activities can comply with the relevant 2GP noise limits including condition 3 of the designation. Based on the above assessment, measures are proposed to be adopted within the DCC conditions of consent for the road upgrade to avoid, remedy, and mitigate adverse noise effects. The proposed conditions are included in **Appendix 17** and require:

- Limiting road upgrade works only occurring between 7.30am – 6pm Monday to Saturday.
- Road upgrade works complying where practicable with the noise limits in *NZS6803: 1999 "Acoustics – Construction Noise".*
- Maintaining a 40 m separation between road construction equipment and the dwellings at 108 and 109 McLaren Gully Road.
- The preparation, approval, and implementation of a Construction Noise Management Plan during construction of the road upgrade works, where the hours of operation cannot be met, or construction equipment is required to encroach the 40 m setback above.

Overall with these measures, the adverse effects of noise from the road upgrade on the environment and the health and amenity of persons residing in noise sensitive activities on adjacent land will be appropriately managed and less than minor.

Other measures will be later incorporated into the outline plan of works application to avoid, remedy, and mitigate the noise effects of the landfill construction and operational activities within the existing designation so as to comply with designation condition 3.

8.14 General Community Effects

Operation of the landfill has the potential to result in a number potential effects on surrounding amenity or public health and safety, including:

- Landfill fire and resultant health and safety risks.
- Windblown litter beyond the site.
- Increased abundances of vermin and flies.
- Contamination of drinking water supplies by birds attracted to the landfill.

Such effects are relevant to the consideration of the ORC consents to discharge waste/hazardous waste, and leachate to land. The potential effects and management measures, are summarised in **Table ~~30~~ 31** below.

Table ~~30~~ 31 – Assessment of Community Effects

Potential Effects	Assessment
Landfill fire and resultant health and safety risks	Landfill fires can occur at the surface, in recently deposited waste in the landfill working face, or deep-seated fires found at depth in material deposited previously. The landfill is also at risk from surrounding forest fires. Underground landfill waste fires are typically very slow burning and by their underground nature are not a significant threat to the surrounding environs. Once started, they are however difficult to extinguish. For underground and other fires, fire prevention through good waste acceptance and site management practices that prohibit ignition sources, and first response fire attendance are important. The following fire prevention measures are proposed to be adopted within the LMP to prevent fires: • Maintaining fire breaks around the site from surrounding forest plantations. • Prohibition on all burning activity on site. • Ensuring no smoking on site. • Supervision of the tip face. • Compaction and daily cover of the waste. The LMP will also include procedures for fire response, and management. A Fire Plan for the landfill will be maintained in conjunction with Fire and Emergency NZ (FENZ) setting out fire response measures. Fire control equipment will be present on site, including the on-site water tanker truck, which will be fitted with a pressure pump and hoses and will provide initial fire response until which time FENZ arrives on site. Operations staff will be trained in the use of such equipment and in techniques for dealing with surface fires and deep-seated fires. Fire response will also be supported by having dedicated on site fire water supply tank of least $100m^3$. The presence of on-site firefighting resources and water supply on site, will also enable fire assistance to be provided to the local community surrounding the landfill.
Windblown litter beyond the site.	Uncontrolled litter can contribute to a loss of amenity experienced surrounding a landfill site. The following measures are proposed to be adopted within the LMP to minimise litter migration beyond the site boundary: • Minimising the area of the working face. • Compaction and daily cover of waste. • Use of litter nets and fences.

Potential Effects	Assessment
	• Regular inspection and removal of litter from fences and areas surrounding the site. In addition to these measures, landscape mitigation planting discussed in **section 8.9** will screen the site from view along Big Stone Road, thereby maintaining amenity from close public views.
Increased abundances of vermin and flies.	Vermin such as mice and rats brought to site or attracted to the landfill can spread disease, cause property destruction, and contaminate food. Flies may also become a problem in summer months where eggs laid in putrescible waste hatch. The following measures are proposed to be adopted within the LMP to minimise vermin and nuisance insects: • Compaction and daily cover of waste. • Pest control and use of insecticides. Pest control measures for rodents (rats and mice) will be undertaken in conjunction with the wider ~~Predator Control~~Plant and Animal Pest Control programme outlined in **Section 8.8** and contained within the LMP so as to minimise health, nuisance, and indigenous flora and fauna effects.
Contamination of drinking water supplies by birds attracted to the landfill.	Birds attracted to landfills can transfer pathogens to drinking water supplies. The houses closest to the landfill are understood to use roofwater for drinking water supply. The measures discussed in **section 8.8** and outlined in detail in the draft Bird Management Plan and contained within the LMP will ensure the attractiveness of the landfill to birds is reduced, and bird numbers are kept to very low levels.

Based on the above assessment, measures are proposed to be incorporated within the conditions and LMP objectives for the ORC consent to discharge waste/hazardous waste, and leachate to land. The proposed conditions are included in **Appendix 17** and require:

- Ensuring the LMP addresses: health and safety, waste acceptance criteria and procedures, site security, firefighting water supply and equipment, Fire Plan, the size of the landfill working face, waste cover, litter prevention, vermin and nuisance insect control.
- ~~Preparation~~Finalisation, implementation, and review of the Bird Management Plan based on the ~~*Draft Smooth Hill Bird Management Plan* prepared by Boffa Miskell Ltd~~draft plan,

These management measures will also be later incorporated into the outline plan of works application. Overall, with these measures, the adverse effects of the project on surrounding amenity and public health and safety will be appropriately managed and no more than minor on the environment, and any persons.

8.15 Conclusion of Assessment of Environmental Effects

Based on the assessment in the sections above, it is considered that the construction, operation, and aftercare will have a range of environmental effects which are both beneficial and adverse in nature. **Table ~~31~~ 32** below presents a summary of the environmental effects of the proposal that fall within the scope of the applications that have been applied for.

Table ~~31~~ 32 – Summary of Environmental Effects (Updated May 2021)

Potential Effects	Assessment Summary
Positive effects for social and economic wellbeing from the disposal of waste.	The landfill will provide for the ongoing disposal of municipal solid waste within Dunedin to meet its waste disposal demands. The landfill will generate significant employment and economic effects ~~over 57 years~~out to the year 2055.
Effects of seismic activity, soil instability, and groundwater seepage on land stability.	The site is a suitable location for a landfill in regard to land stability. Detailed design of the landfill will ensure seismic risks, the placement of waste to ensure waste stability, and the stability of cut and fill slopes for the landfill and road upgrades are appropriately addressed to ensure the effects of land stability are no more than minor.
Effects of the discharge of waste contaminants to land on the receiving environment and human health and safety.	The landfill has been designed as a class 1 landfill with appropriate levels of containment and controls consistent with the Waste MINZ guidelines. Consistent with the guidelines, the landfill will only accept municipal solid waste, and potentially hazardous wastes that meets Ministry for the Environment leachability criteria. Proposed waste acceptance procedures will detect and deter the inappropriate disposal of material, and ensure unacceptable wastes are easily identified, segregated, and rejected. Effects from waste contaminants will therefore be no more than minor.
Effects on groundwater and surface water flows and levels within the site and the downstream receiving environment.	Predicted changes in groundwater levels through a reduction in recharge, and the resulting downstream shift of the point at which the tributary of the Ōtokia Creek transitions from valley floor marsh wetland system to a permanently flowing waterway system are expected to be mitigated by direct recharge through the attenuation basin ~~forebay~~ which is expected to provide a net increase in groundwater flow through the valley floor. The site is estimated to currently contribute no more than 1.6% of flood flows to the catchment. A predicted overall ~~50~~20% reduction in surface water flows from the site to the downstream tributary of the Ōtokia Creek is expected to have no significant impacts on flows and levels in the catchment beyond the immediate vicinity of the site. Flows immediately downstream of the site are already intermittent in nature and the effects of the changes in flows will also be relatively less important downstream as recharge occurs from other tributaries (e.g. East Gully) and as the relative proportion of the catchment affected by the landfill decreases.

	Effects on groundwater and surface water quantity will therefore be no more than minor.
Effects on groundwater and surface water quality within the site and downstream receiving environment.	The landfill liner will contain leachate within the landfill and prevent it from entering the underlying soils or groundwater. While leakage of leachate through the liner is possible, given the reduction in contaminant flux in comparison to the existing environment, and the levels of dilution predicted, the effects to groundwater and connected surface water quality in the immediate vicinity of the site from leakage of leachate are expected to be negligible. Proposed stormwater, erosion and sediment control, and operational management measures will ensure waste contaminated and sediment runoff is appropriately managed and minimised to ensure less than minor effects on water quality. The long-term effects of the landfill in terms of sediment management may be largely beneficial as the sediment discharge from the final cap and swale drains will be reduced compared to the existing forestry operations. Effects on groundwater and surface water quality will therefore be no more than minor.
Effects on air quality.	Potential odour receptors are not located down-valley from the landfill and are not predicted to be downwind of the landfill for significant periods of time. Construction of the landfill in accordance with best practice engineering, and operational management measures will ensure it is unlikely that any odours detected at nearby receptors will be considered 'offensive or objectionable, and consequently odour impacts on nearby receptors will be not be significant. Proposed dust control measures will ensure there is no discernible dust received at sensitive receptors, or any adverse effects beyond the site boundary. Landfill gas containment and management measures consistent with the NESAQ will ensure risks to health and safety, amenity and the environment are low. Concentrations of pollutant emissions from the landfill gas flare in combination with existing background concentrations will be well below the relevant air quality criteria, and there will be limited potential for adverse off-site air quality effects. Effects on air quality will therefore be no more than minor.
Effects on terrestrial vegetation communities, avifauna, and herpetofauna.	The vegetation communities that will be lost all frequently occur in nearby areas or the wider ecological district (ED), or are otherwise small/degraded. The loss of these vegetation communities will have a low, very low, or negligible level of ecological effect. Implementation of a ~~Terrestrial~~ Vegetation Restoration Management Plan ~~and Wetland Restoration Plan~~ will ensure no net loss or net gain in ~~treeland/forest/~~wetland habitat to mitigate and offset the loss of "significant" indigenous flora and habitats.

