DCC WASTE FUTURES 2023

LANDFILL FEASIBILITY WORKSTREAM

PREPARED FOR DUNEDIN CITY COUNCIL

February 2019

Stantec

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Executive Summary

Introduction

The Dunedin City Council (the Council) have embarked on the Waste Futures 2023 Project to develop a comprehensive waste management and diverted material system for Dunedin.

The Green Island Landfill plays a significant role in Dunedin's waste management system, however the resource consent for the operation of the landfill expires in 2023. Hence, as part of the overall Waste Futures 2023 Project, the Council has engaged Stantec to carry out an assessment of landfill feasibility for the existing Green Island Landfill up to and beyond 2023 and the designated Smooth Hill Landfill site (Workstream 1) and carry out a Programme Business Case process (Workstream 2).

Objectives adopted for Workstream 1 to clarify the requirements for each site are:

- **Green Island Landfill Objective:** Operate the Green Island Landfill until an alternative Class 1[1] landfill site is available
- **Smooth Hill Landfill Objective:** Confirm the technical feasibility of Smooth Hill as an alternative Class 1 landfill site.

Workstream 1 was undertaken in two stages. In Stage 1, available data and information for both landfill sites was reviewed, with the initial findings discussed and landfill feasibility assessment approach agreed at a Council staff workshop on 28 August 2018. In Stage 2, landfill filling plans and financial models were developed for each site and landfill feasibility was assessed in terms of engineering, economics, environment, social and cultural aspects, with outcomes discussed and agreed at a Council staff workshop on 1 October 2018. This report summarises the overall findings of Workstream 1.

The work carried out for Workstream 1 is limited to a desk-top study, largely dependent on published or otherwise recorded material for the existing Green Island Landfill site and the designated Smooth Hill Landfill site. Site investigations were limited to a site walkover and a drone survey at each site. No subsurface work has been carried out.

The output from the landfill feasibility (Workstream 1) was used to inform the development of the programmes in the business case process (Workstream 2).

Landfill Feasibility Assessment

The feasibility of Green Island Landfill was considered based on operating the landfill until consent expiry in 2023 ('Green Island – Consented Profile') and extending the landfill footprint and operating beyond 2023 ('Green Island – Southern Extension'). The feasibility of Smooth Hill Landfill was considered based on developing and operating the landfill for the next 30+ years ('Smooth Hill'). Resource consents would be required to close Green Island Landfill, extend Green Island Landfill or develop Smooth Hill Landfill.

The approach adopted to assess landfill feasibility at each site was based on two key functions of a landfill:

- **Providing a reliable service,** which is required under both the Local Government Act 2002 (LGA) and the Waste Minimisation Act 2008 (WMA)
- **Protecting the environment,** by avoiding, remedying or mitigating adverse effects on the physical, social and cultural environment as required under the Resource Management Act 1991 (RMA).

A traffic light based ranking system was used to assess key aspects of landfill feasibility. The ranking system was different for the two landfill functions, with 'provide reliable service' based on ability to meet the site specific landfill objective (ie Green Island or Smooth Hill Landfill) and 'protect environment' based on likely extent of adverse environmental effects. The adopted traffic light based ranking system was:

- 'green' to indicate minimal expected or observed issues
- 'orange' to indicate possible issues, and
- 'red' to indicate significant issues with specific mitigation measures or need for more investigation.

[1] Where a Class 1 landfill is a landfill that accepts municipal solid waste, as defined in the Technical Guidelines for Disposal to Land (WasteMINZ, 2018).

Table 1-1 and Table 1-2 summarise the landfill feasibility assessment for the Green Island and Smooth Hill site, as agreed at the workshop on 1 October 2018, based on information available at that time.

Table 1-1: Landfill Feasibility – Provide Reliable Service

Key Aspect	Green Island		Smooth Hill
	Consented Profile	Southern Extension	
Period of Service			
Site capacity (Filling Space)	837,000 m^3	1,600,000 m^3	5,572,000 m^3
Number of years service @ 160,000 m^3/year[2]	5.3 years *(consents expire 2023[3])*	10.1 years *(not consented)*	>30 years *(not consented)*
Ability to meet demand for landfill (current, natural disasters, other)	Minimal	Short term, sensitive to fluctuations	Long term
Waste catchment (city, out-of-district)	Limit to DCC	Limit to DCC	Could consider wider catchment
Economics			
Governance	Options restricted by existing operation		Options open
Cost- IBC (cleanfill at 5% of IBC) *(IBC described in Section 4.3.2)*	About $23 / tonne	About $40 / tonne	$86 / tonne
Cost - ETU risk *(ETU and UEF described in Section 3.4)*	Low UEF[4]		High UEF[25]
Competition	No other landfill classed as waste disposal facility in WMA		Potential for competition over landfill life
Proximity to generators (distance, time)	Established, operational & close to city		Greater distance from Dunedin: T/S upgrade needed
Waste Type			
Accept Class 1 materials	Can accept Class 1 waste		Design for Class 1
Regulatory Compliance			
Compliant with HSNO, HSWA	Largely compliant		Design for regulations
Level playing field (RMA, WMA, ETS)	Other landfills (other site taking Class 1 waste, greenwaste sites) with lower gate charges and/or lower standards		Local regulations and advocate for national & regional regulations to level playing field
Physical Assets			
Design standards	Not Class 1		Class 1
Design life/ fit for purpose	~5 year capacity	~10 year capacity	30 year capacity
Conditions of assets	Detailed review required		new
Operational performance	Issues in wet weather and odour		Design and operate to Class 1
Input Control			
Acceptance criteria	Class 1		Class 1
Input monitoring	Some limitations, due to diversion of material after weighbridge		New weighbridge to record all waste to landfill

[2] Based on 75,000 tpa general waste, 12,000 tpa special waste and 75,000 tpa cleanfill

[3] Current consents based on 270 m^3/day. See commentary in Section 3.2.1 of Appendix M

[4] UEF is the Unique Emissions Factor. Low UEF means higher ETS charges with more units needed, and a high UEF means lower ETS charges with less units needed

Table 1-2: Landfill Feasibility – Protect Environment

Key Aspect	Green Island	Smooth Hill
Compliance		
Discharge consents	Comply, expire 2023[5]	None
Designation	Comply	Not given effect to
Baseline Information	No information on wet weather effects and ecological impact, esp in Estuary	No baseline for GW, SW, air, ecology. May be difficult to establish control sites as at head of catchment
Hazards		
Flood Risk	2GP: Next to moderate risk area; risk remains as a closed landfill site	None identified on 2GP
Effect on Airport	No impact	Bird strike & Hinder flight fan
Land Instability	2GP: Areas of moderate risk around site	None identified on 2GP, however site outside area of GNS study, and minimal geotechnical investigation have been conducted.
Physical Effects		
Discharges to land and water	Some discharge of leachate and treated stormwater to groundwater and surface water, particularly during wet weather	Leachate will be directed offsite, so only discharges of treated stormwater (not in contact with waste) to surface water (Otokia Creek >> coast)
Discharges to air	Odour complaints Retro-fit gas collection	Potential for odour issues (closest resident ~300m towards coast) New gas collection
Conservation / Ecology	UCLA10[6] (Kaikorai Estuary, Fairfield) to north of site ASCV[7]: • Edge of Kaikorai Estuary, Estuary and Lagoon next to site (C106) • Westwood Recreational Reserve at estuary mouth (C037)	ASCV[28]: • McLarens Gully Covenant 1.5km to N (C075) • Hope Hill Scenic Reserve 1.2km to E (C030)
Cultural effects		
Discharge to water	Discharge of leachate and treated stormwater to groundwater and surface water	Only discharges of treated stormwater (not in contact with waste) to surface water.
Wāhi tūpuna[8] in 2GP	51 Kaikarae adjacent 52 Beach at Kaikarae at estuary mouth	59 Coast from Taieri Mouth to Brighton 2.5km to S 60 Taieri Maori Reserve 5km to SW 61 Pā site and Kāik at Omoua and Maitapapa (Henley) 5km to W 62 Taieri River 3.5km to N
Kai Moana	Adjacent to Estuary	Distant from coast but hydraulically connected to Brighton estuary via Otokia Creek
Transport of waste *(import to or export from Dunedin)*	Accepts Waitaki District waste	Potential for non-DCC waste
Social effects		
Noise	Existing activity in area with industrial activities. Could increase. 100m to Green Island community	Change in noise level, particularly during landfill development phase. 300m to individual houses
Dust	Minimal issues identified currently	Minimal as road will be sealed.
Traffic	Minimal change	Significant increase on local road (50 trucks/day), however not residential area and road will be sealed
Landuse zoning	Underlying Rural Coastal and Industrial to E and Recreation to NE	Rural Coastal
Archaeology	Adjacent to Alert Layer for whole coastline	Specific small areas identified in vicinity & coastline

[5] Current waste quantities exceed or are near the current consent limits for Green Island landfill, depending on the waste compaction density adopted.
[6] UCLA is an urban landscape conservation area defined in the current Dunedin City District Plan. This is not included in the Proposed Second Generation Dunedin City District Plan
[7] ASCV is an area of significant conservation value as defined in current Dunedin City District Plan and Proposed Second Generation Dunedin City District Plan
[8] **Wāhi tūpuna:** Defined in the Proposed Second Generation Plan as landscapes and sites that embody the ancestral, spiritual and religious traditions of all the generations prior to European settlement.

Key Aspect	Green Island	Smooth Hill
Landscape	Currently screened but not if built higher NCC[9]: Island Park @ estuary mouth	Protected ridgeline through site but landfill development and buildings can be positioned below ridgeline out of sightlines. SNL[10]: Saddle Hill 2km to N & extend to NE NCC[30]: Kuri Bush along coast to S & Brighton Road Beach on coast to E
Proximity to reserves	Reserve: Kaikorai Stream along edge of landfill	Strips: Fern Stream to S & Otokia Creek to NE

Key Residual Risks with Green Island and Smooth Hill Landfill Options

Key residual risks associated with the Green Island and Smooth Hill Landfill sites are presented in the main body of the report. A key risk common to both sites is the ability of Council to continue to have access to a waste disposal facility in the short to medium term. The indicative timeline in Figure 1-1 shows that there is likely to be a shortfall in the order of 3 to 5 years (shown in yellow) from when the existing consents for the Green Island Landfill expire and airspace at Green Island Landfill is fully utilised to Smooth Hill Landfill being operational. During this shortfall period, Council will need to either:

- obtain a new resource consent for and develop an extended Green Island Landfill,
- secure a contract(s) to dispose of waste elsewhere, or
- rely on the private sector.

Therefore, there is an urgent need for the Council to decide on the best way forward for Dunedin with respect to waste disposal. There is also a benefit to the Council of implementing robust methods to minimise waste quantities disposed to Green Island Landfill, and hence maximise the landfill life.

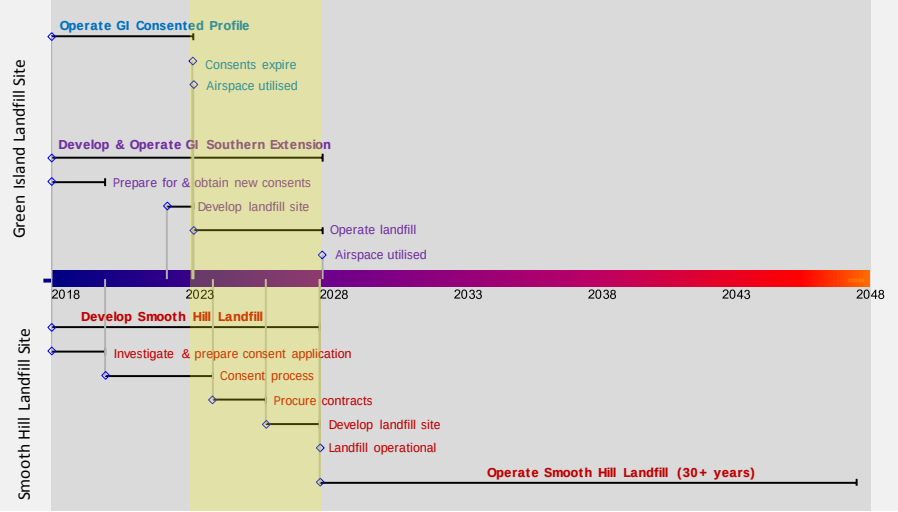

Figure 1-1: Indicative Timeline for Green Island and Smooth Hill Landfills. Yellow area is period at risk.

Waste Disposal Options To 2063 and Beyond

Long-term waste disposal options for Council following Green Island Landfill consent expiry in 2023 are:

1. **Long-term 'export'**: Use existing landfills rather than develop the Smooth Hill site as a Class 1 landfill
2. **Short-term 'export' and Develop Smooth Hill Landfill:** Develop the Smooth Hill site as a Class 1 or a combined Class 1 and Class 2 landfill and, if required, use existing landfills (short-term 'export' option) for time between Green Island Landfill consents expiring and Smooth Hill Landfill being available.
3. **Extend GILF and Develop Smooth Hill Landfill:** Develop the Smooth Hill site as a Class 1 or a combined Class 1 and Class 2 landfill and extend Green Island Landfill operation for an additional 2 to 5 years to provide time for Smooth Hill Landfill to be developed.