Effects on aircraft safety from birds attracted to the landfill operation.	Given that none of the native gully habitat on site will be lost, and ~~,~~the lost re-planted radiata pine habitat type is very abundant in the surrounding landscape ~~the small loss of native gully habitat will have~~there will be a very low level of ecological effect on eastern falcon and other native birds due to the abundance of these habitats on the site or surrounding environment. Proposed construction management measures will ensure disturbance of falcon during the breeding season will result in a low level of ecological effect. ~~Predator~~ Pest control measures will ensure increased predation of birds by rodents will have a very low level of ecological effect. Proposed operational procedures as well as good bird monitoring, management and control in accordance with a Bird Management Plan will ensure bird numbers (particularly black-backed gulls) at the landfill are kept to very low numbers and therefore result negligible strike risk with aircraft, and a very low level of ecological effect. Proposed pre-construction salvage and relocation of lizards during construction, and habitat enhancement through revegetation within the designation site that provides habitat and food resources will result in a very low level of ecological effect on the lizard population. Effects will on terrestrial vegetation communities, avifauna, and herpetofauna will therefore be no more than minor.
Effects on freshwater ecology.	Predicted changes in groundwater levels, and a predicted overall ~~50~~20% reduction in surface water flows from the site to the downstream tributary of the Ōtokia Creek. Groundwater infiltration from the proposed stormwater attenuation basin is however anticipated to provide sufficient soakage to mitigate the loss of groundwater recharge, and the alteration to downstream water flows is expected to result in only a slight change and limited to the 300 m of waterway section between the swamp wetland within the designation site and the large pond downstream of the site. The main obligate wetland species that are most vulnerable to an altered (reduced) water supply, in terms of cover, are exotic species which are not considered to have intrinsic ecological value. Pūrei, which could possibly reduce in extent, is a Not Threatened indigenous species that is extremely common in the surrounding area and at the level of the ED. The continuous overall wetland feature (within and below the designation site) has a number of hydrological influences that will alter with time irrespective of the landfill proposal (including climate change effects, and land use changes in other tributaries). Such factors render it difficult to assess the likelihood or extent of possible wetland changes. Taking into account the uncertainties and assumptions, the worst case effect of the landfill, in terms of potential habitat changes (change in wetland species composition) is assessed as a **Low** level of ecological effect for the swamp wetland and a **Very low** level of ecological effect for the better-buffered valley floor marsh wetland below. ~~may result in the~~

	~~contraction or disappearance of permanently wet area and resultant swamp vegetation, most likely nearest the designation site. This area comprises a mix of largely exotic species and indigenous wetland plant species that are all common in the area and the wider (ED) landscape. A reduction in groundwater and surface water may also reduce the perennial extent of the waterway resulting in a loss of habitat for freshwater species.~~ ~~The potential loss of wetland and freshwater habitat would amount to a low to moderate level of ecological effect, with this range reflecting the uncertainty regarding the effects of reduced wetland water supply.~~ Implementation of a ~~Wetland~~ Vegetation Restoration Management Plan, ~~incorporating an adaptive management approach~~ will ensure no net loss or net gain in in wetland ~~and freshwater~~ habitat to mitigate and offset the loss of "significant" indigenous flora and habitats. Proposed erosion and sediment control measures will ensure fine materials are not discharged downstream, resulting in a very low level of ecological effect on freshwater flora and fauna in the downstream Ōtokia Creek receiving environment. Proposed leachate containment and monitoring measures will ensure there will be a very low level of ecological effect on freshwater flora and fauna in the receiving environment. Predicted reductions in contaminant flux ~~may have~~are likely to have a positive effect on downstream wetland vegetation. Effects on freshwater ecology will therefore be no more than minor.
Effects on the natural character of wetlands, rivers, and their margins.	~~The landfill, potential downstream effects, and loss of existing wetland adjacent to McLaren Gully Road would occur in the context of an existing working rural environment, and established road corridor with lower apparent levels of natural character. Following implementation of the ecological mitigation, including the Wetland Restoration Plan there will be no potential for any significant residual adverse effects on natural character.~~ The landfill will avoid the ephemeral streams and wetlands within the site and preserve the limited levels of natural character expressed in these areas. The waterbodies associated with the upgrade to McLaren Gully Road adjoin an established road corridor and surrounding rural landscape expressing a higher degree of modification and more limited natural character. Overall, the removal of 17m^2 of low-quality wetland will result in a very low level of effects. Providing substantial ecological planting throughout the designation site in accordance with the Vegetation Restoration Management Plan will in time result in low beneficial natural character effects. Effects on natural character will therefore be no more than minor.

Effects on landscape character.	Given the relative containment of the landfill site and the gradual and intermittent nature of the filling and earthworks activity, potential landscape character effects will be moderate-low adverse during operation outside of the site which reduce to low adverse effects at completion. Construction of the roading upgrades will reveal a raw work appearance generating moderate adverse effects, but will not appear uncharacteristic given their association with the existing rural road network. Once completed, the upgraded road corridor will assimilate within this rural ~~context~~ character resulting in low landscape effects. Effects on landscape character will therefore be no more minor.
Effects on visual amenity.	The location and physical nature of the site, within in a folded gully system, contains and mitigates most visual effects of the landfill on the surrounding area. Any partial and transient views will entail a foreground of productive plantation forestry and very distant backdrop of Maungatua beyond the Taieri Plains generating some short term moderate adverse effects, principally from adjoining roads. Once perimeter planting has been established, visual effects along the boundary of the landfill will reduce to low adverse effects. Effects on visual amenity will therefore be no more than minor.
Effects on archaeology.	There is the potential for undiscovered archaeology to be encountered during the proposed works associated with European farming activities, and earlier Māori occupation of the area. Proposed archaeology discovery measures will ensure effects on archaeological values are no more than minor.
Effects on cultural values.	Potential impacts on cultural values identified in the Cultural Impact Assessment, will be addressed through robust design measures, and operational, and monitoring practices that will persist beyond the ~~55~~40-year operational life of the landfill, to ensure effects on the mauri and whakapapa of the receiving environment are avoided to the fullest extent possible. ~~Creation and e~~Enhancement of wetland/riparian habitat, and pest management are also proposed to offset effects on mauri and whakapapa, and restore mahika kai values. Ongoing engagement with Te Rūnanga o Ōtākou following lodgement of the applications and beyond is proposed to address the CIA key messages and recommendations, including input into the detailed management and monitoring measures in the LMP and associated ecological management plans that will support recognition of mana whenua, and exercise of rakatirataka and kaitiakitaka. Subject to further engagement with mana whenua, it is considered that the effects of the landfill can be managed so as to be minor.

Effects on the road network.	The temporary effects of road construction on the operation of the road network, and other road users will be managed through the preparation and implementation of a Construction Traffic Management Plan to ensure the safe and efficient interaction of construction traffic with other road users. An increase of approximately 25 heavy vehicle trips, and 25 light vehicle trips a day to and from the landfill is expected to have no noticeable effect on the operation of the receiving road environment, or impact the ability of residents on McLaren Gully Road or Big Stone Road to access driveways. The road upgrades, including to the SH1 / McLaren Gully Road intersection will ensure the roads can safety accommodate increased traffic demands arising from the operation of the landfill. Effects on the road network will therefore be no more than minor.
Effects of noise on sensitive receptors from landfill/road construction and operation.	The construction works and operational landfill activities will comply with the relevant 2GP noise limits including condition 3 of the designation, resulting in noise effects that are less than minor.
General community effects, including pests, litter, fire risk.	Proposed operational management measures will ensure potential effects from landfill fire; windblown litter; increased abundances of vermin and flies; and contamination of drinking water supplies by birds attracted to the landfill will be managed so as to be no more than minor.

9.0 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 (NESAQ)
- National Environmental Standard for Freshwater 2020 (NESFW)
- National Policy Statement for Freshwater Management 2020 (NPSFW)
- The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)
- Partially Operative Regional Policy Statement (PORPS)
- Otago Regional Plan: Waste (Waste Plan)
- Otago Regional Plan: Water (Water Plan)
- Proposed Dunedin City District Plan (2GP)
- Operative Dunedin City District Plan (Operative DP)

As for the assessment of effects in **section 8.0**, the focus of the 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.

The Otago Regional Plan: Air has not been considered in the assessment below. This is due to discharges to air from landfills instead being captured by the provisions of the Otago Regional Plan: Waste, and all other non-landfill discharges to air (e.g. dust emissions from roading upgrades) being a permitted activity and not requiring resource consent under the Air 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 partially operative PORPS and NPSFWM. This has resulted in a fragmented policy framework which results in some conflicts and uncertainty in the policy direction for managing the use and development of resources, including the proposed project. Adding to this fragmentation is the recent gazettal of the new replacement NPSFW and NESFW which ~~come~~came into force on the 3rd of September 2020, and which will drive the need for further changes to the regional policy statement and regional plans.

A list of the relevant objectives and policies of the statutory documents is set out in **Appendix ~~19~~18**. Rather than assessing the provisions of each document in turn, the following assessment groups and assesses the relevant provisions from all documents holistically under policy themes. This approach enables policy differences and conflicts between the documents and any resulting

uncertainty in the resulting policy direction to be identified, analysed, and reconciled for each theme.

It is relevant to note that a number of the relevant policy documents are in a state of review. In particular, the following is noted:

- The NPSFW 2020 ~~comes~~ came into force on the 3rd of September 2020, replacing the earlier NPSFW 2014. How the fundamental concept – Te Mana o te Wai, the objectives and policies, and related National Objectives Framework (NOF) is ultimately implemented in regional planning documents will be subject to further ORC plan review processes, including consultation with communities, and therefore it is not possible to determine with certainty how the NESFW will change future management of freshwater environments within and downstream of the site. The NPSFW also includes ~~a number of~~several specific policies relating to wetlands and rivers which are required to be included directly within regional plans. To the extent practicable, the NPSFW provisions have been considered in this assessment.
- The PORPS is in the advanced stages of replacing the Operative RPS. All provisions of the PORPS relevant to these resource consent applications are either operative or beyond appeal. ~~This is with the exception of Policy 5.4.6(c) of the PORPS which is not yet fully resolved. This provision however has no equivalent provision in the Operative RPS~~, and therefore, the Operative RPS has not been considered further in this assessment.
- A review of the PORPS has also commenced, with a new proposed RPS ~~originally~~ due to be notified in ~~November 2020~~June 2021, which is expected to give effect to the new replacement NPSFW and NESFW 2020.
- Plan Change 1 to the Regional Plan: Waste, and Plan Changes 7 and 8 to the Regional Plan: Water were 'called in' and notified by the Environmental Protection Authority (EPA) on the 6th of July 2020. The plan changes are currently being heard and considered by the Environment Court. The plan changes introduce additional policies and make changes to existing policies relevant to the project. These changes have been considered in this assessment.
- The Operative DP is in the advanced stages of its review process and being replaced by the 2GP. The majority of provisions relevant to DCC resource consent applications are operative. Some provisions however remain subject to unresolved appeals, and where that is the case, the corresponding provisions of the Operative DP have been considered in this assessment.

In undertaking the assessment of the statutory documents in the following sections, provisions that remain subject to unresolved appeals are denoted by shading, and proposed provisions introduced by notified Plan Changes 1, 7, and 8 to the Waste Plan and Water Plan are shown underlined. The relevance of provisions to the assessment of the different resource consents required from ORC and DCC are also identified.

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 14**. The relevant NRMP provisions are set out in Appendix D of the CIA and are

therefore not repeated in **Appendix ~~19~~18**. Discussion of particular NRMP provisions in the CIA are captured in the following assessment.

9.1.1 Economic, Social, and Cultural Wellbeing Provisions

The relevant provisions addressing economic, social, and cultural wellbeing are set out in **Table ~~32~~33**.

Table ~~32~~ 33 – Economic, Social, and Cultural Wellbeing – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objectives 1.1 and Policies 1.1.1, 1.1.2 Objective 2.2 and Policies 2.2.1, 2.2.2	ORC and DCC resource consents.
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.2, objectives (i), (ii), (iii), and (iv)	ORC and DCC resource consents

PORPS 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 in particular 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.

PORPS objective 2.2, and policy 2.2.1 requires the cultural values in Schedule 1 of the PORPS 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".* 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 landfill and associated road upgrades will provide for, economic, social, and cultural wellbeing, and health and safety. Specifically, the project will provide for Dunedin's future waste disposal needs thereby providing for community resilience and avoiding adverse effects on human health from inadequate waste management. Construction and operation of the landfill is projected to generate additional significant economic benefits and additional employment opportunities for Dunedin City.

The design of the landfill together with proposed 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 to the extent possible. Ongoing engagement with Te Rūnanga o Ōtākou, including input into the final detailed management and monitoring measures 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 ~~33~~34**.

Table ~~33~~ 34 – Integrated Management – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
National Policy Statement for Freshwater Management 2020 (NPSFW)	Policies 3 and 4	ORC consents.
Partially Operative Otago Regional Policy Statement (PORPS)	Objectives 1.2 and Policy 1.2.1	ORC and DCC resource consents.

NPSFW 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.

PORPS 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.

The landfill will provide for the integrated management of natural and physical resources. The project been designed cognisant of the interactions between land, freshwater, and ecosystems on a whole-of-catchment basis. In particular, waste and leachate containment measures and stormwater treatment and discharge methods are proposed, which will avoid or mitigate adverse contaminant effects on groundwater and connected surface water quality in the downstream receiving environment, and its ecosystems. Similarly, the proposed takes, damming, and diversions of water will ensure the continuance of downstream flows in the wider catchment that promotes healthy freshwater ecosystems. Where there is a ~~contraction~~ change in the vegetation structure~~of~~ wetland~~/freshwater~~ habitats immediately downstream of the landfill though a reduction in water supply, any loss will be mitigated and offset by wetland enhancement~~/creation~~.

9.1.3 Waste Management Provisions

The relevant provisions addressing waste management are set out in **Table ~~34~~35**.

Table ~~34~~ 35 – Waste Management – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policy 3.1.7 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	ORC consents

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 and Policies 7.4.1, 7.4.3, 7.4.4, 7.4.5, 7.4.6, 7.4.8 and 7.4.11	ORC consents
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.6, Objectives (i), (ii), and (iii), and Policies 22 and 23	ORC resource consents

PORPS objective 3.1, and policy 3.1.7 require the life supporting capacity of soils be *"safeguarded"* and manage soils to as far as practicable *"maintain or enhance"* their: function in the storage or cycling of water, nutrients, and other elements; and function as a buffer or filter for contaminants from human activities. The policy also however recognises that infrastructure development may result in the loss of soil values. Development of the landfill will result in the loss of soil cover, particularly for the time the landfill is in operation. Soils however will be stockpiled and later reused as a capping layer such that its life supporting capacity is safeguarded for future primary production use, while also maintaining its function in the water cycle, and as a buffer for landfill contaminants.

PORPS 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. 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 landfill will ensure that waste materials and hazardous substances will not harm human health or the quality of the environment. The landfill 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 so as to minimise the amount of residual waste being disposed of to the landfill. This will include the composting of municipal organic waste. Notwithstanding minimisation efforts, as recognised in the WWMP there will remain a need for a future landfill for the disposal residual waste.

Residual waste will be disposed of in an environmentally safe manner. The landfill waste and leachate containment measures have been developed in accordance with WasteMINZ guidelines for a class 1 landfill to enable acceptance of municipal solid waste and hazardous materials that meet the leachability (TCLP) limits in the Ministry for Environment 2004: Module 2: Hazardous Waste Guidelines – Class A. No other hazardous wastes or hazardous substances will be

accepted, with other measures signalled in the WWMP ensuring they are collected, recycled or disposed of in accordance with regulatory requirements so as to avoid adverse effects.

PORPS objective 5.3, and policy 5.3.1 require activities in rural areas be managed to support the region's economy and communities by: *"providing for"* activities that have a functional need to locate in rural areas; and *"restricting"* the establishment of incompatible activities that are likely to lead to reverse sensitivity 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 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.

The landfill will support the region's economy and community by providing for Dunedin's future waste disposal needs and generating additional economic benefits and employment. The landfill has a functional need to locate in a rural area owing to the area of land required, and to enable management of potential environmental effects, which could not otherwise be readily achieved in an urban location.

The landfill has been appropriately sited at the head of a catchment whereby surface water flows can be readily managed and separated from the waste stream, and with underlying geotechnical conditions that support landfill stability to minimise risks from natural hazard risks and ensure the natural containment of contaminants. The site is in a location that is sufficiently separated from surrounding sensitive land uses, and where any adverse effects in terms of amenity or health and safety can be readily avoided or mitigated.

The landfill design together with proposed design, construction, operating and post closure monitoring and management measures contained in the site specific LMP 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: adoption of the Class 1 landfill waste acceptance criteria; waste acceptance procedures to confirm compliance of incoming waste for compliance with the criteria; 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, 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 the design of the landfill together with proposed monitoring and management measures avoiding, remedying, and mitigating adverse effects on mauri of resources to the extent possible, and ensuring protection of toaka species (such as eastern falcon). Ongoing engagement with Te Rūnanga o Ōtākou will be maintained and will provide further opportunities for taking into account Kāi Tahu cultural values.

9.1.4 Water Quantity Provisions

The relevant provisions addressing water quantity are set out in **Table ~~35~~36**.

Table ~~35~~ 36 – Water Quantity – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
National Policy Statement for Freshwater Management 2020 (NPSFW)	Objective 2.1 and Policies 1, 2, 5,11, 13 15.	ORC consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policies 3.1.1, 3.1.3, 3.1.11.	ORC consents
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, 6.3.3, 6.3.6, and Policies 6.4.0A, 6.4.1A, 6.4.2, 6.4.16, 6.4.19 Objectives 9.3.1, 9.3.3, policy 10A.2.2	ORC consents
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.	ORC consents

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 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"*.

PORPS 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."*

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 landfill will result in a reduction in groundwater levels through reduced recharge, the resulting downstream shift of the point at which the tributary of the Ōtokia Creek transitions from valley floor marsh wetland system to a permanently flowing waterway system, and a predicted overall ~~50~~20% reduction in contribution to surface water flows downstream. The reduction in groundwater levels will be mitigated through direct recharge through the attenuation basin ~~forebay~~ which is expected to provide a net increase in groundwater flow through the valley floor, while reduction

in surface water flows downstream is expected to have no effects on flows and levels in the catchment beyond the immediate vicinity of the site.