[9] NCC: Natural Coastal Character as designated in Proposed Second Generation Plan
[10] SNL: Significant Natural Landscape as designated in Proposed Second Generation Plan

Table 1-3: Waste Disposal Options for Dunedin City

No	Option[1]	Waste Disposal Option and Annual Costs[2]			Consenting[5]	Negative Risk	Benefit	Risk Mitigation
		To 2023	2023-2028	2028-2063+				
1	GILF closure + 'export'	Develop, operate & close GILF ~$6M/year[2]	'export' to more than 1 site ~$15M/year, TBC[4]		Close GILF: ~$200k-$700k	• Reputation risk associated with reliance on independent operator • GILF full before export contract in place • No ready LF access for emergency waste • Disposal service limitations eg service withdrawn • Private sector offers low cost alternative • Private lower standard LF(s) undercuts export charge • Iwi concern about export • High export cost compromises contract eg minimum quantity vs rates	• Remove DCC risk in consenting SH • Remove DCC risk in funding operation • DCC has reduced liability for disposal site(s) • DCC potentially secures low cost export contracts	• To preserve GILF capacity to 2023 • To secure export contracts
2	GILF closure (+ 'export') + SHLF	Develop, operate & close GILF ~$6M/year[2]	'export' to more than one site until SHLF available ~$15M/year, TBC[4]	Develop, operate & close SHLF ~$9M/year[3]	Close GILF: ~$200k-$700k Develop SHLF: ~$800k - $1.3M	• GILF full before export contract in place • High export cost compromises contract eg minimum quantity vs rates • SHLF costs not recovered by operational income • Private sector offers low cost alternative • DCC retains liability for SH site • Iwi concern about export	• DCC secures low cost export contracts	• To preserve GILF capacity to 2023 • To secure export contracts • To secure consents/confirm feasibility of SHLF • To develop procurement strategy to minimise commercial risk with SHLF
3	Extend GILF + SHLF	Develop, operate & close GILF (extended) ~$7M/year[2]		Develop, operate & close SHLF ~$9M/year[3]	Extend GILF: ~$600k-$1M Close GILF: ~$200k-$700k Develop SHLF: ~$800k - $1.3M	• GI full before 2023 • Resource consents not granted for GI extension • SHLF costs not recovered by operational income • Private sector offers low cost alternative • Private lower standard LF(s) undercuts DCC • DCC retains liability for SHLF site	• Ready LF access for emergency waste • Greater control of gate fee • Greater control of general waste & special waste	• To preserve GILF capacity to 2028 • To secure consents/confirm feasibility of GILF extension • To secure consents/confirm feasibility of SHLF • To develop procurement strategy to minimise commercial risk with SHLF

Notes:

1. *Green Island Landfill (GILF), Smooth Hill Landfill (SHLF).*
2. *Indicative disposal costs are provided for the purpose of comparing waste disposal option. They are based on disposal of 75,000 t/year general waste, 12,000 t/year special waste and 25,000 t/year cleanfill. They include transport costs and landfill gate charges but exclude waste levy and ETS charges (currently these collectively equate to $33/tonne, or about $3M/year).*
3. *GILF and SHLF gate charges are based on outputs from the Full Cost Accounting Modelling carried out by Stantec in the Landfill Feasibility Report. Annual GILF costs are derived from total landfill cost (Table 4-5 for 'consented profile' based on 4 years operation for Option 1 and 2, Table 4-8 for 'southern extension' based on 9 years operation for Option 3). Annual GILF cost = Total GILF cost / 4 or 9 years, rounded to nearest million. Total GILF cost = (prorated operations and operational contingency based on total waste in 4 or 9 years / total waste for model) plus other landfill costs (ie sunk costs, base costs, development, closure, capital contingency) less existing aftercare fund. SHLF costs based on $88/tonne for general waste (75,000 tpa), 133% of general waste rate for special waste (12,000 tpa) and 5% of general waste rate for cleanfill (25,000 tpa).*
4. *Landfill gate charges for 'export' provide a perspective on costs based on publicly available information, where available or assumed rates. DCC may or may not be able to secure contracts and if secured, the rates may be more or less than the adopted rates.*
5. *Consenting costs include legal, planning and regulatory costs, with planning costs covering planning, science assessments (eg hydrogeology, ecology) and engineering (survey, geotech, preliminary design) but excluding stakeholder and community consultation.*

Summary of Conclusions

Key conclusions from the landfill feasibility assessment to date are:

- Council should urgently consider implementing robust methods to minimise waste quantities disposed to Green Island Landfill to preserve landfill airspace for waste (ie maximise landfill life).
- The Green Island Landfill site will reach capacity around the time the current resource consents expire (2023) with current waste quantities. There are operational issues that need addressing (eg as well as management and monitoring associated with wet weather events), however landfill closure will largely mitigate these.
- The Green Island Landfill site could be extended to the south to accommodate current waste quantities to 2028, with landfill costs about $1M/year more than the current operation if development costs are spread over the next 9 years. However, it is likely to be costly ($0.6M to $1M) and technically challenging to consent. Challenges include ability to implement operational changes to mitigate existing issues for continued operation, proximity to neighbours, inability to meet Class 1 landfill standards, and being located in a low lying area adjacent to an estuary of significant cultural and conservation value. Additional characterisation and monitoring would need to be undertaken to support any consent application.
- The Smooth Hill site has capacity to accommodate current waste quantities to 2063 and beyond, with landfill costs about $3M/year more than the current operation. No fatal flaws were identified during the landfill feasibility assessment. However additional characterisation and monitoring would need to be undertaken to support any consent application, including hydrogeology, ecology, water quality, bird strike hazard, and geotechnical assessments. Preliminary design is also required to confirm assumptions used to develop landfill costs (including management of leachate, landfill gas and stormwater, power supply and access from State Highway to the site). Consent costs are likely to be slightly higher than consenting Green Island for an extended period of operation (ie $0.8M to $1.3M).
- If the Council wish to progress Smooth Hill, there is a need to urgently pursue the resource consent work, including associated investigations and assessments. However, even if this process starts now, there is likely to be a shortfall from when the existing consents for the Green Island Landfill expire and Smooth Hill Landfill being operational.
- Options available to the Council to manage the shortfall are to obtain consents to extend Green Island Landfill, secure contracts to dispose of waste elsewhere (ie 'export') or rely on the private sector (however this option is not in keeping with the Waste Futures 2023 Project's investment objectives). Given the costs and uncertainties of reconsenting an extended Green Island Landfill and the unknown total 'export' cost that the Council may be able to secure, it is prudent for the Council to urgently develop a procurement strategy for waste disposal for Dunedin to better characterise options. Such a strategy could also be used to minimise commercial risks associated with developing Smooth Hill or to work with other Councils with a view to Smooth Hill being a regional facility.

Acknowledgements

Stantec firstly wish to acknowledge the input from the Council's solid waste technical team, specifically Megan Bell and Lincoln Coe, to Workstream 1. Megan and Lincoln's collective understanding of the landfill sites, particularly Green Island, and their quick responses to our numerous queries strongly contributed to the success of this project. We thank Chris Henderson and the wider Council for enabling Megan and Lincoln to provide this support to us.

Stantec also want to thank the contributions of our subcontractors involved with Workstream 1:

- Clint Rissmann from Land and Water Science, who provided technical expertise in leachate and landfill gas management as well as environmental monitoring, and
- John Cocks from John Cocks Limited, who acted in a technical advisor capacity and reviewed our key deliverables.

Dunedin City Council

Landfill Feasibility Workstream

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1. Introduction

1.1 Background

The Dunedin City Council (the Council) has embarked on delivering three waste management projects, collectively branded as the Waste Futures 2023 Project. The Waste Futures 2023 Project covers:

- A review of the Council's Waste Minimisation and Management Plan 2013 (WMMP).
- Investigation of options for reducing the amount of Dunedin's organic (food and/or green) waste going to landfill
- Preparing for the closure of the Green Island Landfill.

The aim of these projects is to develop a comprehensive waste management and diverted material system for Dunedin that aligns with the Council's responsibility under the Waste Minimisation Act 2008 to 'promote effective and efficient waste management and minimisation'. The Council has also signalled a commitment to reducing the carbon emissions generated from waste, given that waste to a Council operated landfill is Council's largest source of greenhouse gas emissions.

The Green Island Landfill plays a significant role in Dunedin's waste management system, however the resource consents for the operation of the landfill expire in 2023. To address this, as part of the overall Waste Futures Project, the Council has engaged Stantec to carry out a landfill feasibility analyses of the existing Green Island Landfill and the designated Smooth Hill Landfill site (Workstream 1) and carry out a Programme Business Case Process (Workstream 2).

This report summarises the findings of the landfill feasibility (Workstream 1), which considers the feasibility of continuing landfill operations at Green Island Landfill site up to and beyond 2023 and developing a new landfill at the designated Smooth Hill Landfill site.

The Business Case (Workstream 2) may identify a range of disposal options, including alternative landfill location (eg in-district or out-of-district), alternative technology (eg Waste to Energy), and various governance models (eg owned by Council or private sector). Identification and assessment of these options are outside the scope of Workstream 1. The output from the landfill feasibility (Workstream 1) was used to inform the development of the programmes in the business case process (Workstream 2).

1.2 Council Objectives

1.2.1 Waste Futures 2023 Project

The following Investment Objectives and Key Performance Indicators (KPIs) were developed and adopted by the Waste Futures 2023 Project Steering Group after gathering feedback from a Councillor Workshop on 6 March 2018.

- **Investment Objective 1:** Identify, procure and retain sufficient Council control of the optimal solid waste solution for Dunedin City to enable us to move towards a zero-waste future.
    - KPI 1: Minimisation of waste
    - KPI 2: Minimisation of carbon-dioxide from waste.
- **Investment Objective 2:** Provide medium to long term assurance for the community to dispose of waste in a customer-focused, cost-effective and environmental impact mitigation (environmental safety) manner.
    - KPI 1: Cost effectiveness of service to ratepayers
    - KPI 2: Environmental impact of operations
    - KPI 3: Refuse and kerbside recycling services meet customer expectations.

Both Investment Objectives are of relevance to Workstream 1, particularly with respect to impact on waste quantities and waste composition (Investment Objective 1) and having access to a waste disposal facility, which for Workstream 1 means a landfill (Investment Objective 2).

1.2.2 Workstream 1 Objectives

The Council has been engaging with the community as part of the Waste Futures 2023 Project. As part of this, Council has signalled to the public its intention to close the Green Island Landfill in the short to medium term and to investigate developing a landfill at the designated Smooth Hill site.

At the workshop on 28 August 2018, the following objectives were adopted for Workstream 1 to clarify the potential requirements for each site:

- **Green Island Landfill Objective:** Operate the Green Island Landfill until an alternative Class 1[11] landfill site is available. This requires two scenarios be considered for Green Island; firstly operating within the consented profile until the existing resource consents expire in 2023 (Green Island Landfill – Consented Profile) and secondly consenting an extended landfill footprint to be able to operate beyond 2023 (Green Island Landfill – Southern Extension)
- **Smooth Hill Landfill Objective:** Confirm the technical feasibility of Smooth Hill as an alternative Class 1 landfill site.

These objectives were discussed and agreed with Council staff at a Workshop 1 on 28 August 2018.

An alternative scenario for Green Island Landfill, is to reduce waste quantities received at the landfill such that the existing consented profile provides sufficient capacity until an alternative Class 1 landfill site is available. This scenario would require a significant reduction in waste quantities to be realised in the near future, which is likely to be difficult to achieve, as well as an extension to the expiry date of the current consents for the Green Island Landfill (assuming an alternative Class 1 landfill is not available prior to consent expiry in 2023). This option has not been considered further as part of this Workstream.

1.3 Scope of Work

A detailed scope of work is in Stantec's proposal dated 31 May 2018. Broadly, the scope comprised:

- Attend project kick-off meeting
- Visit both sites, accompanied by the Council's Landfill Engineer
- Carry out drone survey of both sites to obtain topographic data and aerial images to enable a 3D model to be constructed for each site
- Review available data and information about:
    - Current national, regional and local regulations, standards and guidelines
    - Dunedin's waste quantities and composition
    - Green Island Landfill site
    - Smooth Hill designated site
    - Environmental monitoring data available for the two sites
    - Social and cultural matters recorded in existing plans.
- At Workshop 1 (held on 28 August 2018 with Council staff, advisors and Stantec team), present the preliminary findings to date, confirm Council's broad objectives for assessing feasibility at the two sites, and discuss and agree a proposed approach for assessing landfill feasibility at each site in line with Council's objectives
- Develop a landfill filling plan for both sites and associated costs using the Ministry for the Environment's Full Cost Accounting (FCA) model.
- Carry out feasibility assessments in terms of engineering, economics, environment, social and cultural feasibility based on the approach agreed at Workshop 1.

[11] Where a Class 1 landfill is a landfill that accepts municipal solid waste, as defined in the Technical Guidelines for Disposal to Land (WasteMINZ, 2018).

- At Workshop 2 (held on 1 October 2018 with Council staff, advisors and Stantec team), present the findings to date, discuss and agree assessment of landfill feasibility at each site, and discuss and agree key residual risks for the project, including broadly identifying further investigations that may be required to confirm feasibility.
- Summarise findings in a report.

1.4 Qualifications

The work carried out for Workstream 1 is limited to a desk-top study, largely dependent on published or other material received from the Council. It considers the existing Green Island Landfill site and the designated Smooth Hill Landfill site. Site investigations carried out as part of Workstream 1 are limited to a site walkover and a drone survey at each site. No subsurface work has been carried out. No consultation with external stakeholders has been undertaken as part of this project and assessments have been based on information from public documents.

2. Landfill Feasibility Assessment Approach

2.1 Defining Feasibility

At Workshop 1 on 28 August 2018, Stantec presented a proposed approach to assess landfill feasibility that was based on two key functions of a landfill; firstly providing a reliable service and secondly protecting the environment. Key aspects that contribute to these functions to be considered during the landfill feasibility assessments were also presented and discussed at the Workshop.

This section summarises the approach adopted to assess landfill feasibility at each site.

Two key functions of a landfill:

- **Providing a reliable service**, which is required under both the Local Government Act 2002 (LGA) and the Waste Minimisation Act 2008 (WMA).
    - The LGA (clause 11a) defines 'solid waste collection and disposal' as a 'core service'. This means that, in performing its role, the Council is required to have particular regard to the contribution that this service makes to its community. In addition, the "Landfill facilities" is a strategic asset in terms of the Council's significance and engagement policy.
    - Under the WMA (clause 42) the Council, as a territorial authority, 'must promote effective and efficient waste management and minimisation within its district'.
- **Protecting the environment**, by avoiding, remedying or mitigating adverse effects on the physical, social and cultural environment as required under the Resource Management Act 1991 (RMA).

Table 2-1 summarises the landfill feasibility approach for the two landfill functions, including key aspects to be considered and the traffic light based ranking system to assess key aspects of feasibility. The ranking system is different for the two landfill functions, with 'provide reliable service' based on ability to meet the site specific landfill objective (ie Green Island or Smooth Hill Landfill given in Section 1.2.2) and 'protect environment' based on actual or potential adverse environmental effects.

Table 2-1: Landfill Feasibility Assessment Approach

Landfill Function	Legislation	Key Aspects	Ranking System	Information Source
Provide reliable service	LGA WMA	Period of Service Economics Waste Type Regulatory Compliance Physical Assets Input control	Based on site objective (ie Green Island/Smooth Hill): Green – no issues / complies Orange – possible issues Red – significant issues / non-complying	Council information Drone survey Landfill model
Protect Environment	RMA	Compliance Hazards Physical Effects Cultural Effects Social Effects	Based on adverse effects: Green – minimal issues identified Orange – possible issues Red – significant issues identified requiring mitigation	Information from Monitoring Programmes Council information Council policy and plans Iwi policy and plans

2.2 Defining Waste Quantities

The ability of Green Island or Smooth Hill Landfill sites to provide a reliable service in terms of landfill life and affordability is highly dependent on the quantity and composition of waste that is received at the landfill during its operational life.