Consequently, overall the surface water flows provided will ensure health and wellbeing of waterbodies and freshwater ecosystems in the wider catchment beyond the immediate vicinity of the ~~site~~ landfill will be 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 of flooding and erosion downstream of the site will be avoided with the attenuation basin attenuating any higher stormwater flows across the less permeable landfill cap. Adverse effects on the natural and human use values for Ōtokia Creek listed in schedule 1 of the Water Plan, natural character, amenity values, and downstream users will also be avoided, noting in particular 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'*. PORPS 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, 6.3.3, 6.3.6, policies 6.4.0A and 6.4.1 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 6.4.19 sets out considerations for the setting of the duration of water permitted, noting that proposed Plan Change 1 policy 10.A.2.2 limits the duration of new consents to take and use water to no more than six years.

The take and use of groundwater ~~(including leachate) are~~ is required to enable the effective construction and operation of 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 ~~(including leachate)~~ will be measured. A consent duration for the take and use of groundwater of 35 years sought, and while inconsistent with the maximum 6 years' duration indicated by proposed PC7 policy 10A.2.2, is considered appropriate in light of the likely low and reducing volumes of water that will be abstracted, long-term use of the landfill, and the value of the investment in landfill infrastructure, and noting that the final form of policy 10A.2.2 is yet to be confirmed ~~through the process of submissions, hearings and decisions~~by the Environment Court.

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"*. 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 design of the landfill together with proposed monitoring and management measures 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.

9.1.5 Water Quality Provisions

The relevant provisions addressing water quality are set out in **Table ~~36~~37**.

Table ~~36~~ 37 – Water Quality – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
National Policy Statement for Freshwater Management 2020 (NPSFW)	Objective 2.1 and Policies 1, 2, 5, 12, 13 15.	ORC consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policies 3.1.1, 3.1.11 Objective 5.4 and Policy 5.4.1	ORC consents
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.3, 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 Objective 9.3.3 and Policies 9.4.14, 9.4.17.	ORC consents
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, 12, 13, 14, 15, 16, 17, 18.	ORC consents

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 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"*.

The PORPS has been developed to give effect to the NPSFW requirements. PORPS 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, PORPS 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"*.

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 7.B.2, and 7.B.3, require objectionable discharges of contaminants are to be *"avoided",* including to maintain Kāi Tahu values, and discharges with minor or short term discharges with short-term effects *"allowed"*. Policy 7.C.5 requires measures

are adopted to prevent contamination of the receiving environment by industrial or trade waste 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 ~~site~~ landfill will be maintained. The landfill has been sited at the head of a catchment whereby surface water flows can be readily managed or separated from the waste stream, and with underlying geotechnical conditions that support the natural containment of contaminants. Waste and leachate containment, and stormwater and erosion and sediment control methods are proposed, which 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 ultimately included in the LMP will prevent, contain, and recover accidental spills. Adverse effects on the natural and human use values for Ōtokia Creek listed in schedule 1 of the Water Plan, sedimentation, and downstream users will also be avoided, noting in particular that sediment management is expected to be beneficial over existing forestry operations, and there are no existing downstream infrastructure or users reliant on freshwater.

NPSFW policy 12 requires the national target for water quality improvement is achieved. Water Plan 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. With the proposed measures, and when compared with the Schedule 15 limits and the ANZG 2018 guidelines predicted concentrations of lead, DRP and ammoniacal nitrogen within the shallow groundwater system down gradient of the landfill are not anticipated to exceed the water quality criteria. ~~w~~Water quality in the shallow groundwater system and connected downstream tributary of the Ōtokia Creek is predicted to be enhanced over existing water quality. ~~, thereby better supporting achievement of the numerical limits for achieving good water quality in Schedule 15 of the Water Plan. While there will be a predicted increase in ammoniacal nitrogen in comparison to the existing environment and Schedule 15 limits, the flux of total inorganic nitrogen is estimated to reduce from approximately 73 kg/year to less than 2 kg/year. Considering nutrient transformations between nitrogen species, groundwater and surface water quality overall will be enhanced.~~

Objective 9.3.3 and policies 9.4.14 and 9.4.17 requires the quality of groundwater is *"maintained"* including by new bores being sealed, and "*preventing*" contaminants entering any aquifer. All groundwater monitoring bores installed downgradient of the landfill will be sealed to prevent contaminants entering groundwater.

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"*. 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. The design of the landfill together with proposed monitoring and management measures 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 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 ~~37~~38**.

Table ~~37~~ 38 – Air Quality – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
National Environmental Standard for Air Quality (NESAQ)	Regulations 25, 26, and 27	ORC consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policy 3.1.6 Objective 5.4 and Policies 5.4.1	ORC consents
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 NESAQ requires landfills to provide a system for the collection of gas 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 provide a landfill gas collection and destruction flaring system that meets the NESAQ requirement that the discharge of gas from the surface of the landfill does not exceed 5000 parts of methane per million parts of air.

PORPS 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."*

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.

Construction of the landfill in accordance with best practice engineering, and operational management measures will ensure detection of 'offensive or objectionable' odours or dust at nearby receptors are unlikely. Concentrations of pollutant emissions from the landfill gas flare in combination with existing background concentrations will be well below the relevant air quality criteria. 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. Indigenous planting is proposed as part of landscape and ecological mitigation 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 ~~38~~39**.

Table ~~38~~ 39 – Beds of Rivers – Policy Framework

Planning Document	Relevant Provisions	Relevant consents
National Policy Statement for Freshwater Management 2020 (NPSFW)	Objective 2.1 and Policies 1, 2, 5, 7, 13, 15, clause 3.24(1).	ORC consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policy 3.1.2	ORC consents
Otago Regional Plan: Water	Objective 5.3.1, 5.3.3, 5.3.4, 5.3.6, and Policies 5.4.2, 5.4.3, 5.4.8, 5.4.9 Objective 8.3.1, 8.3.2, 8.3.4, and Policies 8.4.1, 8.6.1, 8.6.2, 8.7.1, 8.8.1, 8.8.2	ORC consents
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.	ORC consents

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 7 requires the loss of *"river extent and values is avoided to the extent practicable".*

PORPS 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."*

Water Plan Objectives 8.3.1, 8.3.2 and policy 8.4.1 require when managing activities in, on, under or over the bed or margin of any lake or river, to give priority to *"avoiding"* changes in the nature of flow and sediment processes in those water bodies; where it would affect existing structures, arises from associated erosion or sedimentation; or arises from any reduction in flood carrying capacity. Policy 8.6.1 requires in managing the disturbance of the bed or 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. Policy 8.8.1 requires the *"consideration"* of practical alternatives to reclamation of the bed of a river, and only cleanfill be used in the reclamation of any river bed.

~~The formation of the landfill attenuation basin and toe embankment will result in the reclamation of a swamp wetland at the bottom of the site, and part of the defined channel that connects it to the valley floor marsh wetland north of the site which contains standing water. The construction of the upgrades to McLaren Gully Road will also result in the clearance of roadside wetland areas.~~

~~All of these areas have out of caution has been assumed to be a "river" for the purposes of the RMA, NESFW, and Water Plan.~~

~~Reclamation of the swamp wetland will result in the localised loss of the uppermost part of the downstream tributary of the Ōtokia Creek.~~ The loss of river extent and values has been avoided to the extent practicable. The footprint of the updated landfill design avoid the areas of wetland within the site, and the updated alignment of the upgrades to McLaren Gully Road also largely avoid roadside wetland areas, affecting an area of just 17m^2. These wetland areas have out of caution has been assumed to be a "river" for the purposes of the RMA, NESFW, and Water Plan. There are no practical alternatives and there is a functional need for reclamation in these locations~~, noting the toe embankment is a critical component ensuring the structural stability of the landfill, and the attenuation basin is required to attenuate stormwater flows from the site, provide additional water quality treatment, and emergency containment in the event of any contaminant spills~~. Any material used in the reclamation will be clean engineered fill won from the ~~site~~ road earthworks. ~~Further design work following the lodgement of these applications is proposed to refine the upgrades to avoid the roadside wetlands to the extent it is practicable.~~

~~Notwithstanding the above,~~Where reclamation is required, the adverse effects have been minimised. While significant in terms of the PORPS and 2GP criteria, ~~T~~the ecological values of ~~the swamp and~~the roadside wetlands have been assessed as being low, and they form part of an existing modified working rural environment which exhibits limited levels of natural character. Beyond the very small area of wetlands that will be lost, good water quality; bank stability; ecosystem health and indigenous biological diversity; natural functioning and character; and amenity values of the downstream river bed will be maintained. Adverse effects of flooding and erosion downstream of the site will be avoided~~, noting that for the landfill the attenuation basin will attenuate any higher stormwater flows from the site~~. Reclamation of the bed will also avoid changes in the nature of downstream flows and sediment that would affect existing structures; arise from associated erosion or sedimentation; or arise from any reduction in flood carrying capacity.

Disturbance of the bed or margin of the ~~swamp and~~ roadside wetland~~s within the site~~ is not expected to have any adverse effect on downstream spawning requirements of indigenous fauna; water quality; and downstream users. In particular, ~~the~~ proposed stormwater measures will capture any sediment laden water during reclamation works and ensure that fine materials are not discharged downstream.

Water Plan policy 8.7.1 *"promotes"* the creation, retention and enhancement of appropriate riparian vegetation. Riparian vegetation will be established as part of wetland enhancement~~/creation~~ to mitigate and offset for the minor loss of the extent of river bed and wetland areas as a result of the ~~landfill and~~ road upgrades.

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"*. 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 design of the landfill together with proposed monitoring and management measures 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 ~~39~~40**.

Table ~~39~~ 40 – Biodiversity – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
National Policy Statement for Freshwater Management 2020 (NPSFW)	Objective 2.1 and Policies 1, 2, 5, 6, 9, 13, 15, clause 3.24(1).	ORC consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policies 3.1.2, 3.1.9, 3.1.11 Objective 3.2 and Policies 3.2.1, 3.2.2, 3.2.15, 3.2.16 Objective 5.4 and Policies 5.4.2, 5.4.6, and 5.6.4A	ORC and DCC consents
Otago Regional Plan: Water (Water Plan)	Objectives 10.3.1, 10.3.2 and Policies 10.4.1, 10.4.1A, 10.4.2	ORC consents
Proposed Dunedin City District Plan (2GP)	Objective 2.2.3 and Policies 2.2.3.1, 2.2.3.2, 2.2.3.6, 2.2.3.7 Objective 10.2.1 and Policies 10.2.1.1, 10.2.1.2, 10.2.1.3, 10.2.1.4, 10.2.1.5, 10.2.1.6, 10.2.1.7 Objective 10.2.2 and Policies 10.2.2.1 and 10.2.2.3, 10.2.2.6 10.9.3 and 10.9.4	DCC consents
Operative Dunedin City District Plan (Operative DP)	Objective 16.2.1, 16.2.2 and Policies 16.3.1, 16.3.2, 16.3.3 and 16.3.4	DCC consents
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), and Policies 1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 15, 16.	ORC and DCC consents

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"*.

PORPS 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. 2GP objective 10.2.1, and policy 10.2.1.1 which are relevant only to the applications to DCC for the road upgrades, require biodiversity values are *"maintained or enhanced"*. Operative DP objective 6.2, and policy 16.3.1 *"encourage"* the retention of areas of indigenous vegetation and habitats of indigenous fauna generally.

The landfill and associated road upgrades overall will maintain ecosystem health, indigenous biological diversity, and areas of predominately indigenous vegetation. The vegetation communities that will be lost frequently occur in nearby areas or wider ecological district, or are otherwise small/degraded. Furthermore, their loss will only result in a small loss of habitat for eastern falcon and other native birds. Implementation of a ~~Terrestrial~~ Vegetation Restoration Management Plan ~~and Wetland Restoration Plan~~ will ensure no net loss or net gain in ~~treeland/forest/~~wetland vegetation communities and habitats. Proposed construction management measures will ensure low ecological effects on falcon and lizards; and leachate containment and monitoring, and stormwater, erosion and sediment control measures will ensure a very low level of ecological effect on downstream freshwater flora and fauna, and also ensure the habitats of indigenous freshwater species are protected.

NPSFW policy 6 requires that *"there is no further loss of the extent of natural inland wetlands, their values are protected, and their restoration is promoted"*. PORPS 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 policies 3.2.15 and 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. Enhancement and rehabilitation of degraded wetlands are *"encouraged"*. 2GP objective 10.2.1, and policy 10.2.1.7 which are relevant only to the applications to DCC for the road upgrades and wetland creation/enhancement, only allows indigenous vegetation clearance in a wetland where there is no net loss or preferably a net gain in biodiversity values.

The ecological values of the swamp wetland and wetlands downstream, and adjacent to McLaren Gully Road that will be lost ~~or contracted by a by~~or affected by a reduction in water supply have been assessed as being low, and they are part of an existing modified working rural environment which exhibits limited levels of natural character. They are not considered to have significant values identified in policy 3.2.15 of the PORPS which are required to be maintained, while ~~their~~ any loss will also be mitigated and offset through the implementation of a ~~Wetland~~ Vegetation Restoration Management Plan, which will provide for ~~creation and~~ enhancement of degraded wetlands, and will ensure no net loss or net gain in the extent of wetland communities and habitats. ~~Further design work following the lodgement of these applications is proposed to r~~Refinement of the design the upgrades to McLaren Gully Road has also avoided ~~to avoid~~ the roadside wetlands to the extent it is practicable.

Water Plan objectives 10.3.1, 10.3.2, and policies 10.4.1, 10.4.1A, and 10.4.2, require adverse effects are to be *"avoided"* on any regionally significant wetland, but remediation or mitigation of effects is allowed where the activity relates to nationally or regionally significant infrastructure. The landfill will not have any adverse effects on the regionally significant Lower Ōtokia Creek Marsh wetland identified in the Water Plan.

While the indigenous vegetation communities and habitats that will be lost have low ecological value, they are considered 'significant' under the relevant PORPS schedule 4, and 2GP criteria. Corresponding PORPS 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. PORPS 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."* The offset is to achieve no net

loss and preferably a net gain in indigenous biological diversity, ensure there is no loss of rare or vulnerable species, and be undertaken where it will result in the best ecological outcome.

2GP objective 10.2.1, and policy 10.2.1.2 which are relevant only to the applications to DCC for the road upgrades ~~and wetland creation/enhancement outside the designation~~, require adverse effects on areas of significant indigenous vegetation and habitats of indigenous fauna are to be *"avoided"*. Policy 10.2.1.6 requires that large scale indigenous vegetation clearance in rural zones is otherwise only allowed where adverse effects on biodiversity values are *"avoided"*, or if not practicable, *"no more than minor".* Corresponding Operative DP objective 16.2.2, and policy 16.3.3 require the effects of land use activities that compromise the protection of areas of significant indigenous vegetation and habitats of indigenous fauna are to be *"avoided"*. Policy 10.2.1.2 require that where avoidance of adverse effects on significant indigenous vegetation is not practicable there is to be no net loss and preferably a net gain in biodiversity values of the area, or adverse effects are to be offset or compensated. Clause 10.9.3 requires an application that includes a proposal for a biodiversity offset is to be accompanied by a biodiversity offset management plan.

While the loss of areas of significant indigenous vegetation and habitats identified under the PORPS schedule 4 and 2GP criteria will not be avoided, or protect or maintain the values that contribute to the areas being significant, the effects will be mitigated and offset through the implementation of a ~~Terrestrial Vegetation, and Wetland~~Vegetation Restoration Management Plan~~s~~ which will provide for the ~~expansion and enhancement of indigenous treeland habitat, and the creation and~~ enhancement of wetlands within the designation ~~and wider application site~~. The implementation of ~~these plans~~the plan will ensure no net loss or a net gain in the extent of ~~indigenous treeland and~~ wetland vegetation and habitats, and ensure there is no loss of rare or vulnerable species, and will be undertaken in locations in the existing swamp wetland which achieve the best ecological outcome. The information required for a biodiversity offset management plan under 2GP clause 10.9.3 is provided in the Ecological Impact Assessment in **Appendix 11**.

2GP objective 10.2.2, and policy 10.2.2.3 which are relevant only to the applications to DCC for the road upgrades ~~and creation/enhancement of wetlands~~, requires vegetation clearance to be set back from water bodies to *"protect"* biodiversity and natural character values. Policy 10.2.2.6 provides that activities will only be allowed adjacent to waterbodies where the biodiversity values and natural character of riparian margins are maintained or enhanced. The works will result in the loss of areas with low biodiversity and natural character value~~, while enabling enhancement/creation of wetland habitats which will enhance such values~~.

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"*. 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 both introduced and indigenous 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.

While the landfill will result in the loss of degraded wetlands of low ecological value, that loss will be mitigated and offset through the ~~creation/~~enhancement of other wetland areas with locally sourced indigenous plants to achieve 'no net loss' or a 'net gain'. Furthermore, the design of the landfill together with proposed monitoring and management measures will ensure the protection of indigenous fish from hazardous operations associated with the landfill. These measures 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, including to ensure physical access to sites.

9.1.9 Transportation Provisions

The relevant provisions addressing transportation are set out in **Table ~~40~~41**.

Table ~~40~~ 41 –Transportation – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 4.3 and Policies 4.3.1, 4.3.2, 4.3.3, and 4.3.5	ORC consents DCC consents
Proposed Dunedin City District Plan (2GP)	Objective 2.3.1 Objective 6.2.1 and Policies 6.2.1.1, 6.2.1.3	DCC consents
Operative Dunedin City District Plan (Operative DP)	Objective 20.2.1, and Policies 20.3.1, 20.3.2, 20.3.9	DCC consents

PORPS 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.

State Highway 1 is a road of national significance. The proposed upgrades to the intersection of the state highway with McLaren Gully will provide for increased safety and efficiency of this intersection so as to ensure adverse effects on the functional needs of the state highway from landfill traffic are avoided. Dunedin Airport is also defined in the PORPS as being infrastructure of national or regional significance. Any risk of bird strike caused by birds being attracted to the landfill will be managed through the implementation of a Bird Management Plan, so as to ensure adverse effects of the functional needs of Dunedin airport are avoided.

2GP objective 6.2.1 and policies 6.2.1.1, 6.2.1.3 provide the operation, repair, and maintenance of the road network is to be enabled. Alterations or additions to existing roads are allowed only where the road: provides for the needs of all users and integrates with surrounding land uses; minimises as far as practicable adverse effects on surrounding sensitive activities; and maintains or enhances the safety and efficiency of the overall transport network. Operative DP objective 20.2.1, and policies 20.3.1, 20.3.2 require the adverse effects on the environment of establishing,

maintaining, improving, and use of transport infrastructure to be *"avoided, remedied, or mitigated"*. The improvement and use of public roads is to be *"provided for"*.