Table 2-2 summarises some previous estimates of quantity of three types of waste (general waste, special waste and cleanfill) that have been disposed of to landfill in Dunedin and compares these to quantities provided by the Council for the Green Island Landfill for the period between 1 July 2017 and 30 June 2018 (2017/18 financial year). Currently Green Island Landfill accepts small quantities of waste from Waitaki District.

Appendix A contains a table that shows how the waste quantities for the 2017/18 financial year have been aggregated into the three waste categories given in Table 2-2. Additional information is provided in Appendix M.

For this Workstream, it has been assumed that both sites will receive the current waste quantities based on the 2017/18 financial year (bolded in Table 2-2). Sensitivity analysis has been carried out on these quantities in terms of landfill life and landfill costs in Section 4. Further scenario modelling based on varying waste quantities and composition will be carried out separately as part of the business case process.

Table 2-2: Estimates of Waste Quantities (tonnes per annum) to Landfill

Landfill Scenario	General Waste	Special Waste	Cleanfill	Total
Previous Estimates				
• Morrison Low (draft WA 2017, levied waste)				80,000
• MWH FCA (2004) o Green Island only, Fairfield operating	27,000	13,000	6,000	46,000
• MWH FCA (2004) o All Dunedin				100,000
Green Island Landfill (2017/18)	**75,000**	**12,000**	**75,000**	**162,000**

Appendix A also shows how the revenue received in 2017/18 for each waste category has been used to determine an approximation of the charging rates of waste categories compared to general waste. The charging rates adopted for this Workstream (and used in Section 4) are given in Table 2-3.

Table 2-3: Charging Rates for Waste Categories

Waste Category	Quantity per year (tpa)	Charging rate compared to general waste
General Waste	75,000	100%
Special Waste	12,000	133%
Cleanfill	75,000	5%
Total	162,000	

3. Information Sources

3.1 Existing Information

A summary of available data and information reviewed as part of this Workstream is provided in Appendix M. This includes an overview of relevant information about

- Current national, regional and local regulations, standards and guidelines
- Dunedin's waste quantities and composition
- Green Island Landfill site
- Smooth Hill designated site
- Environmental monitoring data available for the two sites.

Key findings and observations relevant to landfill feasibility are provided in Section 5.1 and 5.2.

3.2 Drone Survey and 3D models

Stantec carried out a drone survey of both sites in August 2018 to obtain topographic data and aerial images to enable Stantec to construct a Digital Terrain Model (DTM) for each site.

Stantec has created DTMs for three landfill development scenarios as follows:

- Green Island Landfill - Consented Profile
- Green Island Landfill – Southern Extension
- Smooth Hill Landfill.

The outputs are provided in Appendix C (Green Island Landfill scenarios) and Appendix F (Smooth Hill Landfill).

DCC has been provided access to an internet-viewable, 3D version of all three models. Due to constraints of the software provider, the models can only be viewed using Chrome and access can only be granted for a limited time. Stantec can extend access if required.

3.2.1 Drone Survey Accuracy and Limitations

The drone survey was undertaken using Aerial drone-captured photography for purposes of topographical survey. The output is a topographical model, but is not "direct" survey measurement.

20 MPixel resolution geolocated aerial imagery was captured by DJI Phantom P4Pro drone. This photography was combined with Propeller Aeropoint self-geo-located ground control targets placed on the ground, and visible in the photography. This data was processed using Pix4D structure-from-motion modelling software to produce a scale model oriented to NZGD2000 survey datum at local projection. The resulting output is a scale topographical surface to a true datum.

Survey Accuracy is a function of:

- **Ground Control Accuracy.** Ground Control Points (GCPs) measure their own accuracy to under 2cm in plan, and 5cm vertically. The confidence of this measure is provided by the Aeropoint Report
- **Ground Control Modelling / Stability.** The Pix4D Structure-from-Motion modelling process provides a report on the accuracy with the GCPs identified in the model
- **Photography resolution effects.** Photography resolution is referred to as ground-sampling distance (GSD) – measured in cm per pixel – and is a function of height above ground and camera used. The phantom P4 Pro provides a GSD of approximately 3.5cm per pixel at a maximum permitted height of 121m. Generally the variance in the identified points in the model is a function of GSD, and very conservatively taken as: 2-3 x GSD accuracy in plan; 3-5 x GSD accuracy vertically

Plan accuracy is <125mm. This is derived from: Ground Control accuracy <10mm; Ground Control Transfer with in Model <10mm; and GSD Modelling accuracy = 3.5cm x 3 <105mm.

Vertical accuracy is <200mm. This is derived from: Ground Control accuracy <15mm; Ground Control Transfer with in Model <35mm; and GSD Modelling accuracy = 3.5cm x 5 <150mm.

Digital Terrain Model

The final point cloud model is processed to provide the nominal "ground/ terrain" model surface. Obvious vegetation and vertical furniture are removed. The residual cloud is decimated to leave only the lowest point per grid resolution selected.

Limitations

Where there is sufficiently dense tall vegetation cover, the terrain model produced has significant "holes" present, and interpolation between ground points is required over significant distances.

At the Smooth Hill site, where there are coppices of tree plantations, the interpolated ground / terrain surface may be as inaccurate as 1-2m in these areas. As the survey is in survey datum terms, the site may be re-visited in the future, once vegetation has been removed, to do in-fill survey as required.

Dense tall vegetation cover was not an issue at the Green Island Landfill site.

3.3 Landfill Development

Stantec has developed high-level concept filling plans for three landfill development scenarios for the purpose of estimating landfill capacity to assess landfill feasibility as follows:

- Green Island Landfill - Consented Profile
- Green Island Landfill – Southern Extension
- Smooth Hill Landfill.

The extent of filling for each landfill development scenario is shown in Figure 3-1 (Green Island, both Consented Profile and Southern Extension) and Figure 3-2 (Smooth Hill).

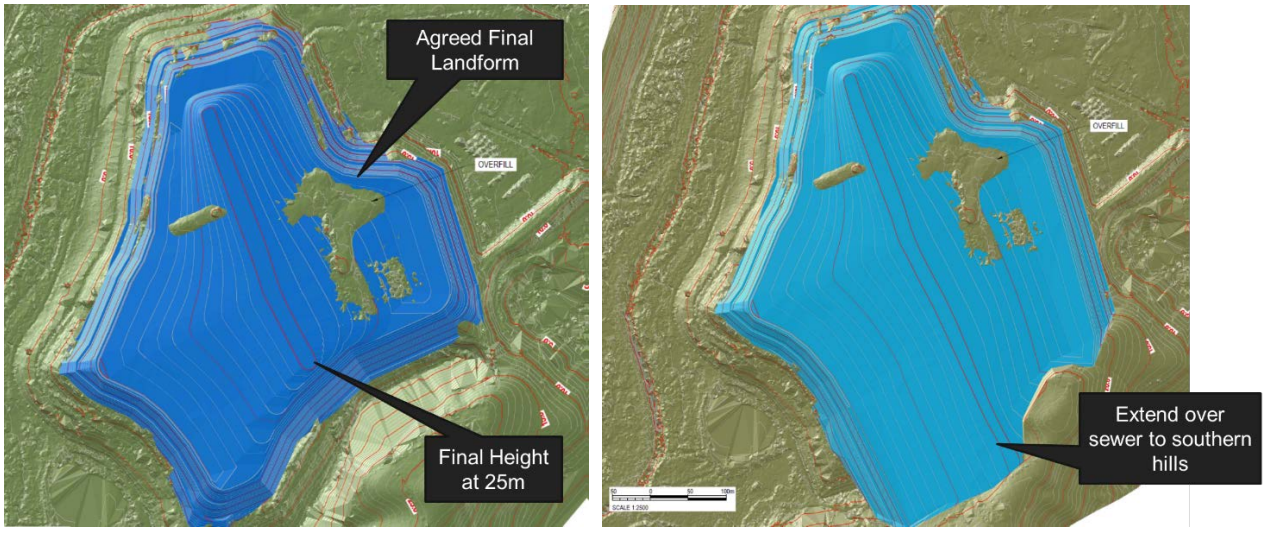

Figure 3-1: Extent of Filling For Green Island Landfill Development Scenarios (Left – 'Consented Profile', Right – 'Southern Extension')

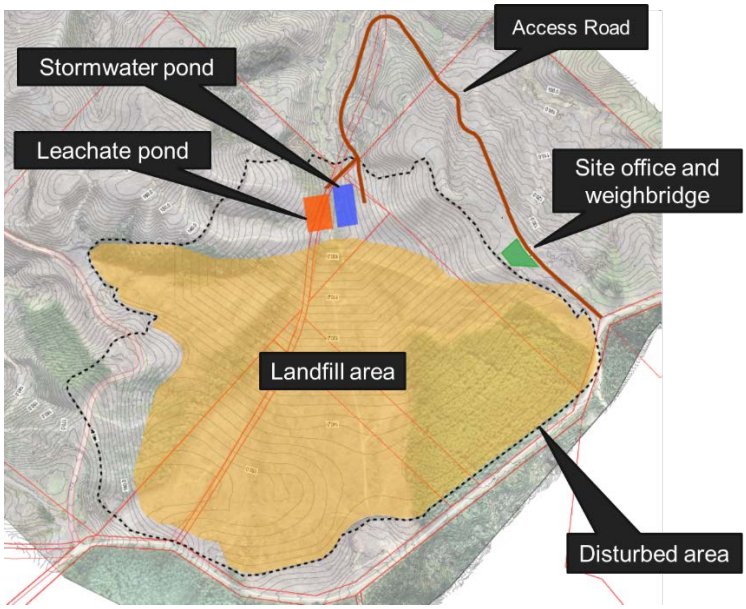

Figure 3-2: Extent of Filling For Smooth Hill Landfill Development Scenario

Details about the landfill development scenarios, including design assumptions and filling plans are provided in Section 4. Key findings and observations are provided in Section 5.1.

3.3.1 Access Via Local Roads

Stantec has also carried out a high-level assessment of the suitability of using the existing local road network from State Highway 1 to the Smooth Hill Landfill site (ie McLaren Gully Road and Big Stone Road). Stantec's assessment considered the suitability of the existing horizontal and vertical alignment as well as whether or not the existing roads are currently within road reserve. As the local roads were outside the area covered by the drone survey, elevation data[12] from Autodesk Infraworks Model Builder was used for the assessment. This data is less accurate but considered a useful first-cut to identify potential risks or issues with using this road to access the landfill site. The findings of this assessment are summarised graphically in Appendix J.

Key findings with respect to using McLaren Gully Road and Big Stone Road to access the site are:

- Horizontal alignment: High-level tracking along the existing road alignment using a 12m rigid vehicle travelling at 40 km/hour showed there are several areas where horizontal curve improvements are required.
- Vertical alignment: There are multiple sections with a grade of more than 8% along the length of McLaren Gully Road and several areas with a grade of more than 12% in the first section of McLaren Gully Road off State Highway 1, with one extended section.
- Legal boundary: The existing road alignment appears to be outside the existing road reserve for the majority of the length of McLaren Gully Road and Big Stone Road (at least from McLaren Gully Road to the landfill site).

Stantec recommends that the Council carry out a topographic survey to better understand the extent of horizontal and vertical geometric design that is required along McLaren Gully Road and Big Stone Road and any associated legalisation of road boundaries and/or land purchases. During preliminary design it would be beneficial to engage with NZTA to understand intersection upgrade requirements at State Highway 1/McLaren Gully Road.

The landfill feasibility assessment provided in Section 5.2 identifies the social effects associated with increased use of the local roads, while issues with existing local roads are identified as a residual risk in Section 6.1

[12] Shuttle Radar Topography Mission (SRTM) elevation data, which is 30m grid data with an accuracy up to 8m

3.4 Economic Assessment

Financial models have been developed for the landfill development scenarios using the Ministry for the Environment's Full Cost Accounting (FCA) model. Details about the FCA models, including inputs, assumptions and outputs of sensitivity analysis are provided in Section 4. Key findings and observations are provided in Section 5.1.

In addition to costs presented in Section 4, a waste disposal facility as defined under the WMA (which includes Green Island Landfill and would include Smooth Hill Landfill) has additional costs associated with the waste levy under the WMA and purchasing New Zealand emission trading units (ETUs or NZUs) to cover methane emissions from landfills under the Climate Change Response Act 2002 (CCRA). The following is noted:

- Waste levy is based on volume of waste disposed of to landfill. The cost of the waste levy is set by Central Government. Currently the waste levy is set at $10/tonne, however Central Government has signalled an intention to significantly increase the waste levy in the next few years as well as apply the levy to other landfill types. This would increase disposal costs at both Green Island and Smooth Hill Landfills
- ETU requirements are based on volume of waste received as well as a landfill factor based on waste composition and landfill gas collection and destruction system. The cost of an ETU is determined by the local market and has increased steadily over the past two years from about $17 per unit to about $23 per unit. The Council is looking to apply for a Unique Emissions Factor (UEF) at Green Island, which would reduce ETU requirements. A higher UEF is likely to apply at Smooth Hill, which would further reduce ETU requirements.

3.5 Airport Risks

The designated Smooth Hill Landfill site is within the flight fan of the Dunedin International Airport at Momona.

To better understand the potential for a proposed landfill at Smooth Hill to increase the risk of planes striking birds which may be attracted to the landfill (ie bird strike risk), the Council has engaged Stantec to carry out additional tasks to the originally agreed scope for Workstream 1,

Stantec has submitted a report summarising key background information (including information in the 1992 Environmental Impact Assessment of the Proposed Smooth Hill Sanitary Landfill and work carried out by Anderson Lloyd in 2018), identified appropriately qualified personal to carry out a bird strike assessment and a staged approach for assessing the bird strike risk for Smooth Hill, and summarised bird mitigation measures used at landfills nationally and internationally. This work is summarised in a report titled *"Landfill Feasibility Assessment: Bird Control at Landfills*", dated 30 August 2018, which is provided in Appendix N.

Key findings with respect to bird mitigation at landfills were:

- The nature and behaviour of bird species is specific for the location and situation
- Prevent the birds from nesting at the site in the first place
- Carefully manage organic waste (ie food sources) and avoid shallow pools and puddles of water
- If birds start being attracted to site, additional control measures need to be implemented (eg changing cover depth, type, density, or frequency of application) in combination with randomly deployed harassment control measures (eg bird scaring devices, shooting if legal).