The upgrades to McLaren Gully Road (including its intersection with State Highway 1) and Big Stone Road will better provide for the needs of all users along the road, including the proposed landfill, and existing forestry and residential activities. The road upgrades have been designed to integrate with surrounding land uses by avoiding fragmentation of land, and providing for connections to existing vehicle access points. The upgrades will enhance the safety and efficiency of the local road network, with any adverse effects being limited to the duration of upgrade works, which will be minimised as far as practicable by the adoption of construction management measures.

9.1.10 Road Earthworks Provisions

Other relevant miscellaneous provisions are set out in **Table 4142**.

Table 41 42 – Miscellaneous – Policy Framework

Planning Document	Relevant Provisions	Relevant Consents
Partially Operative Otago Regional Policy Statement (PORPS)	Objective 3.1 and Policy 3.1.8 Objective 5.2 and Policy 5.2.3	DCC consents
Proposed Dunedin City District Plan (2GP)	Objective 4.2.1 and Policy 4.2.1.1 Objective 8A.2.1 and Policies 8A.2.1.1 8A.2.1.2, 8A2.1.3, Objective 9.2.2, and Policy 9.2.2.1 Objective 10.2.2, and Policies 10.2.2.2, and 10.2.2.5 Objective 13.2.4 and Policy 13.2.4.1	DCC consents
Operative Dunedin City District Plan (Operative DP)	Objective 17.2.3 and Policy 17.3.9 Objective 21.2.2, and Policies 21.3.3, 21.3.7	DCC consents
The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP)	Section 5.4, Objectives (i), (ii), (iii), and Policies 1, 2, 11, 12, 13. Section 5.6, Objectives (i), (ii), (iii), and Policies 19, 20, 21.	DCC consents

PORPS objective 3.1, and policy 3.1.8 requires soil erosion from activities is to be *"minimised"*, by: using appropriate controls; maintaining vegetation cover; remediating land; and encouraging activities that enhance soil retention. 2GP objectives 8A.2.1, 10.2.2, and policies 8A2.1.1, 8A.2.1.2, 8A.2.1.3, 10.2.2.2, and 10.2.2.5 require earthworks are undertaken in a way that *"minimises"* adverse effects on surrounding sites and the wider area. Large scale earthworks are only allowed where effects on: visual amenity and character; amenity of surrounding properties; and stability of land and buildings are *"avoided"*, or if not practicable, adequately *"mitigated"*. Earthworks are to enable the biodiversity and natural character values of riparian margins to be

"maintained or enhanced", and *"minimise as far as practicable"* the risk of sediment entering water bodies. 2GP objective 4.2.1, and policy 4.2.1.1 require temporary activities (including construction) are to be designed and operated to *"minimise, as far as practicable"*, adverse effects on amenity or surrounding property, and people's health and safety.

Earthworks associated with the road upgrades will be undertaken in a way that minimises adverse effects on surrounding sites and the wider area, and people's health and safety. Specifically, the earthworks will not be uncharacteristic in this rural landscape, and reinstatement of batters with vegetation will ensure they tie into the landscape context such that effects on visual amenity and character are avoided or mitigated. Effects on amenity will also be managed through ensuring a sufficient setback to sensitive residential receptors or otherwise implementing a Construction Noise Management Plan to mitigate the effects of construction noise and implementing dust control measures.

The detailed design of the road will be informed by geotechnical investigations and undertaken in accordance with appropriate road design standards so as to ensure the stability of road cut and fill batters, and adjacent land. Erosion and sediment control measures will be implemented to minimise as far as practicable the risk of sediment entering water bodies. Loss of roadside indigenous vegetation ~~will be~~has been avoided as far as practicable through ~~proposed~~ refinement of the road footprint ~~following the lodgement of these applications~~, and wetland areas that are lost will be mitigated and offset by through wetland ~~creation/~~enhancement under a ~~Wetland~~ Vegetation Restoration Management Plan.

PORPS objective 5.2 and policy 5.2.3 requires adverse effects on areas or places containing archaeological sites, wahi tapu, or wahi taoka are to be avoided where they are of regional or national significance, and significant adverse effects on other values minimised, or otherwise remedied or mitigated. 2GP objective 13.2.4, and policy 13.2.4.1 require an archaeological authority is to be obtained prior to undertaking earthworks, where one is required. NRMP policies require an accidental discovery protocol for all road realignments/widening.

The road upgrade works fall outside any identified archaeological remains associated with existing archaeological sites I45/67, 145/79, I45/80, I45/81, and I45/82, and therefore adverse effects on these places will be avoided. The potential for other undiscovered archaeological remains being encountered during the proposed works will be managed through the implementation of an accidental discovery protocol which will ensure any significant adverse effects are minimised. An archaeological authority will be applied for prior to any modification of an archaeological site.

2GP objective 9.2.2, and policy 9.2.2.1 requires activities be designed and operated to avoid the adverse effects of noise on the health of people, or if not practicable, ensure effects are insignificant. The adverse effects of noise from the road upgrade works will be temporary and managed through ensuring a sufficient setback to sensitive residential receptors or otherwise implementing a Construction Noise Management Plan to ensure adverse noise effects will be insignificant on people's health.

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

9.2.1 Dunedin City Council Waste Minimisation and Management Plan 2020

As outlined in section 3.1.1, the Waste Minimisation Act requires Dunedin City Council to adopt a Waste Management and Minimisation Plan (WMMP). A new replacement 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:

1. *Reduce the municipal solid waste generation per capita by at least 15% by 2030 compared to 2015.*
2. *Reduce the amount of municipal solid waste disposed to landfill and incineration by at least 50% by 2030 compared to 2015.*
3. *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 Green Island Landfill'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 landfill is consistent with the vision, objectives, and methods of the WMMP. Whilst the Council is actively committed to realising 'zero waste' and enabling appropriate diverted material solutions, there is still a need for a landfill and the landfill proposed at Smooth Hill will meet the future community demand for waste disposal facilities. The proposed landfill has been designed, and will be constructed and operated in accordance with the best practice WasteMINZ guidelines, and be well managed in accordance with a Landfill Management Plan. Hazardous wastes that exceed the leachability limits in the Ministry for the Environment Module 2: Hazardous Waste Guidelines (2004) - Class A 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 introduced through proposed Plan Change 1 requires the siting, design, construction, construction, operation, and management of new landfills be in accordance with the guidelines.

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.
- Landfill gas 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 landfill gas.

As outlined in this AEE, the siting and concept design for the landfill, as well as the proposed means to minimise environmental effects, have been developed in accordance with the guidelines.

The siting of the landfill has considered relevant site constraints. The site has inherent geological, hydrogeological and topographical characteristics that support a high level of containment that ensure there will not be significant adverse impacts on the environment. The location will also ensure minimal disruption to the community and provides an appropriate buffer to neighbouring sensitive activities surrounding the site. ~~While~~ Furthermore environmentally sensitive areas in the form of wetlands, ~~and~~ areas of indigenous vegetation's and habitats of indigenous fauna ~~will not be fully~~have been avoided to the extent practicable, and the assessments undertaken as part of this AEE have confirmed the areas affected have low ecological value, and their loss can be mitigated through ~~vegetation/wetland~~ enhancement of similar habitat ~~and creation~~.

Engineered environmental protection by way of a liner and leachate collection system with appropriate redundancy, landfill cap, and landfill gas management are all proposed consistent with the guidelines. Stormwater control, and treatment is also proposed to ensure sediment is captured prior to discharge of stormwater into the receiving environment.

A monitoring regime is proposed, along with operational controls that will be further detailed in the LMP. These include waste acceptance criteria and procedures to ensure the waste accepted is compatible with the engineered containment and controls proposed, including ensuring hazardous wastes that do not meet the leachability criteria are not accepted. Monitoring of downstream/downgradient surface and groundwater quality, leachate quantity and quality, and landfill gas are all proposed to ensure the containment and treatment methods remain effective, or correction 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 outlined in this AEE, the landfill provides high levels of natural and engineered containment that will contain waste and leachate contaminants from entering the underlying soils or groundwater. While leakage of leachate through the liner is possible, the predicted quantities will result in a reduction in contaminant flux in comparison to the existing environment, following reasonable mixing and dilution, resulting in negligible effects on surface water quality.

Proposed stormwater, erosion and sediment control, and operational management measures will prevent the discharge of waste contaminated runoff into the receiving waters, and ensure stormwater is treated to remove sediment contaminants prior to discharge to ensure less than minor effects on water quality. The long-term effects of the landfill in terms of sediment management may be largely beneficial as the sediment discharge from the final cap and swale drains will be reduced compared to the existing forestry operations.

Given the above it is considered unlikely that the proposed discharges of contaminants to land and water will give rise to the effects listed in section 107 of the RMA in the receiving waters, after reasonable mixing.