To progress the bird hazard assessment and with the Council's approval, Stantec engaged Ryder Environmental Ltd to prepare a methodology for carrying out a bird hazard assessment to assess three broad risks. These risks are: bird collision risk to aircraft using Dunedin Airport and Taieri Airport; public health risks arising from birds foraging at the operating face or foraging or roosting on settlement ponds; and risk of nuisance issues arising from birds at the landfill and environments.

The bird hazard assessment methodology, provided in full in Appendix N, comprises the following:

- Review statutory and non-statutory requirements
- Review existing bird management practices at Dunedin Airport, Taieri Airport and Green Island Landfill

- Compile existing information on birds and bird habitats in and around the Smooth Hill site and also provide an overview of bird hazards at other New Zealand airports to provide a perspective of the relative risks at Dunedin Airport.
- Analysis and report on information gaps and site-specific bird-related risks as well as propose methods to gaps in order to support an assessment of the proposed Smooth Hill Landfill and inform a bird management plan for the landfill
- Carry out field investigations to address information gaps
- Develop a bird management plan for the proposed Smooth Hill Landfill.

The Council provided the full methodology to the Dunedin Airport and have requested Stantec (and Ryder) provide a proposal for this work. Stantec recommends that the Council continue to progress this work as it will be required for any resource consent application for Smooth Hill Landfill.

The landfill feasibility assessment provided in Section 5.2 and residual risks identified in Section 6.1 are based on the information available prior to carrying out the bird hazard assessment. The Smooth Hill site is physically within the flight fan for the Dunedin Airport and hence potentially poses a risk of bird strike. However, given the location of the proposed Smooth Hill Landfill, that it will be designed and operated as a modern landfill, and experience at other airports in New Zealand, it is not considered a 'fatal flaw' at this stage.

3.6 Environmental, Social and Cultural Assessment

Stantec has reviewed the following information to inform assessment of adverse effects on the physical, social and cultural environment:

- Consent compliance monitoring for Green Island Landfill
- Council's 2GP information with respect to areas identified as having environmental, social or cultural significance
- Kāi Tahu Ki Otago Natural Resources Management Plan (2005) describes Kāi Tahu values, knowledge and perspectives on natural resource and environmental management issues.

Key findings and observations relevant to landfill feasibility are provided in Section 5.2. Additional information, including relevant maps, is presented in Appendix K, Appendix L and Appendix M. No consultation with external stakeholders has been undertaken as part of this project. This will be an important part of the next stages of the wider project.

4. Landfill Filling Plans and Financial Models

4.1 Overview

This section presents the landfill filling plans and financial models that Stantec have developed for the Green Island Landfill site, based on the current consents ('Green Island Landfill - Consented Profile') and extending the landfill to the south ('Green Island Landfill - Southern Extension', unconsented), as well as the designated Smooth Hill Landfill site ('Smooth Hill Landfill', unconsented).

The landfill filling plans and financial models have been developed for the purpose of assessing feasibility in terms of landfill capacity (and hence landfill life) and high level life-cycle costs for the purpose of comparing options.

The methodology and key assumptions used to develop the filling plans and financial models are presented in this section as are key outputs. It is noted that costs presented in this section do not include an allowance for costs associated with the waste levy or emissions trading units. The costs include some allowance for financing costs.

As noted in Section 1.2.2, an alternative scenario for Green Island Landfill, is to reduce waste quantities received at the landfill such that the existing consented profile provides sufficient capacity until an alternative Class 1 landfill site is available. This scenario would require a significant reduction in waste quantities to be realised in the near future, which is likely to be difficult to achieve, as well as an extension to the expiry date of the current consents for the Green Island Landfill (assuming an alternative Class 1 landfill is not available prior to consent expiry in 2023). This option has not been considered further as part of this Workstream, however the overall order of magnitude of landfill costs will be similar to that the 'Green Island Landfill – Consented Profile' with some increase in total operational costs due to the extended period of operation.

4.2 Green Island Landfill Filling Plan

4.2.1 Agreements with Otago Regional Council

In 1999, DCC's Solid Waste Engineer provided Otago Regional Council with information in a letter[13] relating to the future filling of the landfill with the proposed final level being at RL 125m[14].

In the letter it was also proposed that the landfill be overfilled to allow for settlement of the waste, with the expected settlement being 15% for waste placed between RL 110 and RL 125.

A concept profile was given in the letter which shows the final filling level before settlement being above RL 125m. This equated to a finished level before settlement of RL 127.25m at the centre of the landfill profile.

The letter enclosed parts of the 1994 Management Plan, a description of the future filling and bund construction programme, and Landfill Development Plans (No. 5526/114 Sheets 1 to 8).

Sheets 5 and 6 have been attached in Appendix B since they show the proposed final filling contours for the existing footprint, and an extended footprint over the sewer line. It is noted that at that time the proposal was to extend the landfill footprint to the east in the area now occupied by the greenwaste drop-off and composting activities. It is also noted that the extended footprint adopted for the 'Green Island Landfill – Southern Extension' for this Workstream extends beyond the area covered by the Green Island Landfill Development Plans in Appendix B.

The letter requested approval from ORC of the proposed filling program.

ORC staff confirmed[15] their acceptance of the filling programme detailed in the documents provided to them, and asked for confirmation that the filling rate would be within the maximum of 270 cubic metres per day, as provided for in the discharge permits.

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[13] *Green Island Landfill – Future Filling Programme*; Letter from DCC to ORC having reference 27/1/16; dated 14 April 1999.

[14] RL 125.0m is assumed to correspond to a level of 25.0m in the drone survey.

[15] *Green Island Landfill – Future Filling Programme*; Letter from ORC to DCC having reference 94693/493157; dated 21 April 1999.

Compliance with the filling rate was confirmed to ORC in a letter[16] from DCC.

From Stantec's review of DCC and ORC correspondence referred to above, it appears that filling at Green Island Landfill is permitted to a profile higher than the final level taking into account future settlement of 15% over the life of the landfill including its aftercare (ie an extended period of time). Stantec requested a copy of the original resource consent application (submitted with the Environment Impact Assessment) and decision from the ORC to confirm decisions made at the time of consent award, however ORC have only provided Stantec with a copy of the resource consent. If overfilling is not permitted, it will effectively reduce the landfill life for both Green Island Landfill scenarios by about 1 year based on current filling rates and calculations presented in Section 4.2.4 and 4.2.5.

It is recommended that written confirmation is sought from the ORC to confirm the agreed settlement is 15% and filling is permitted to a profile higher than the final level taking account of settlement, particularly given the timeframes required to achieve final settlement, to provide certainty on the remaining landfill capacity and hence life. However, consultation with ORC as part of the landfill feasibility workstream was outside of Stantec's scope.

4.2.2 Updated Development Plans

In 2001 City Consultants prepared an updated development plan which showed the final levels of the landfill without filling over the sewer line, taking into account the change of the footprint in the eastern side of the landfill. This plan is attached in Appendix B.

In 2004 MWH prepared two final landform plans (Drawings G09 and G10 – see Appendix B) which showed the final landform with and without extending the landfill over the sewer line (referred to in this report as the 'Consented Profile' and the 'Southern Extension'). The landforms were based on the 2001 landform shape but did not show the final level at RL 125m.

The shape derived by MWH has been used as the reference for the final landform in Workstream 1 for calculating the volume of airspace remaining at Green Island. The only change being that the landform has included the final level contour at RL 125m. This is shown in the plan used in 2017 by TL Survey Services which is also attached in Appendix B.

4.2.3 Drone Survey

A drone survey of the landfill site was carried out by Stantec as part of Workstream 1 in August 2018. A copy of the plan is attached in Appendix C. Accuracy and limitations with the drone survey are outlined in Section 3.2.1.

A Digital Terrain Model (DTM) has been developed by Stantec from the drone survey to facilitate modelling of waste profiles and landform completion surfaces.

The levels given as 25.0m in the drone survey for Green Island Landfill site are assumed to correspond to levels shown as RL 125.0m in previous plans for the site.

4.2.4 Landfill Footprint – Consented Profile

The MWH 2004 landform (Drawing G09) has been used as the basis for estimating the available airspace capacity in Workstream 1.

A Digital Terrain Model (DTM) surface was developed and placed over the existing landfill surface, as shown in the drawing GREEN ISLAND LANDFILL – EG and TARGET FINAL SURFACE, attached in Appendix C.

This drawing shows areas on the landfill where the current extent of filling has exceeded the proposed final landform level, and such areas were excluded from further modelling to ensure that no further filling of waste was assumed over those areas, but no allowance has been included for cutting these areas back to the required profile.

Assuming a capping thickness of 1.0m, a surface was created in the DTM which represented the final top of waste, assuming settlement has occurred. It is anticipated that initial settlement may take around 10 years, with further settling to the final landform over subsequent years. At its highest elevation, this waste profile would be at RL 124.0m.

[16] *Green Island Landfill – Future Filling Programme – Daily Filling Rate*; Letter from DCC to ORC having reference 27/1/16; dated 23 April 1999.

Using the DTM, a grid of 5m by 5m was created over the landfill and at each grid point the depth of waste between the existing landfill surface and the final waste profile was calculated. This depth was then increased by 15% to allow for future settlement and a new surface produced which corresponds to the proposed finished waste profile. This surface is shown in Appendix C.

Note that the waste level is up to 25.0m[17], which implies settlement of at least 1.0m along a north-south trending ridge line.

The volume between this surface and the existing waste surface was then calculated using the DTM which indicated an available volume of 837,000m^3 for the Green Island Landfill – Consented Profile.

A separate exercise has been carried out to determine the amount of airspace available, not allowing for 15% settlement. This amounts to an available volume of 725,000m^3, which is a reduction in volume of 112,000 m^3 if settlement is not allowed for and the height restriction is imposed as soon as filling finishes.

4.2.5 Landfill Footprint – Southern Extension

The same methodology as described in the section above has been used for estimating the available landfill volume for a landfill footprint that extends over the existing sewer line to abut the hill located to the south of the landfill in Workstream 1.

The MWH 2004 landform (Drawing G10) has been used as the basis for estimating the available airspace capacity.

The hills comprise clayey soils and a borrow area has been previously developed on part of the hill. As part of the proposed development, the borrow area has been enlarged and shaped to accommodate a landfill liner. A plan showing the proposed extent and shape of the borrow area is included in Appendix C. Not only does enlarging the borrow area provide additional storage capacity, but the earthworks derived can be used for capping of the completed landfill surface.

It is further assumed that the gully between the existing landfill and the hill will be filled to level 5.0m to facilitate drainage of leachate from the extension area.

Modelling the borrow area and proposed landfill extension as a DTM allows the volume of earthworks to be calculated and indicates that there will be approximately 113,000m^3 of cut and 17,000m^3 of fill, giving a net surplus of 96,000m^3.

A DTM surface of the extended landform and a drawing showing the final waste filling contours, allowing for 15% settlement, are attached in Appendix C.

The volume between the final waste filling surface and the existing waste surface has been calculated to be about 1,600,000m^3 for the Green Island Landfill – Southern Extension.

As was done for the consented landfill footprint, a separate exercise has been carried out to determine the amount of airspace available, not allowing for 15% settlement for the southern extension. This amounts to an available volume of 1,383,000m^3, which is a reduction in volume of 217,000 m^3 if settlement is not allowed for and the height restriction is imposed as soon as filling finishes.

4.2.6 Green Island Landfill Life

For both Green Island Landfill scenarios (ie the Consented Profile and the Southern Extension), the available capacity is inflexible, and the rate at which it is used is determined entirely by the quantity of waste and cover that are disposed in the landfill, and the extent to which they are compacted.

Table 4-1 states the assumptions that have been made about the waste and cover characteristics, and shows the volume of airspace used for two different scenarios for annual quantities of cleanfill.

Table 4-1: Cleanfill Volumes For Two Annual Quantities of Cleanfill

	For 75,000 tpa of Cleanfill	For 37,500 tpa of Cleanfill
General Waste Tonnage per year	75,000	75,000
Special Waste Tonnage per year	12,000	12,000
Total Waste Tonnage per year	87,000	87,000

[17] Levels given as 25.0m in the drone survey are assumed to correspond to levels shown as RL 125.0m in previous plans.

	For 75,000 tpa of Cleanfill	For 37,500 tpa of Cleanfill
Total Waste Volume in m^3 per year at 0.8t/m^3	108,750	108,750
Required Daily Cover Volume in m^3 at ratio of 1 to 4 for cover to waste	27,188	27,188
Available Cleanfill Tonnage per year	75,000	37,500
Available Cleanfill Volume in m^3 per year	50,000	25,000
Surplus Cleanfill Volume in m^3 per year	22,813	0
Total Volume Used in m^3 per year	158,750	135,938

Conclusions:

- With 75,000 tonnes per year of cleanfill going into the landfill, there is a surplus of material (22,813m^3) that can be used for bund building, provided this material is stockpiled for this purpose.
- If all the cleanfill is used for daily cover and none is stockpiled, then the ratio of cover to waste will be 1 in 2.175, which is significantly less than 1 in 4, and which implies a poor use of the cleanfill and available airspace resources.

Using these annual volumes, the lives of both Green Island Landfill scenarios have been assessed allowing for 15% settlement, as shown in Table 4-2.

Table 4-2: Estimated Green Island Landfil Life For Consented Profile and Southern Extension

Green Island Landfill Scenario	General Waste (tpa)	Special Waste (tpa)	Cleanfill (tpa)	Estimated Life in years
Consented Profile	75,000	12,000	75,000	5.3
Consented Profile	75,000	12,000	37,500	6.2
Southern Extension	75,000	12,000	75,000	10.1
Southern Extension	75,000	12,000	37,500	11.8

Conclusions:

- Halving the amount of cleanfill increases the life of the existing consented landfill by about 0.9 years (ie the Green Island Landfill – Consented Profile scenario).
- For the Green Island Landfill – Southern Extension scenario, the life is increased by about 1.7 years when the cleanfill quantity is halved.
- For both Green Island Landfill scenarios, the life is decreased if there is no allowance for settlement. This equates to a decrease of about 0.7 years for the Consented Profile and a decrease of about 1.4 years for the Southern Extension, based on 15% settlement and the 2017/18 waste quantities given in Table 2-2.

4.2.7 Cleanfill Quantity Needed for Bund Building and Daily Cover

Table 4-3 sets out the assumptions and calculations for determining how much cleanfill is needed per year for the existing Green Island Landfill (ie Green Island Landfill – Consented Profile), assuming the bunds to be built will be completed in the next five years and that no material has already been stockpiled for this purpose.

Table 4-3: Cleanfill Requirements At Existing Green Island Landfill

Landfill Activity	Quantity
Bund building over remaining life	85,000m^3 in Total 17,000m^3 per year
Daily cover requirements (1 in 4 ratio, and compaction density of 0.8t/m^3	27,200m^3 per year
Total Volume of Cleanfill needed per year	44,200m^3 per year
Total Tonnage of Cleanfill needed per year (at compaction density of 1.5 tonnes per m^3)	**66,300 tonnes per year**

Conclusions:

- Over the next five years the average amount of cleanfill needed for daily cover and bund building activities is about 66,300 tonnes. This is less than the 75,000 tonnes of cleanfill recorded in the year from 1 July 2017 to 30 June 2018.
- Cleanfill needs to be stockpiled for use in bund building and not all used as daily cover.

4.3 Green Island Landfill Full Cost Accounting

4.3.1 FCA Model Description

An analysis tool, the MfE Landfill Full Cost Accounting model, has been used to assess the full life-cycle costs associated with disposal of solid waste at the landfill. This is the same tool that was used by MWH in 2004 to compare Green Island Landfill with the proposed Smooth Hill Landfill site.

The purpose of the FCA model is *"...to assist decision-makers to implement a consistent full cost accounting (FCA) approach to landfills, incorporating landfill planning, development, operation, closure and aftercare in a uniform and consistent way."*

For landfills, whole-of-life costs relate to the total costs of the facility and include:

- planning and pre-development e.g. site investigations, preliminary design, consultation, resource consents, site acquisition
- engineering and detailed design
- development e.g. site access, construction, leachate management system, landfill gas management system, environmental monitoring, stormwater management system, cover and closure
- operation e.g. refuse placement, maintenance, leachate treatment and disposal
- aftercare e.g. post closure monitoring/rehabilitation, post closure leachate disposal.

The modelling tool provides an indicative base cost (or IBC) for landfills, expressed in $/tonne of waste disposed. The IBC corresponds to the price (in "real terms" i.e. present-day dollars) that should be charged over the operational life of the landfill in order to recover all whole-of-life costs. It does not incorporate any profit margin in it.

There are other costs associated with the waste disposal process, (such as the development of transfer stations, the transportation of waste from the transfer station to the landfill, waste levy and ETS charges), that will need to be included to determine the full cost of waste disposal.

4.3.2 Model Inputs for Green Island Landfill – Consented Profile

Assumptions regarding the Green Island Landfill – Consented Profile FCA model inputs can be identified in the "General Input", "Geometric Input" and "Cost Input" worksheets attached in Appendix D. Typical allowances were used for landfill infrastructure and development, which would need to be confirmed following preliminary design for the site.

The following base assumptions are pertinent:

- General Input
  - Project commencement date assumed to be 1 July 2017
  - Operations commence in available airspace (837,000m^3) on 1 July 2018
  - Base waste tonnages as for Green Island Landfill 2017 – 2018
  - Waste charging based on Green Island Landfill
  - Financial assumptions (discount rate etc) – as used in 2004 model.
- Geometric Input
  - Future development limited to:
    - Bund building
    - Extend access road over top of landfill
    - Install additional landfill gas wells
    - Capping of completed landform
  - Capping thickness of 1.0m
  - Landfill gas wells at 80m horizontal spacings, with horizontal collectors at 5m depth spacings
- Cost Input
  - Construction rates derived from recent New Zealand landfill projects Stantec has been involved with and, where required, escalating previous FCA model cost inputs
  - Operational costs derived from Green Island Landfill operational contract, which includes for operating the transfer station and resource recovery centre.
  - The Aftercare Fund is assumed to have accrued to $6,500,000, as indicated by DCC staff.

4.3.3 Model Outputs for Green Island Landfill - Consented Profile

The FCA model output "Summary" and "Cashflow Summary" worksheets for the Green Island Landfill – Consented Profile are attached in Appendix D. Typical allowances were used for landfill infrastructure and development, which would need to be confirmed following preliminary design for the site.

It is noted that there are error messages on the "General Input" and "Summary" worksheets. Working through the model it appears that the error messages are related to the limited availability of airspace but this does not appear to unduly affect the outcome of the model. However, the value of the Aftercare Fund has a considerable impact on the FCA model, as is discussed further in this section.

The FCA model results for the Green Island Landfill – Consented Profile are shown in Table 4-4. Note that the IBC does not include for any waste levies or charges made under the New Zealand Emissions Trading Scheme.

Table 4-4: FCA Model Results for Green Island Landfill – Consented Profile

Base Scenario Description	Indicative Base Cost	Aftercare Levy per tonne
Waste quantities assumed: • General waste – 75,000 tpa • Special waste – 12,000 tpa • Cleanfill – 75,000 tpa Aftercare Fund of $6,500,000 Cover : Waste ratio of 1:3[18]	**$23.12**	**-$34.77** *(see discussion)*

Ordinarily, one would expect the Aftercare Levy per tonne to be a positive value (ie. a cost in the model), since it represents the amount to be charged per tonne of waste over the operational life of the facility, to build up an aftercare fund sufficient to pay for the care of the landfill after closure. In this case the Aftercare Levy is negative due to the amount of funds already accumulated in the Council's Aftercare Fund ($6,500,000), however this should not be interpreted as the existing Aftercare Fund being too high.

The FCA model is based on "typical" aftercare costs for a landfill constructed, operated and maintained according to "modern" standards and doesn't consider the reality of the Green Island Landfill site, which includes being an older-style landfill, not ideally sited and retro-fitted with measures to mitigate effects of leachate and landfill gas. The existing Aftercare Fund for Green Island Landfill should be kept intact until such evidence demonstrates whether or not this money is needed.

The model does not classify cleanfill as waste, and so does not take account of the volume occupied by the cleanfill, unless it is assumed to be consumed as cover material. With the large amount of cleanfill material being assumed (75,000 tonnes per year), the minimum ratio of cleanfill to waste allowed in the model is still too large to model properly the volume occupied by that amount of cleanfill. So, this affects the model's estimation of the life of the facility, and so the results should only be regarded as being broadly indicative to compare the Green Island Landfill scenarios (ie Consented Profile and Southern Extension).

A separate spreadsheet has been used to estimate the life of the landfill under different scenarios, as discussed in Section 4.2.6.

A summary of the costs, assuming there is no Aftercare Fund, is given in Table 4-5. Note that only those costs marked with * are affected by changing the Aftercare Fund value.

Table 4-5: Landfill Costs excluding Aftercare for Green Island Landfill – Consented Profile

Cost Description	Amount
Sunk Costs	$4,950,000
Base Costs (P&G, Engineering Design)	$1,873,232
Development	$8,718,375
Operations*	$19,556,114*
Closure (on top of capping costs)	$185,097
Contingency on Capital Costs	$2,136,831
Contingency on Operational Costs*	$1,955,611*
Total	**$39,375,260***

[18] Based on current estimates of daily cover usage at Green Island

4.3.4 Model Sensitivity Analyses for Green Island Landfill – Consented Profile

Sensitivity analyses have been carried out for the FCA model for the Green Island Landfill – Consented Profile (GI-CP) by varying the following inputs:

- Value of the Aftercare Fund to determine the value of the Aftercare Fund that the FCA model determines is required for the site (i.e. the value of the Aftercare Fund where the Aftercare Levy is zero)
- Cleanfill quantities for two scenarios given the discussion in Section 4.2.7.

The results are shown in Table 4-6.

Table 4-6: FCA Model Sensitivity Analyses for Green Island Landfill – Consented Profile

Scenario	Aftercare Fund	Cleanfill Quantity	Indicative Base Cost	Aftercare Levy
GI-CP 1 Base Scenario	$6,500,000	75,000	$23.12	-$34.77
GI-CP 2	$6,500,000	37,000	$23.59	-$34.77
GI-CP 3	$5,000,000	75,000	$39.91	-$17.53
GI-CP 4	$5,000,000	37,000	$40.72	-$17.53
GI-CP 5	$3,500,000	75,000	$54.78	-$2.26
GI-CP 6	$3,500,000	37,000	$55.88	-$2.26
GI-CP 7	$2,381,000	75,000	$56.98	$0.00
GI-CP 8	$2,381,000	37,000	$58.13	$0.00
GI-CP 9	$2,000,000	75,000	$57.73	$0.77
GI-CP 10	$2,000,000	37,000	$58.90	$0.77
GI-CP 11	$0	75,000	$61.67	$4.82
GI-CP 12	$0	37,000	$62.91	$4.82

Conclusions

- The modelled value of the Aftercare Fund affects the IBC significantly. The more funds available in the Aftercare Fund, the less one needs to charge to cover future costs.
- Theoretically an Aftercare Fund value of around $2,381,000 appears to be sufficient to ensure that no further aftercare levies need be applied. However, the aftercare requirement for Green Island Landfill is likely to be higher than that inherent in the FCA model as discussed in Section 4.3.3.
- If there was no Aftercare Fund available, theoretically the IBC would need to be set at $61.67 (for 75,000 tonnes of cleanfill) and the aftercare levy would need to be $4.82 per tonne of waste, however the reality for Green Island is likely to be different (see Section 4.3.3).
- Halving the amount of cleanfill causes a slight increase in the IBC. This is because the revenue stream from the cleanfill is reduced, whereas the cleanfill tonnage is not classed as "waste tonnes".

4.3.5 Model Inputs for Green Island Landfill – Southern Extension

Assumptions regarding the Green Island Landfill – Southern Extension FCA model inputs can be identified in the "General Input", "Geometric Input" and "Cost Input" worksheets attached in Appendix E. Typical allowances were used for landfill infrastructure and development, which would need to be confirmed following preliminary design for the site.

The following additional base assumptions are pertinent:

- General Input
  - Operations commence in available airspace (1,600,000m^3) on 1 July 2018
- Geometric Input
  - Future development includes:
    - Development of borrow area on southern hill slope
    - Lining of extended footprint area
    - Subsoils, leachate collection and stormwater controls in extended footprint area
    - Relocation or protection of existing sewer line
    - Landfill gas wells at 80m horizontal spacings, with horizontal collectors at 5m depth spacings
    - Capping of completed landform
- Cost Input
  - No changes from the consented profile.

4.3.6 Model Outputs for Green Island Landfill – Southern Extension

The base model output "Summary" and "Cashflow Summary" worksheets for the Green Island Landfill – Southern Extension FCA model are attached in Appendix E.

There is an error message, as noted in Section 4.3.3, but the model does not appear to be unduly affected.

The base model results are shown in Table 4-7. Note that the IBC does not include for any waste levies or charges made under the New Zealand Emissions Trading Scheme.

Table 4-7: FCA Model Results for Green Island Landfill – Southern Extension

Base Scenario Description	Indicative Base Cost	Aftercare Levy per tonne
Waste quantities assumed: • General waste – 75,000 tpa • Special waste – 12,000 tpa • Cleanfill – 75,000 tpa Aftercare Fund of $6,500,000 Cover : Waste ratio of 1:3[19]	**$40.10**	**-$22.38** *(see discussion)*

As noted in Section 4.3.3, the value of the Aftercare Fund ($6,500,000) appears to be affecting the modelled results.

A summary of the costs, assuming there is no Aftercare Fund, is given in Table 4-8. Note that only those costs marked with * are affected by changing the Aftercare Fund value.

[19] Based on current estimates of daily cover usage at Green Island

Table 4-8: Landfill Costs excluding Aftercare for Green Island Landfill – Southern Extension

Cost Description	Amount
Sunk Costs	$4,950,000
Base Costs (P&G, Engineering Design)	$5,328,491
Development	$22,169,688
Operations*	$32,669,273*
Closure (on top of capping costs)	$210,360
Contingency on Capital Costs	$5,520,672
Contingency on Operational Costs*	$3,266,927*
Total*	**$74,115,412***

4.3.7 Model Sensitivity Analyses for Green Island Landfill – Southern Extension

Sensitivity analyses have carried out for the FCA model for the Green Island Landfill – Southern Extension (GI-SE) by varying the following inputs:

1. Value of the Aftercare Fund to determine the value of the Aftercare Fund that the FCA model determines is required for the site (i.e. the value of the Aftercare Fund where the Aftercare Levy is zero)
2. Cost of relocating or protecting the sewer line for two scenarios of costs.

The results from the sensitivity analysis for varying the Aftercare Fund are shown in Table 4-9. In all of these the scenarios, it was assumed that the sewer costs are $3M.

Table 4-9: FCA Model Sensitivity Analyses to After care Fund for Green Island Landfill – Southern Extension[20]

Scenario	Aftercare Fund	Cleanfill Quantity	Indicative Base Cost	Aftercare Levy
GI-SE 1 Base Scenario	$6,500,000	75,000	$40.10	-$22.38
GI-SE 2	$5,000,000	75,000	$56.40	-$5.14
GI-SE 3	$3,500,000	75,000	$59.56	-$1.80
GI-SE 4	$2,136,400	75,000	$61.27	$0.00
GI-SE 5	$2,000,000	75,000	$61.44	$0.18
GI-SE 6	$0	75,000	$63.93	$2.82

Conclusions from the sensitivity analysis for the modelled value of the Aftercare Fund :

- The modelled value of the Aftercare Fund affects the IBC significantly. The more funds available in the Aftercare Fund, the less one needs to charge to cover future costs.
- Theoretically an Aftercare Fund value of around $2,136,400 appears to be sufficient to ensure that no further aftercare levies need be applied. However, the aftercare requirement for Green Island Landfill is likely to be different (see Section 4.3.3). In addition, the Aftercare Fund value is less for the Southern Extension than for the Consented Profile scenario because the landfill airspace and hence waste tonnage is significantly more (ie longer period of time to build up the aftercare fund and a greater tonnage of waste disposed to which the Aftercare levy may be applied).

[20] Assumes that the cost of the sewer is $3M.

- If there was no Aftercare Fund available, theoretically the IBC would need to be set at $63.93 (for 75,000 tonnes of cleanfill), and the aftercare levy would need to be $2.82 per tonne of waste, however the reality for Green Island is likely to be different (see Section 4.3.3).

The results from the sensitivity analysis for the capital cost for relocating or protecting the sewer line are shown in Table 4-10. In 2001 City Consultants looked at options and associated costs for relocating or protecting the sewer that would otherwise be filled over for this landfill scenario. The technical feasibility or associated costs of these options have not been revisited as part of Workstream 1. However, to provide some perspective on the effect of capital cost for relocating or protecting the sewer line on the IBC and Aftercare Levy, two cost scenarios have been assessed ($3M[21] and $4.5M). The assessment is based on the Aftercare Fund value being $0 at the start of the project.