10.0 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(f) – the protection of historic heritage from inappropriate subdivision, use, and development.
- 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 proposed landfill will provide for Dunedin's social, economic, and cultural wellbeing. Specifically, it will provide for its future waste disposal needs recognising the finite life of the Green Island landfill, while generating additional significant economic benefits and additional employment opportunities. The siting and design of the landfill together with proposed monitoring and management measures 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:

- Areas of ecological significance (e.g. West Gully 3) have been avoided and effects on wetlands have been avoided through the updated design to the extent practicable. Affected wetlands, rivers, margins, and areas indigenous vegetation and habitats have low levels of natural character and ecological values. Their loss or potential contraction has been avoided to the extent practicable, and will otherwise be mitigated and offset to ensure 'not net loss' or 'net gain', including through enabling direct recharge of downstream groundwater baseflows for downstream wetlands, and ~~indigenous treeland and~~ wetland ~~creation and~~ enhancement. This ensure the overall preservation of natural character, and the protection of areas of significant indigenous vegetation and habitats of indigenous fauna.
- The design and proposed monitoring and management measures recognise and provide for the relationship of Te Rūnanga o Ōtākou and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga to the extent possible. Ongoing engagement with Te Rūnanga o Ōtākou, including input into the detailed management and monitoring measures will ensure exercise of kaitiakitaka.
- Heritage values will be protected through the implementation of archaeological discovery protocols during construction.
- The underlying geology and design will ensure the long term stability of the landfill thereby managing any significant risks of natural hazards.
- The landfill is located on land close to its principal waste catchment of Dunedin City, and is on a site which is designated for its proposed use and has been heavily modified by plantation forestry use. Development of the site presents an efficient use and development of natural and physical resources.
- The location of the landfill in relation to potential receptors means that potential noise effects will be less than minor, and odour and dust effects will not be significant. This along with design and proposed operational management measures will ensure the maintenance of amenity values, and the maintenance of the quality of the environment.
- 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 principles of the Treaty of Waitangi have been taken into account. In its engagement and consultation to date and proposed ongoing collaboration with Te Rūnanga o Ōtākou in the 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.

11.0 Consultation

12.2 Consultation Approach

The following section sets out the consultation process undertaken ~~to date~~ by Dunedin City Council (DCC) from May 2019 to lodgement of consent applications for the development of the Smooth Hill landfill, which has been in addition to the publicly notified designation process for the site under the 2GP. DCC led the consultation and engagement with support from the wider project team. The section has also been updated to reflect further consultation with key stakeholder's post-lodgement.

Consultation has been undertaken in accordance with Dunedin City Council'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.

A Consultation and Engagement Plan was also prepared to guide the engagement process from the period in early 2019 to lodging the consent applications and post-lodgement. Consultation and engagement ~~will~~ has continued post lodgement and will continue through to securing the consent for the development of Smooth Hill. This activity~~,~~ will be guided by a separate Consultation and Engagement Plan.

A range of stakeholders were identified, and a range of consultation and information techniques have been used. The consultation techniques varied in accordance with the areas of interest of each stakeholder and their level of influence on the project. This is in accordance with good practice as set out by IAP2. Key stakeholders identified included:

- Local Government agencies
- Central Government and statutory agencies
- Elected community representatives
- Mana whenua
- Landowners and occupiers of properties in proximity to the landfill designation
- Dunedin International Airport Ltd
- Utility companies
- The Dunedin community

12.3 Consultation undertaken

The following sections summarises the consultation undertaken ~~to date~~ by DCC throughout 2019 and 2020 for each of the stakeholder groups identified above. It has been updated to reflect further consultation with key stakeholder's post-lodgement.

12.3.1 Local Government Agencies

Otago Regional Council (ORC)

DCC initially engaged with ORC in September 2019 to obtain feedback/input into the consent process, the scopes of the technical assessments, and the requirements for the applications for resource consent. Regular engagement continued from September 2019 to lodgement as part of the pre-application process. Areas of interest included the proposed landfill design and assessment of effects as it relates to the Regional Waste Plan, the Regional Water Plan and Regional Policy Statement; including potential effects on air quality, water quality and ecology. Engagement with ORC consents team continued post-lodgement in response to Section 92 requests and questions.

Dunedin City Council Resource Consent team

Initial engagement with the DCC consents team was held in May 2019; the purpose of which was to seek input into the application requirements in relation to the land use resource consents. Engagement continued following completion of the technical assessments and design report, including initial design work for the proposed upgrades to McLaren Gully Road and Big Stone Road. Areas of interest included consenting requirements under the 2GP for the supporting landfill infrastructure outside of the site, including the road upgrades and associated earthworks. Engagement with DCC consents team continued post-lodgement in response to Section 92 requests and questions.

12.3.2 Central Government and statutory agencies

Waka Kotahi New Zealand Transport Agency (NZTA)

DCC commenced discussions with representatives from NZTA resource consenting team in mid-2019. Initial meetings provided an opportunity to discuss the project, including the proposed upgrade of McLaren Gully Road and potential impacts of the upgrade on the intersection with SH1. A further meeting was held on 12 September 2019 to identify key areas of interest and receive feedback on the proposed design. Areas of interest included overall intersection design, including lighting at the intersection, and the provision of a separate left turn lane southbound, and northbound side shoulder for trucks to pull off SH1 prior to turning into McLaren Gully Road. The proposed design incorporates this feedback. Engagement with NZTA will continue throughout the project. To date (May 2021) no further engagement has been undertaken with NZTA post-lodgement.

Heritage New Zealand Pouhere Taonga (HNZ)

There has been no formal engagement to date with HNZ. An archaeological assessment has been prepared by New Zealand Heritage Properties Ltd in accordance with guidelines established by HNZ (HNZPT, 2006). There will be engagement with HNZ prior to modifying the site, and an archaeological authority will be sought.

Department of Conservation (DOC)

Engagement with DOC has primarily been as part of the development of the technical assessments including the Ecological Assessment Report (August 2020) and the Bird Management Plan (August 2020). The purpose of the engagement was to provide DOC with information about the project and seek permission to undertake site investigations in accordance

with the requirements of the Wildlife Act 1953. Areas of interest included the effects on indigenous flora and fauna and biodiversity. Applications will be made to DOC for wildlife authorities and there will be further engagement with DOC in relation to this. Engagement with DOC has continued post-lodgement and will continue throughout the project. Areas of interest for DOC continue to be the effects on indigenous flora, fauna and biodiversity.

12.3.3 Elected Community Representatives

Dunedin City Councillors

Regular briefings on the Waste Futures programme, including the Smooth Hill project have been given to Dunedin City Councillors as part of the Solid Waste Management Quarterly Report updates to the Infrastructure Services and Networks Committee and the Dunedin City Council 2021-2031 10-Year Plan process. The updates provide an overview of the project and ~~proposed~~ ongoing consenting process. Areas of interest identified by the Councillors include~~d~~ how the Smooth Hill development will contribute to DCC zero-waste and carbon reduction objectives, the potential effects of the landfill design and operation on the community and environment, and funding options for the project. Post lodgement, ~~E~~engagement ~~with the~~ continues with Councillors, ~~will be ongoing~~ as part of the 2021-2031 10 Year plan process. ~~.~~

Community Boards

DCC have provided updates on the project to both 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 project, including status of the existing designation and the consenting process. Areas of interest included the possible impact on cultural landscapes and local communities, effects on freshwater and coastal water quality, noise, air quality dust, and traffic safety on McLaren Gully Road and Big Stone Road. The Saddle Hill Community Board has particular interest in the potential effects of the proposed landfill on the Brighton Community. Engagement with the Community Boards will be ongoing and consultation on funding for development of Smooth Hill has also occurred as part of the Council's 10 Year Plan process for 2021-2031.

~~.~~12.3.4 Manawhenua engagement

Te Rūnanga o Ōtākou and Kāti Huirapa Rūnaka ki Puketeraki

Dunedin City Council initially engaged with Aukaha on the Waste Futures programme, including Smooth Hill development 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. In relation to the development of Smooth Hill, the key issues for whānau were identified as the effects on water quality, biodiversity and cultural landscapes. On 23 October 2019, mana whenua attended a second hui with DCC staff and the wider project team. This included a site visit to Smooth Hill which provided an opportunity for mana whenua to hear directly from the ecological and engineering consultants.

Following the October site visit, there has been regular engagement with Aukaha to assist them with the development of the Cultural Impact Assessment. Information has been shared in relation to the design, and the scopes and outcomes of the technical assessments required for the AEE, including the assessments in relation to archaeology, water quality, ecology, and air quality.

Engagement ~~will continue~~ with Aukaha ~~and mana whenua~~ has continued post-lodgement including sharing of information in relation to s92 requests, and updates to the technical assessments and the lodged landfill design. An additional site visit also occurred to further assist Aukaha with updating the Cultural Impact Assessment to reflect the updated design, including where the design could be amended to avoid, where practicable, adverse effects on wetlands. Engagement will continue throughout the project to ensure that ~~their~~mana whenua~~-~~ concerns and aspirations are consistently understood and considered.

12.3.5 Landowners and occupiers of properties in proximity to landfill designation

DCC began engaging with both rural residential and commercial landowners and occupiers in the vicinity of the site in late 2018, as part of the wider engagement on the Waste Futures programme. DCC staff visited neighbouring properties and hand delivered information, which included the next steps for the planning for the landfill. Letters were sent again in February 2020, updating them on work currently underway in relation to the design and consenting process.

The letters also provided links to information about the project on Dunedin City Council Waste Futures website, including the location of the designation. Priority was given to consultation with directly affected owners. Several one-on-one meetings were also held onsite with landowners and occupiers throughout June and July 2020. The purpose of these meetings was to provide information and seek feedback on the proposed design prior to lodging the applications. Areas of interest included impact of the effects of the landfill and road upgrades on private land, effects on freshwater and coastal water quality, odour, noise, dust, and traffic safety.