Table 4-10: FCA Model Sensitivity Analyses to Sewer Cost for Green Island Landfill – Southern Extension[22]

Scenario	Sewer Relocation / Protection cost	Cleanfill Quantity	Indicative Base Cost	Aftercare Levy
GI-SE 6	$3,000,000	75,000	$63.93	$2.82
GI-SE 7	$4,500,000	75,000	$66.07	$2.82

Conclusions from the sensitivity analysis for the modelled cost to relocate or protect the sewer:

- In round terms, an increase in capital cost of $1,500,000 increases the IBC by about $2.15 per tonne. It is not regarded as being very sensitive to this change in cost.

4.4 Smooth Hill Landfill Filling Plan

4.4.1 Drone Survey

A drone survey of the landfill site was carried out by Stantec as part of Workstream 1 in August 2018. A copy of the plan is attached in Appendix F. Accuracy and limitations with the drone survey are outlined in Section 3.2.1.

A Digital Terrain Model (DTM) has been developed from the drone survey to facilitate modelling of waste profiles and landform completion surfaces.

4.4.2 Design Assumptions

The following design assumptions have been made for the proposed Smooth Hill Landfill site:

- The landfill design is a concept design. It has not been optimised to provide the maximum volume of airspace capacity for the minimum footprint area.
- The footprint of the landfill is approximately based on the footprint adopted by Beca, which was also followed by MWH in 2004.
- It is assumed that the depth of excavation, particularly on the spurs between the gullies, will be between 5m and 10m.
- Assume a maximum required capacity of 200,000m^3 per year (about 192,000 tonnes per year), which allows for an additional 30,000 tonnes of waste per year from out of district, or other sources.
- The target volume for a 30 year life is then 6,000,000m^3 net of the capping layer and liner.
- The underlying footprint is to be shaped to a steepest slope of 1V:4H. This facilitates construction of a compacted clay liner on a slope and also allows for a 1V:3H slope over 30m (10 m height rise), and a 10m wide bench which can be used as a stormwater cut-off.

[21] Based on $1M estimate in 1998 escalated by 5%pa, rounded up. Watermain follows similar alignment to sewer. Watermain rerouting is a minor cost in comparison to the sewer, being $130k based on $50k estimate in 1998 and escalation of 5%pa. The $3M adopted for sewer relocation includes this allowance for watermain relocation.
[22] Assumes Aftercare Fund is $0 at start of project.

- Shape the front face of the landfill to a moderate slope of 1V: 8H.
- The State Highway 1 intersection with McLaren Gully Road is assumed to be upgraded with a widened shoulder, however NZTA may have additional requirements. The 4.5km length of local road from State Highway 1 to the landfill site (ie McLaren Gully Road and part of Big Stone Road) is assumed to be upgraded along the existing alignment to provide a 8m sealed carriageway, with a third requiring reconstruction to achieve the new width. A topographic survey is required to confirm the extent of horizontal and vertical geometric design required and any associated legalisation of road boundaries and/or land purchase.
- The access road into the site (from Big Stone Road) is to have a steepest grade of 1V:10H. It is assumed that this will be located on the eastern spur which allows the site office to be located in such a way that affords a view over the whole site, and also allows full vehicles to enter into the landfill on a downhill grade.
- Leachate is assumed to be pumped to the Brighton pump station. It is assumed that the pump station, network and wastewater treatment plant have sufficient capacity to accommodate the leachate. This has not been specifically checked as part of this project.
- Power is assumed to be connected to the 11kV spur line that terminates on Big Stone Road, about 3.7km directly from site. It has been assumed that the supply to this point would not need to be upgraded. A detailed assessment of this has not been carried out as part of this project.

4.4.3 Filling Plan

The concept phasing plan encompasses six phases, as described further in Table 4-11. Drawings of the various phases are attached in Appendix G.

Figure 4-1 shows a possible landfill site layout. Based on this, the landfill filling area and associated facilities (eg internal access road, site office, weighbridge, leachate pond and stormwater pond) could be accommodated within the designated area. It is noted that additional land may be required along McLaren Gully Road and Big Stone Road depending on the outcome of a topographic survey to understand the extent of horizontal and vertical geometric design required and any associated legalisation of road boundaries and NZTA requirements for the State Highway 1 intersection upgrade (see Section 3.3.1).

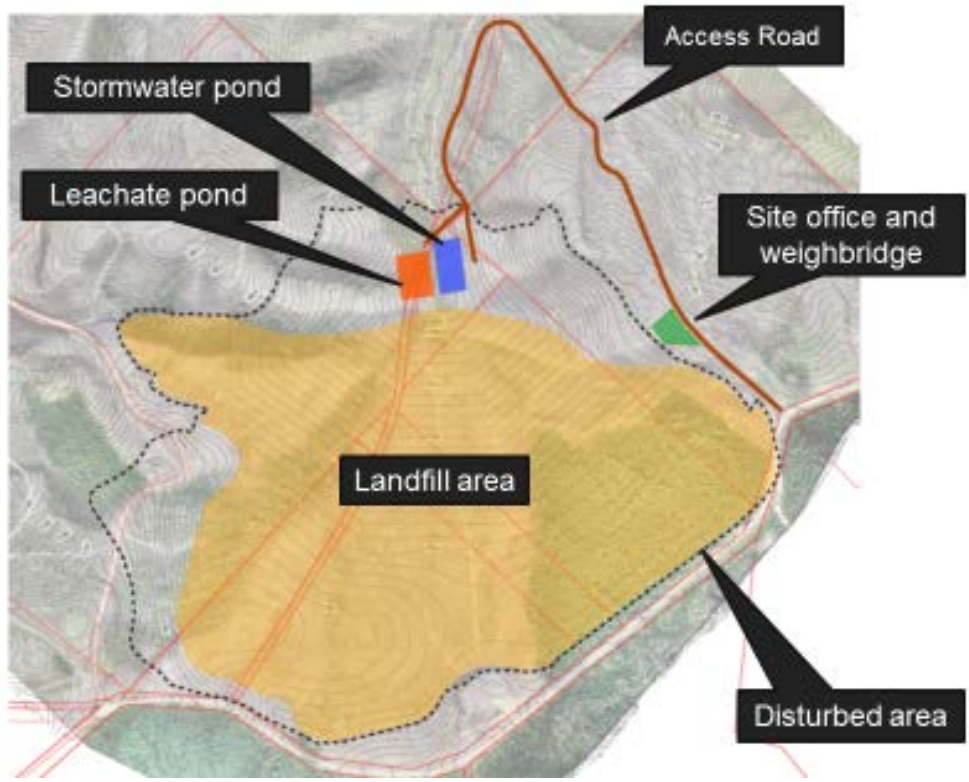

Figure 4-1: Possible Landfill Site Layout at Smooth Hill

Table 4-11: Concept Phasing Plan for Smooth Hill Landfill

Phase	Description	Cut Earthworks (m^3)	Fill Earthworks (m^3)	Net Airspace Volume (m^3)
1	Develop and fill the broad right hand gully (presently occupied by pine trees) from approximately RL 100m to RL 140m	373,000	60,000	1,111,000
2	Develop and fill the broad left hand gully from approximately RL 100m to RL 140m.	407,000	158,000	1,656,000
3A	Fill largely on top of Phase 2 from RL 140m to RL 150m.	0	0	513,000
3B	Develop and fill the small western gully located adjacent to Phase 2, from approximately RL 100m to RL130m.	129,000	64,000	163,000
4	Develop and fill from the toe of Phases 1, 2 and 3B, from approximately RL 95m to RL 135m.	108,000	13,000	1,404,000
5	Fill on top of Phases 4, 3A and 1, from approximately RL 135m to RL 155m.	0	0	725,000
	TOTALS	**1,017,000**	**295,000**	**5,572,000**

Conclusions:

- The concept design phasing yields a net airspace capacity of 5,572,000m^3. This is with a very conservative front face slope of 1V:8H. It is likely that this slope could be steepened to a slope of 1V:5H without any issues of instability, and in doing so would certainly yield a net airspace capacity in excess of 6,000,000m^3.
- There will be a significant amount of excavated material available that could meet some of the requirements for constructing liners, bunds, daily cover and final capping.

4.4.4 Smooth Hill Landfill Life

Table 4-12 shows how the life of Smooth Hill Landfill would be affected by changing the waste quantities being disposed of at the landfill (eg. by accepting out of district waste), or by reducing the amount of cleanfill being accepted.

Table 4-12: Estimated Smooth Hill Landfill Life

Waste Scenario	General Waste (tpa)	Special Waste (tpa)	Cleanfill (tpa)	Landfill Life
Present waste quantities	75,000	12,000	75,000	35.1 years
Current waste, half cleanfill	75,000	12,000	37,500	41.0 years
Include 15,000 tpa from out of district	90,000	12,000	75,000	31.4 years
Include 30,000 tpa from out of district	105,000	12,000	75,000	28.4 years

Conclusions:

- Halving the amount of cleanfill increases the life of the proposed landfill by about 6 years.
- The landfill has almost sufficient capacity to accommodate an extra 30,000 tonnes of waste per year over a 30 year period. This equates to the waste quantities estimated from Clutha District and Waitaki District by MWH in 2004.

4.5 Smooth Hill Landfill Full Cost Accounting

4.5.1 Model Inputs for Smooth Landfill

Assumptions regarding the Smooth Hill Landfill FCA model inputs can be identified in the "General Input", "Geometric Input" and "Cost Input" worksheets attached in Appendix H.

The following base assumptions are pertinent:

- General Input
  - Project commencement date assumed to be 1 July 2019
  - Operations commence date assumed to be on 1 July 2025 (noting that it may longer than 6 years to consent, design, construct and procure an operational contract for a new landfill)
  - Base waste tonnages as for Green Island Landfill 2017 – 2018
  - Waste charging based on Green Island Landfill
  - Financial assumptions (discount rate etc) – as used in 2004 model.
- Geometric Input
  - Future development covers all infrastructure needed to develop a modern Class 1 landfill
  - Landfill gas wells at 80m horizontal spacings, with horizontal collectors at 5m depth spacings
- Cost Input
  - Construction rates derived from recent New Zealand landfill projects Stantec has been involved with and, where required, escalating previous FCA model cost inputs
  - Operational costs derived from Green Island Landfill operational contract, which includes for operating the transfer station and resource recovery centre. (Note these Is no allowance for costs to transport waste from Green Island Transfer Station to Smooth Hill Landfill.)
  - District road upgrade costs assumed to be $1,000,000
  - Intersection upgrade with SH1 assumed to be $120,000
  - Access road inside the landfill boundary costed at $650,000 per km
  - Cost of providing a rising main to Brighton pump station costed at $2,000,000
  - Cost to connect to power costed at $400,000.

4.5.2 Model Outputs for Smooth Hill Landfill

The base model output "Summary" and "Cashflow Summary" worksheets for the Smooth Hill Landfill FCA model are attached in Appendix H.

The base model results are shown in Table 4-13. Note that the IBC does not include for the transport of waste from a transfer station in Dunedin to Smooth Hill, neither does it include for any waste levies or charges made under the NZ ETS.

Table 4-13: FCA Model Results for Smooth Hill Landfill

Base Scenario Description	Indicative Base Cost	Aftercare Levy per tonne
Waste quantities assumed: • General waste – 75,000 tpa • Special waste – 12,000 tpa • Cleanfill – 75,000 tpa Cover : Waste ratio of 1:4	**$85.83**	**$1.42**

A summary of the costs is given in Table 4-14.

Table 4-14: Landfill Costs for Smooth Hill Landfill

Cost Description	Amount
Sunk Costs	$ 760,000
Planning / Pre-development Costs	$ 1,836,667
Base Costs (P&G, Engineering Design)	$ 21,448,772
Development	$ 86,806,478
Operations	$ 82,384,364
Closure (on top of capping costs)	$ 346,354
Contingency on Capital Costs	$ 22,053,019
Contingency on Operational Costs	$ 8,238,436
Total	**$ 223,874,088**

The costs to get the landfill up and running (up to end of Phase 1) can be identified from the "Cashflow Detail" worksheet (see Appendix H). They amount to the capital costs (rounded) in Table 4-15.

Table 4-15: Landfill Costs for Smooth Hill Landfill Up to End of Phase 1

Cost Description	Amount
Sunk Costs	760,000
Planning / Pre-development Costs	$ 1,840,000
Base Costs (P&G, Engineering Design)	$ 6,510,000
Development	
• Site access	$1,900,000
• Site amenities and services	$3,280,000
• Cell construction, Earthworks, Liner, Leachate	$20,180,000
• Stormwater management	$550,000
• Gas management	$ 1,080,000
Contingency on Capital Costs	$ 7,270,000
Total*	**$ 43,370,000**

Note that these costs cover the construction of the whole of Phase 1 which has a capacity of 1,111,000m^3 and could last for almost 7 years. It could be split into separate sub-phases thus reducing the costs for the first sub-phase to an estimated $31,000,000. This assumes that only 50% of the cell construction, gas management and associated contingency costs need to be incurred to commission the landfill.

4.5.3 Model Sensitivity Analyses for Smooth Hill Landfill

The IBC is sensitive to the quantity of waste and the cleanfill quantities. To illustrate this, sensitivity analyses have carried out for the Smooth Hill Landfill (SH) by varying the following inputs:

- General waste quantities
- Cleanfill quantities.

The results are shown in Table 4-16.

Table 4-16: FCA Model Sensitivity Analyses for Smooth Hill Landfill

Scenario	General Waste (tpa)	Special Waste (tpa)	Cleanfill (tpa)	Indicative Base Cost
SH 1 – Base Scenario: As for Green Island Landfill presently	75,000	12,000	75,000	$85.83
SH 2- Include 15,000 tpa of out-of-District waste	90,000	12,000	75,000	$79.60
SH 3 - Include 30,000 tpa of out-of-District waste	105,000	12,000	75,000	$73.47
SH 4 - Current waste, half cleanfill amount	75,000	12,000	37,500	$87.56
SH 5 - Current waste, third cleanfill amount	75,000	12,000	25,000	$88.16

Conclusions:

- Progressively increasing the general waste quantities (scenarios SH 1 to SH 3) causes the IBC to reduce by about $1/t for every 2,500 tonnes of waste increase.
- Comparing scenarios SH 1, SH 4 and SH 5, reducing the amount of cleanfill causes the IBC to increase marginally as the revenue derived from the cleanfill reduces.

5. Landfill Feasibility

At Workshop 2 on 1 October 2018, Stantec presented the preliminary landfill feasibility assessment for the Green Island and Smooth Hill sites based on the approach agreed at Workshop 1 on 28 August and outlined in Section 2.1. These findings were discussed with the workshop participants, being Council staff, Council advisor and the Stantec team. The landfill feasibility assessments presented in Section 5.1 (provide reliable service) and Section 5.2 (protect environment) are the collective agreement of the workshop participants at the time, based on the information available at that time.

A traffic light based ranking system was used to assess key aspects of feasibility. The ranking system was different for the two landfill functions, with 'provide reliable service' based on ability to meet the site specific landfill objective (ie Green Island or Smooth Hill Landfill) and 'protect environment' based on likely extent of adverse environmental effects. However in all cases:

- 'green' indicated minimal expected or observed issues
- 'orange' indicated possible issues, and
- 'red' indicated significant issues with specific mitigation measures or need for more investigation.

5.1 Provide Reliable Service

Table 5-1 summarises the landfill feasibility assessment for the Green Island and Smooth Hill sites for the landfill function of providing a reliable service.

Table 5-1: Landfill Feasibility – Provide Reliable Service

Key Aspect	Green Island		Smooth Hill
	Consented Profile	Southern Extension	
Period of Service			
Site capacity (Filling Space)	837,000 m³	1,600,000 m³	5,572,000 m³
Number of years service @ 160,000 m³/year[23]	5.3 years *(consents expire 2023[24])*	10.1 years *(not consented)*	>30 years *(not consented)*
Ability to meet demand for landfill (current, natural disasters, other)	Minimal	Short term, sensitive to fluctuations	Long term
Waste catchment (city, out-of-district)	Limit to DCC	Limit to DCC	Could consider wider catchment
Economics			
Governance	Options restricted by existing operation		Options open
Cost- IBC (cleanfill at 5% of IBC) *(IBC described in Section 4.3.2)*	About $23 / tonne	About $40 / tonne	$86 / tonne
Cost - ETU risk *(ETU and UEF described in Section 3.4)*	Low UEF[25]		High UEF[25]
Competition	No other landfill classed as waste disposal facility in WMA		Potential for competition over landfill life

[23] Based on 75,000 tpa general waste, 12,000 tpa special waste and 75,000 tpa cleanfill

[24] Current consents based on 270 m³/day. See commentary in Section 3.2.1 of Appendix M

[25] UEF is the Unique Emissions Factor. Low UEF means higher ETS charges with more units needed, and a high UEF means lower ETS charges with less units needed

Key Aspect	Green Island		Smooth Hill
	Consented Profile	Southern Extension	
Proximity to generators (distance, time)	Established, operational & close to city		Greater distance from Dunedin: T/S upgrade needed
Waste Type			
Accept Class 1 materials	Can accept Class 1 waste		Design for Class 1
Regulatory Compliance			
Compliant with HSNO, HSWA	Largely compliant		Design for regulations
Level playing field (RMA, WMA, ETS)	Other landfills (other site taking Class 1 waste, greenwaste sites) with lower gate charges and/or lower standards		Local regulations and advocate for national & regional regulations to level playing field
Physical Assets			
Design standards	Not Class 1		Class 1
Design life/ fit for purpose	~5 year capacity	~10 year capacity	30 year capacity
Conditions of assets	Detailed review required		new
Operational performance	Issues in wet weather and odour		Design and operate to Class 1
Input Control			
Acceptance criteria	Class 1		Class 1
Input monitoring	Some limitations, due to diversion of material after weighbridge		New weighbridge to record all waste to landfill

5.2 Protect Environment

Table 5-2 summarises the landfill feasibility assessment for the Green Island and Smooth Hill sites for the landfill function of protecting the environment, including physical, social and cultural environment. In the following tables, "2GP" identifies information that has been sourced from the Proposed Second Generation Dunedin City District Plan.

Table 5-2: Landfill Feasibility – Protect Environment

Key Aspect	Green Island	Smooth Hill
Compliance		
Discharge consents	Comply, expire 2023[26]	None
Designation	Comply	Not given effect to
Baseline Information	No information on wet weather effects and ecological impact, esp in Estuary	No baseline for GW, SW, air, ecology. May be difficult to establish control sites as at head of catchment
Hazards		

[26] Discharge Permit 94693_V1 permits discharge of up to 270m³/day of municipal, domestic, hazardous and industrial waste to land. Assuming compliance is based on compacted (ie landfilled) volume, then the current waste quantities exceed or are near the current consent limits for Green Island landfill, depending on the assumed waste compaction density. See commentary in Section 3.2.1 of Appendix M.

Key Aspect	Green Island	Smooth Hill
Flood Risk	2GP: Next to moderate risk area; risk remains as a closed landfill site	None identified on 2GP
Effect on Airport	No impact	Bird strike & Hinder flight fan
Land Instability	2GP: Areas of moderate risk around site	None identified on 2GP, however site outside area of GNS study, and minimal geotechnical investigation have been conducted.
Physical Effects		
Discharges to land and water	Some discharge of leachate and treated stormwater to groundwater and surface water, particularly during wet weather	Leachate will be directed offsite, so only discharges of treated stormwater (not in contact with waste) to surface water (Otokia Creek >> coast)
Discharges to air	Odour complaints Retro-fit gas collection	Potential for odour issues (closest resident ~300m towards coast) New gas collection
Conservation / Ecology	UCLA10[27] (Kaikorai Estuary, Fairfield) to north of site ASCV[28]: • Edge of Kaikorai Estuary, Estuary and Lagoon next to site (C106) • Westwood Recreational Reserve at estuary mouth (C037)	ASCV[28]: • McLarens Gully Covenant 1.5km to N (C075) • Hope Hill Scenic Reserve 1.2km to E (C030)
Cultural effects		
Discharge to water	Discharge of leachate and treated stormwater to groundwater and surface water	Only discharges of treated stormwater (not in contact with waste) to surface water.
Wāhi tūpuna[29] in 2GP	51 Kaikarae adjacent 52 Beach at Kaikarae at estuary mouth	59 Coast from Taieri Mouth to Brighton 2.5km to S 60 Taieri Maori Reserve 5km to SW 61 Pā site and Kāik at Omoua and Maitapapa (Henley) 5km to W 62 Taieri River 3.5km to N
Kai Moana	Adjacent to Estuary	Distant from coast but hydraulically connected to Brighton estuary via Otokia Creek
Transport of waste *(import to or export from Dunedin)*	Accepts Waitaki District waste	Potential for non-DCC waste
Social effects		
Noise	Existing activity in area with industrial activities. Could increase. 100m to Green Island community	Change in noise level, particularly during landfill development phase. 300m to individual houses

[27] UCLA is an urban landscape conservation area defined in the current Dunedin City District Plan. This is not included in the Proposed Second Generation Dunedin City District Plan

[28] ASCV is an area of significant conservation value as defined in current Dunedin City District Plan and Proposed Second Generation Dunedin City District Plan

[29] **Wāhi tūpuna:** Defined in the Proposed Second Generation Plan as landscapes and sites that embody the ancestral, spiritual and religious traditions of all the generations prior to European settlement.

Key Aspect	Green Island	Smooth Hill
Dust	Minimal issues identified currently	Minimal as road will be sealed.
Traffic	Minimal change	Significant increase on local road (50 trucks/day), however not residential area and road will be sealed
Landuse zoning	Underlying Rural Coastal and Industrial to E and Recreation to NE	Rural Coastal
Archaeology	Adjacent to Alert Layer for whole coastline	Specific small areas identified in vicinity & coastline
Landscape	Currently screened but not if built higher NCC[30]: Island Park @ estuary mouth	Protected ridgeline through site but landfill development and buildings can be positioned below ridgeline out of sightlines. SNL[31]: Saddle Hill 2km to N & extend to NE NCC[30]: Kuri Bush along coast to S & Brighton Road Beach on coast to E
Proximity to reserves	Reserve: Kaikorai Stream along edge of landfill	Strips: Fern Stream to S & Otokia Creek to NE

[30] NCC: Natural Coastal Character as designated in Proposed Second Generation Plan
[31] SNL: Significant Natural Landscape as designated in Proposed Second Generation Plan

6. Key Residual Risks with Green Island and Smooth Hill Landfill Options

6.1 Nature of Risks

At Workshop 2 on 1 October 2018, after agreeing the landfill feasibility assessments presented in Section 5.1 (provide reliable service) and Section 5.2 (protect environment), the workshop participants discussed and agreed key residual risks for landfill feasibility (ie Workstream 1), based on the information available at that time. These key residual risks are presented in Table 6-1.

Table 6-1: Key Residual Risks

Green Island – consented profile	Green Island – Southern Extension	Smooth Hill
• May reach capacity prior to 2023 unless incoming waste quantities are managed / cleanfill use is reviewed • Only landfill in district classed as a waste disposal facility in WMA • Otago Regional Council may not accept 15% settlement allowance, reducing landfill capacity • Risk of odours (especially if receive increased volumes of sludge) • Some of the received cleanfill needs to be stockpiled for use in bund building and not all used for cover material	• May not provide sufficient capacity to cover time required for new landfill to be operational unless incoming waste quantities are managed • May not be cost effective to consent, develop and operate extended landfill for relatively short time • May be technically challenging to reconsent (environmental, social and cultural issues) • Constructing landfill over a sewer will not meet Class A landfill requirements • May be more cost effective to relocate sewer • Only facility in district classed as a waste disposal facility in WMA • Settlement allowance • Risk of odours (especially if receive increased sludge volume) • Perceived as contradicting DCC publicity about site closing	• Site has been designated for some years and Council's intention to pursue this site as a potential new landfill has been on the Council's website and in the media, however, resistance by community and iwi may be experienced. There are several properties located between Smooth Hill site and coast line • May take more than 6 years to consent, procure and develop Smooth Hill • Likely to be shortfall between Green Island reaching capacity and new landfill being operational • Reducing waste quantities will essentially increase gate charge required to cover 'investment' costs. • No existing environmental monitoring data to provide 'baseline'. A hydrogeological model may be required to determine appropriate monitoring as site is at the head of the catchment. • Need to progress bird hazard assessment to understand any site limitations/ requirements • Access from SHI not in road reserve and may require horizontal and vertical geometric design. • Paper road through site requires closing • Changing regulations including levelling the playing field (eg MfE Waste Levy review) will affect waste quantities to Class 1 landfill.

Green Island – consented profile	Green Island – Southern Extension	Smooth Hill
		• Preliminary design required to confirm assumptions used to develop landfill costs (eg management of leachate, landfill gas, stormwater; power supply, access from State Highway to site)

6.2 Programme Risks

A key residual risk for landfill feasibility is the ability of Council to continue to have access to a waste disposal in the short to medium term.

Pertinent dates and timeframes related to the Green Island and Smooth Hill Landfill sites, shown in Figure 6-1, are as follows:

- **Green Island Landfill**:
  - Current resource consents expire in 2023.
  - Current consented landfill airspace ('Consented Profile') is estimated to be fully utilised in 2023 or 2024 based on current waste quantities.
  - If new resource consents are obtained for an extended landfill footprint ('Southern Extension'), airspace estimated to be fully utilised in 2028 or 2029 based on current waste quantities.
- **Smooth Hill Landfill**:

  A realistic timeframe to allow to investigate, consent, design, construct and procure an operational contract for Smooth Hill Landfill is in the order of 6 (or less if the consents are not appealed to the Environment Court) to 10 years. Some landfills have taken less time[32]. This timeframe is based on:
  - 1-2 years for site investigations and resource consent preparation
  - 3-4 years for resource consent process (including an environment court hearing)
  - 1-2 years for procurement of landfill development and operation services
  - 1-2 years for landfill development prior to landfill operation commencing.

[32] Timeframes observed at other landfills in New Zealand are given in Appendix M.

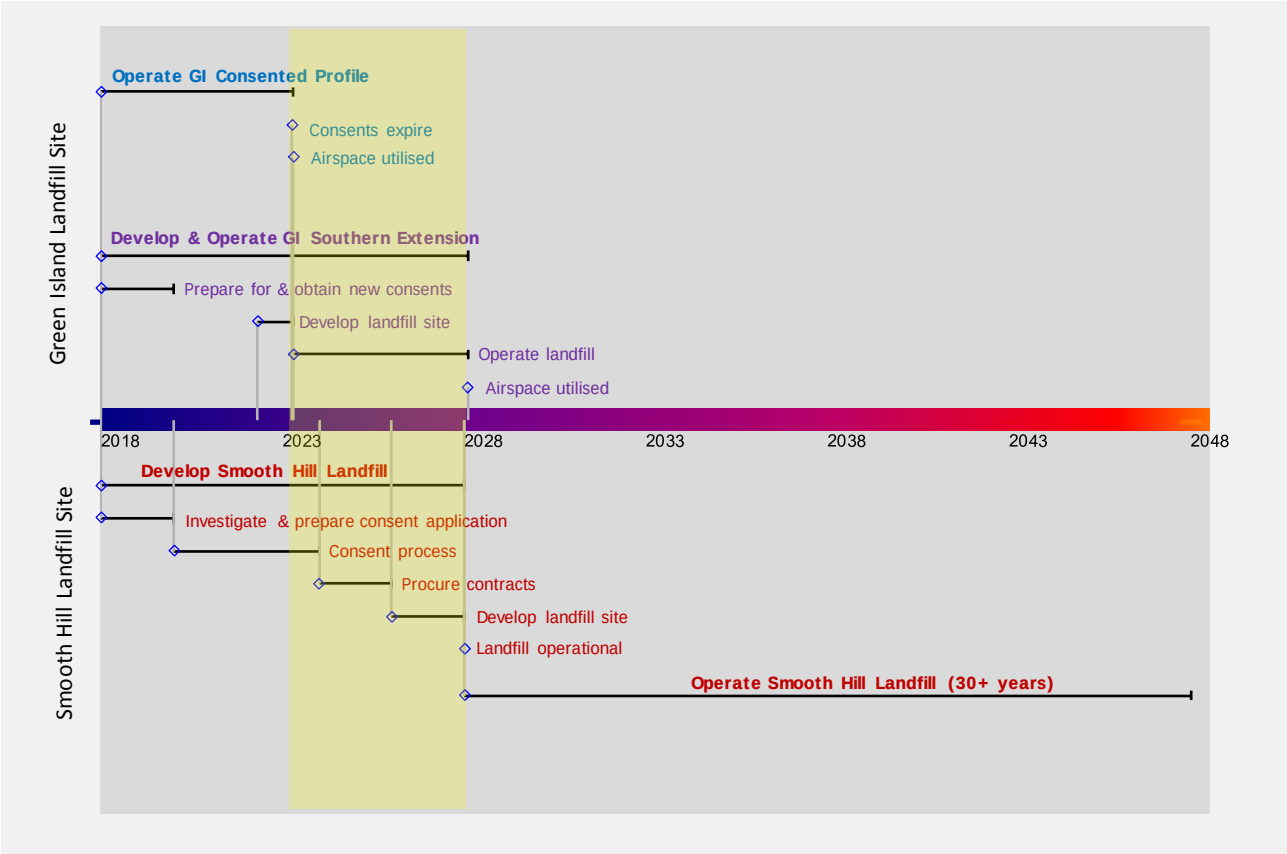

Figure 6-1: Indicative Timeline for Green Island and Smooth Hill Landfills (based on upper timeframes for Smooth Hill Landfill. Yellow area is period at risk between Green Island Landfill closing and Smooth Hill Landfill opening))

A key residual risk for landfill feasibility is the ability of Council to continue to have access to a waste disposal in the short to medium term. The indicative timeline in Figure 1-1 shows that there is likely to be a shortfall in the order of 3 to 5 years (shown in yellow) from when the existing consents for the Green Island Landfill expire and airspace at Green Island Landfill is fully utilised to Smooth Hill Landfill being operational. During this shortfall period, Council will need to either:

- obtain a new resource consent for and develop an extended Green Island Landfill
- secure a contract(s) to dispose of waste elsewhere, or
- rely on the private sector.