Commercial forestry landowners and occupiers were also interested in the extent to which landfill construction and operations may affect forestry operations, including how fire risk will be managed. There will be ongoing engagement with neighbouring commercial landowners and occupiers, including the forestry companies, throughout the project and post lodgement engagement occurred ~~specifically~~ as part of the development of the draft Landfill Management Plan (~~LMP~~).~~.~~Areas of interest included traffic management and volumes on McLaren Gully Road, management of effects on wetlands and Otaki Creek and fire, litter and pest (animal and plant) management.

12.3.6 Dunedin International Airport Ltd

DCC commenced discussions with representatives from Dunedin International Airport Ltd regarding the Smooth Hill landfill consenting process in late-2019. 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.

A further meeting was held in July 2020, to update the airport team on the project, the consenting process and timeframes, together with providing details and receive feedback on the draft recommendations from the Bird Management Plan. Post lodgement further consultation occurred to help inform the development of the draft Landfill Management and specifically the draft Bird Management Plan. There will ~~be~~ continue to be ongoing engagement with Dunedin International

Airport Ltd throughout the project ~~and~~ , ~~specifically as part of the development of the LMP, and Bird Management Plan.~~

12.3.7 Utility companies

Auora Energy

DCC met with representatives from Aurora Energy in May 2020 to provide an overview of the landfill and road upgrades, including the technical assessments. Areas of interest focused on any future need for powerline and transformer upgrades resulting from the development and scope for future gas generation on site from landfill gas. It was noted that this would be addressed at the detailed design stage. Engagement with Aurora Energy will continue throughout the project. There has been no further engagement post-lodgement.

12.3.8 The Dunedin community

To date there has been no formal Dunedin wide engagement as part of the consenting process for the landfill. Community wide engagement was undertaken as part of the designation process in 1995 and again as part of the preparation and decision making on the 2GP. The decision on the level of public involvement as part of the statutory RMA process will be made by the respective consenting authorities post lodgement of the consent applications and following the Section 92 process.

The dedicated Waste Futures website has been regularly updated with Waste Futures information, including the planning for Smooth Hill, since it was established in 2018; and the formal updates to the Community Boards and Council Committees are publicly available. Dunedin residents were also informed as part of the Kerbside Collection Engagement process in March 2020. A pamphlet delivered to each household seeking feedback on proposed changes to the kerbside collection also outlined the wider Waste Futures Programme including of the proposal to develop a landfill at Smooth Hill.

In August 2020 the consent application and documents were made available on the DCC website and continue to be available on-line[35]. Most recently, ~~Post lodgement the DCC will continue to provide information to the wider Dunedin Community about Smooth Hill as part of a wider Waste Futures~~in May 2020, ~~communications and engagement plan.~~ the DCC publicly consulted on the preferred kerbside collection option, and funding for development of Smooth Hill as part of the Council's 10 Year Plan process for 2021-2031.

[35] https://www.dunedin.govt.nz/council/council-projects/waste-futures/smooth-hill-consent-application-and-documents

12.0 Conclusion

The Dunedin City Council has embarked on the Waste Futures Project to develop an improved comprehensive waste management and diverted material system for Dunedin, including future kerbside collection and waste disposal options. A key component of the project is the development of a new landfill at Smooth Hill to replace the Council's current Green Island Landfill which is likely to come to the end of its functional life sometime between 2023 and 2028.

Whilst the Council is actively committed to realising 'zero waste' and enabling appropriate diverted material solutions, there remains a need for a landfill to meet the future community demand for waste disposal facilities. The site at Smooth Hill was identified as a future landfill site part of a comprehensive assessment of replacement landfill options undertaken in the late 1980's and early 1990's, culminating in its designation in the district plan for use as a landfill.

DCC ~~is applying~~has applied for resource consents from ORC for the construction, operation, and aftercare of a new class 1 landfill for the disposal of municipal solid waste on existing designated land at Smooth Hill. Resource consents have also been applied for DCC for the upgrades required to McLaren Gully Road (including its intersection with SH1), and Big Stone Road to access the site~~, as well as wetland creation/enhancement outside of the designated site~~. All of the required resource consents are discretionary activities under the respective regional and district plans. An outline plan of works for the new landfill under the 2GP designation, will be applied for following detailed design of the landfill.

The original design has been updated in response to requests for further information under section 92 of the RMA, including to avoid areas of wetland within the designated site, and along the road upgrade footprint, to the extent practicable. The reduced footprint under updated design also reflects revised estimates in future waste disposal rates, taking into account a future increase in waste diversion. The design has also been refined in response to other matters raised in the further information requests.

The ~~concept~~ updated design for the landfill has been designed in accordance with the best practice WasteMINZ guidelines, and National Environmental Standards for Air Quality. The design provides for high levels of natural and engineered containment of waste, and infrastructure to safely contain, collect, manage, and dispose of leachate, landfill gas, groundwater, and stormwater so as to effective manage consequential adverse effects on the receiving environment.

The construction, operation, maintenance, and aftercare of the landfill will occur in accordance with a comprehensive Landfill Management Plan (LMP) which documents site-specific procedures to ensure the landfill achieves pre-determined operational and environmental objectives and compliance with resource consent conditions, to ensure the potential for adverse environmental effects is minimised. A draft LMP has been prepared and is being submitted with this updated AEE and includes draft ecological and bird management plans.

Technical assessments that have been prepared in support of the applications have identified that the landfill will have benefits for social and economic wellbeing, while ensuring the adverse effects of the construction and operation of the landfill and associated road upgrades are able to be avoided, remedied, mitigated, and offset so as to be minor on the surrounding environment. In particular:

- The landfill will generate significant employment and economic effects.
- The site is a suitable location for a landfill in regard to land stability, and seismic risks, the placement of waste to ensure waste stability, and the stability of cut and fill slopes for the landfill and road upgrades will be addressed through detailed design.
- The landfill has been designed as a class 1 landfill with appropriate levels of containment and controls consistent with the Waste MINZ guidelines. Proposed waste acceptance procedures will detect and deter the inappropriate disposal of material, and ensure unacceptable wastes are easily identified, segregated, and rejected.
- Changes in groundwater levels and consequential effects on base flows in the downstream receiving waters from the landfill are expected to be mitigated through direct recharge that will provide a net increase in groundwater flows downstream. The effects of a reduction in surface water flows downstream are expected to be limited to the immediate vicinity of the site.
- The landfill liner will contain leachate within the landfill and prevent it from entering the underlying soils or groundwater. Even with potential leachate leakage, there is predicted to be a reduction in contaminant flux in the receiving environment in comparison to the existing environment. Stormwater, erosion and sediment control, and operational management measures will ensure waste contaminated and sediment runoff is appropriately managed and minimised.
- Operational management measures will ensure it is unlikely that any odours or dust detected at nearby receptors will be considered 'offensive or objectionable'. Landfill gas containment and management measures consistent with the NESAQ will ensure risks to health and safety, amenity and the environment are low.
- The vegetation communities that will be lost all frequently occur in nearby areas or the wider ecological district (ED), or are otherwise small/degraded. Implementation of a ~~Terrestrial~~ Vegetation Restoration Management Plan ~~and Wetland Restoration Plan~~ will ensure no net loss or net gain in ~~treeland/forest/~~wetland habitat to mitigate and offset the loss of "significant" indigenous flora and habitats.
- Construction management measures will ensure no effects on 'at risk' falcon during the breeding season, or lizards. ~~Predator~~ Pest control measures will ensure no increased predation of native fauna by rodents.
- Operational procedures as well as bird monitoring, management and control in accordance with a Bird Management Plan will ensure bird numbers (particularly black-backed gulls) at the landfill are kept to very low numbers and therefore result in negligible additional strike risk with aircraft.
- The project will occur in the context of an existing working rural environment, and established road corridor with lower apparent levels of natural character. Following implementation of the ecological mitigation, including the ~~Wetland Restoration~~Vegetation Restoration Management Plan there will be no potential for any significant residual adverse effects on natural character.
- Modification of the landscape will be consistent with the effects anticipated by the underlying designation and any effects will remain largely internalised within the site.

Construction of the roading upgrades will not appear uncharacteristic given their association with the existing rural road network, and once complete will assimilate within the rural context.

- The location and physical nature of the site, within in a folded gully system, contains and mitigates most visual effects of the landfill on the surrounding area. Any partial and transient views will be largely limited to adjoining roads, and over time screened by perimeter planting.
- Archaeology discovery measures will ensure no adverse effects on Māori or European archaeological values.
- Potential impacts on cultural values will be addressed through robust design measures, and operational, and monitoring practices, to ensure effects on the mauri and whakapapa of the receiving environment are avoided to the fullest extent possible. ~~Creation and e~~Enhancement of wetland/riparian habitat, and pest management are also proposed to offset effects on mauri and whakapapa, and restore mahika kai values. Ongoing engagement with Te Rūnanga o Ōtākou will ensure recognition of mana whenua, and exercise of rakatirataka and kaitiakitaka.
- Temporary effects of road construction on the operation of the road network, and other road users will be managed through a Construction Traffic Management Plan, and construction works will comply with the relevant 2GP noise limits. The road upgrades will ensure the roads can safety accommodate the increased traffic demands arising from the operation of the landfill.
- Operational management measures will ensure potential effects from landfill fire; windblown litter; increased abundances of vermin and flies; and contamination of drinking water supplies by birds attracted to the landfill will be managed.

A suite of draft resource consent conditions has been developed, including draft objectives for the LMP and other management plans, that ensure any adverse effects will be avoided, remedied, mitigated, or offset.

The landfill and associated road upgrades 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 the project. Notwithstanding, the proposal is considered in an overall sense to be consistent with the direction of these documents in their current form, and will achieve the purpose and principles of the RMA.