Therefore, there is an urgent need for the Council to decide on the best way forward for Dunedin with respect to waste disposal.

The indicative timeline also highlights the benefit to the Council of implementing robust methods to minimise current waste quantities disposed to Green Island Landfill, and hence maximise the life of the Green Island Landfill based on the 'Consented Profile'.

7. Waste Disposal Options To 2063 and Beyond

7.1 Overview

Following Workshop 2 for the landfill feasibility workstream and Workshop 3 for the business case workstream, DCC engaged Stantec to identify broad waste disposal options for the Council following the Green Island Landfill consent expiry in 2023. A detailed scope of work is in Stantec's Project Change Notice No. 4 dated 25 October 2018.

A report summarising the findings of this work is in Appendix O, including:

- Waste quantity and type currently received at Green Island Landfill in the context of alternative waste disposal options
- Potential waste 'export' options for Dunedin
- Consenting costs for closure of Green Island Landfill in 2023, extending Green Island Landfill footprint and operation for an additional 3-5 years then closure, and development and operation of Smooth Hill Landfill. Specific consents for each landfill site to be confirmed during the consenting process but broadly similar range of consents required as currently held for Green Island Landfill. Exact consents required is dependent on the development methodology.
- Comparison of a 'total' export option, based on waste disposal to a combination of existing out-of-district landfills and local cleanfills, against the option of developing Smooth Hill Landfill.
- Summary of three board waste disposal options for the short to medium term (<2023 to 2028) and long term (2028 to 2063+) with associated disposal and consenting costs, benefits. negative risks, and risk mitigation.

7.2 Key Findings

In summary, the three long-term waste disposal options for Council following Green Island Landfill consent expiry in 2023 are:

1. **Long-term 'export'**: Use existing landfills rather than develop the Smooth Hill site as a Class 1 landfill
2. **Short-term 'export' and Develop Smooth Hill Landfill:** Develop the Smooth Hill site as a Class 1 or a combined Class 1 and Class 2 landfill and, if required, use existing landfills (short-term 'export' option) for time between Green Island Landfill consents expiring and Smooth Hill Landfill being available.
3. **Extend GILF and Develop Smooth Hill Landfill:** Develop the Smooth Hill site as a Class 1 or a combined Class 1 and Class 2 landfill and extend Green Island Landfill operation for an additional 2 to 5 years to provide time for Smooth Hill Landfill to be developed.

By way of explanation:

- Existing landfills considered in waste disposal options that include 'export' are levied Class 1 landfills in Otago, Southland and South Canterbury, as identified in this report
- Classes of landfills (ie Class 1 and Class 2) are as defined in the Disposal to Land Technical Guidelines (WasteMINZ 2018)
- Levied landfills are those defined as such in the Waste Minimisation Act 2008.

7.2.1 Option 1: Long-term 'export'

The only existing Class 1 levied landfills (ie permitted to take household waste) in the Otago, Southland and Canterbury regions with long term capacity are:

- Victoria Flats landfill
- AB Lime Landfill
- Kate Valley Landfill (but has a consent condition that limits the waste catchment to the Canterbury region and hence cannot currently accept waste from Dunedin).

Hence levied landfills that may be accessible for long-term waste disposal based on preliminary discussions with landfill owner, operators or both are:

- AB Lime Landfill subject to the quantity of waste sent there being in the order of 40,000t /year (in order for AB Lime landfill to operate within the 100,000 t/yr consent discharge limit) or AB Lime securing a consent change that adequately increases or removes the discharge limit
- Victoria Flats Landfill subject to the Queenstown Lakes District Council agreeing to this (Queenstown Lakes District Council has indicated it would be receptive to an approach from the Council).

The Nash and Ross Landfill in Kaikorai Valley is permitted to take waste that typically would be disposed to a Class 2 Landfill (ie lined landfill). This landfill has a large capacity.

7.2.2 Option 2: Short-term 'export' and Develop Smooth Hill Landfill

Levied landfills that may be accessible for short-term waste disposal are:

- AB Lime Landfill subject to the quantity of waste sent there being in the order of 40,000t /year (in order for AB Lime landfill to operate within the 100,000 t/yr consent discharge limit) or AB Lime securing a consent change that adequately increases or removes the discharge limit
- Victoria Flats Landfill subject to the Queenstown Lakes District Council agreeing to this (Queenstown Lakes District Council has indicated it would be receptive to an approach from the Council)
- Mt Cooee Landfill subject to necessary resource consents for this site (to extend life beyond 2023 and increase permitted discharge rate) and an acceptable reciprocity agreement with Clutha District Council (which could be for any option)
- Redruth landfill subject to an acceptable reciprocity agreement with the Timaru District Council (which could be for any option) and resource consents that are enabling.

A key commercial risk to the Council developing Smooth Hill (or an alternative Class 1 landfill) is the private sector offering a lower cost alternative (either a new in-district landfill or 'export' to an out-of-district landfill). The reality of this risk is highlighted by the recently reported predicament in which the South Taranaki District Council finds itself. It is developing a new regional landfill (Eltham Landfill) to serve the region and, as development is progressing, a private company (operator of Bonnie Glenn Landfill) in the Rangitikei District has offered districts in the Taranaki region a competitive disposal rate, which may put the future of the new landfill at risk.

7.2.3 Option 3: Extend Green Island Landfill and Develop Smooth Hill Landfill

The option of 'extend GILF', involves securing resource consents for an extension within the designated landfill area over the sewer, as described in the Landfill Feasibility Report, and developing and operating this extension until SHLF is available. The length of time that the extended GILF is required to be operated for is largely dependent on the consenting and procurement process for SHLF. It may be that the Council consents an extended GILF but is able to secure a long-term waste disposal solution (eg Smooth Hill Landfill) prior to these consents being required.

7.2.4 Risk Mitigation Measures

Under all options, the Council should take steps to conserve the airspace for Green Island Landfill to ensure that the landfill has capacity until 2023, when consents expire, or longer. This includes considering:

- Maximise diversion away from Green Island Landfill
- Minimise landfill cover
- Manage structural fill tightly
- Investigate alternative capping option that uses less volume.

Key risks for options 2 and 3 are the uncertainty of securing consents for a Smooth Hill Landfill and private sector competition compromising any Council investment (for example, as in the Eltham Landfill case). To mitigate these risks, the Council should:

- Begin resource consent application work for Smooth Hill as soon as possible
- Develop a procurement strategy that keeps all options open as soon as possible and confirms if extending Green Island Landfill is the best interim option (if it is required).

7.2.5 Summary of Options

Table 7-1 illustrates the relative costs and risks of the main waste disposal scenarios for Dunedin. From this table it is apparent that there are three immediate actions for the Council to consider:

1. Interventions to preserve Green Island Landfill airspace for waste (ie maximise life)
2. Pursue resource consent work on Smooth Hill Landfill
3. Develop a procurement strategy for waste disposal for Dunedin.

Table 7-1: Waste Disposal Options for Dunedin City

No	Option[1]	Waste Disposal Option and Annual Costs[2]			Consenting[5]	Negative Risk	Benefit	Risk Mitigation
		To 2023	2023-2028	2028-2063+				
1	GILF closure + 'export'	Develop, operate & close GILF ~$6M/year[2]	'export' to more than 1 site ~$15M/year, TBC[4]		Close GILF: ~$200k-$700k	• Reputation risk associated with reliance on independent operator • GILF full before export contract in place • No ready LF access for emergency waste • Disposal service limitations eg service withdrawn • Private sector offers low cost alternative • Private lower standard LF(s) undercuts export charge • Iwi concern about export • High export cost compromises contract eg minimum quantity vs rates	• Remove DCC risk in consenting SH • Remove DCC risk in funding operation • DCC has reduced liability for disposal site(s) • DCC potentially secures low cost export contracts	• To preserve GILF capacity to 2023 • To secure export contracts
2	GILF closure (+ 'export') + SHLF	Develop, operate & close GILF ~$6M/year[2]	'export' to more than one site until SHLF available ~$15M/year, TBC[4]	Develop, operate & close SHLF ~$9M/year[3]	Close GILF: ~$200k-$700k Develop SHLF: ~$800k - $1.3M	• GILF full before export contract in place • High export cost compromises contract eg minimum quantity vs rates • SHLF costs not recovered by operational income • Private sector offers low cost alternative • DCC retains liability for SH site • Iwi concern about export	• DCC secures low cost export contracts	• To preserve GILF capacity to 2023 • To secure export contracts • To secure consents/confirm feasibility of SHLF • To develop procurement strategy to minimise commercial risk with SHLF
3	Extend GILF + SHLF	Develop, operate & close GILF (extended) ~$7M/year[2]		Develop, operate & close SHLF ~$9M/year[3]	Extend GILF: ~$600k-$1M Close GILF: ~$200k-$700k Develop SHLF: ~$800k - $1.3M	• GI full before 2023 • Resource consents not granted for GI extension • SHLF costs not recovered by operational income • Private sector offers low cost alternative • Private lower standard LF(s) undercuts DCC • DCC retains liability for SHLF site	• Ready LF access for emergency waste • Greater control of gate fee • Greater control of general waste & special waste	• To preserve GILF capacity to 2028 • To secure consents/confirm feasibility of GILF extension • To secure consents/confirm feasibility of SHLF • To develop procurement strategy to minimise commercial risk with SHLF

Notes:

1 Green Island Landfill (GILF), Smooth Hill Landfill (SHLF).

2 Indicative disposal costs are provided for the purpose of comparing waste disposal option. They are based on disposal of 75,000 t/year general waste, 12,000 t/year special waste and 25,000 t/year cleanfill. They include transport costs and landfill gate charges but exclude waste levy and ETS charges (currently these collectively equate to $33/tonne, or about $3M/year).

3 GILF and SHLF gate charges are based on outputs from the Full Cost Accounting Modelling carried out by Stantec in the Landfill Feasibility Report. Annual GILF costs are derived from total landfill cost (Table 4-5 for 'consented profile' based on 4 years operation for Option 1 and 2, Table 4-8 for 'southern extension' based on 9 years operation for Option 3). Annual GILF cost = Total GILF cost / 4 or 9 years, rounded to nearest million. Total GILF cost = (prorated operations and operational contingency based on total waste in 4 or 9 years / total waste for model) plus other landfill costs (ie sunk costs, base costs, development, closure, capital contingency) less existing aftercare fund. SHLF costs based on $88/tonne for general waste (75,000 tpa), 133% of general waste rate for special waste (12,000 tpa) and 5% of general waste rate for cleanfill (25,000 tpa).

4 Landfill gate charges for 'export' provide a perspective on costs based on publicly available information, where available or assumed rates. DCC may or may not be able to secure contracts and if secured, the rates may be more or less than the adopted rates.

5 Consenting costs include legal, planning and regulatory costs, with planning costs covering planning, science assessments (eg hydrogeology, ecology) and engineering (survey, geotech, preliminary design) but excluding stakeholder and community consultation.

8. Summary of Conclusions

Key conclusions from the landfill feasibility assessment to date are:

- Council should urgently consider implementing robust methods to minimise waste quantities disposed to Green Island Landfill to preserve landfill airspace for waste (ie maximise landfill life).
- The Green Island Landfill site will reach capacity around the time the current resource consents expire (2023) with current waste quantities. There are operational issues that need addressing (eg odour as well as management and monitoring associated with wet weather events), however landfill closure will largely mitigate these.
- The Green Island Landfill site could be extended to the south to accommodate current waste quantities to 2028, with landfill costs about $1M/year more than the current operation if development costs are spread over the next 9 years. However, it is likely to be costly ($0.6M to $1M) and technically challenging to consent. Challenges include ability to implement operational changes to mitigate existing issues for continued operation, proximity to neighbours, inability to meet Class 1 landfill standards, and being located in a low lying area adjacent to an estuary of significant cultural and conservation value. Additional characterisation and monitoring would need to be undertaken to support any consent application.
- The Smooth Hill site has capacity to accommodate current waste quantities to 2063 and beyond, with landfill costs about $3M/year more than the current operation. No fatal flaws were identified during the landfill feasibility assessment. However additional characterisation and monitoring would need to be undertaken to support any consent application, including hydrogeology, ecology, water quality, bird strike hazard, and geotechnical assessments. Preliminary design is also required to confirm assumptions used to develop landfill costs (including management of leachate, landfill gas and stormwater, power supply and access from State Highway to the site). Consent costs are likely to be slightly higher than consenting Green Island for an extended period of operation (ie $0.8M to $1.3M).
- If the Council wish to progress Smooth Hill, there is a need to urgently pursue the resource consent work, including associated investigations and assessments. However, even if this process starts now, there is likely to be a shortfall from when the existing consents for the Green Island Landfill expire and Smooth Hill Landfill being operational.
- Options available to the Council to manage the shortfall are to obtain consents to extend Green Island Landfill, secure contracts to dispose of waste elsewhere (ie ‘export’) or rely on the private sector (however this option is not in keeping with the Waste Futures 2023 Project’s investment objectives). Given the costs and uncertainties of reconsenting an extended Green Island Landfill and the unknown total ‘export’ cost that the Council may be able to secure, it is prudent for the Council to urgently develop a procurement strategy for waste disposal for Dunedin to better characterise options. Such a strategy could also be used to minimise commercial risks associated with developing Smooth Hill or to work with other Councils with a view to Smooth Hill being a regional facility.