Appendix 6: Geotechnical Factual Report





Dunedin City Council

Waste Futures Phase 2, Workstream 3 Smooth Hill Landfill Smooth Hill Consenting - Geotechnical Factual Report



August 2020 (updated May 2021

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1. Introduction

1.1 Project background

The Dunedin City Council (Council) collects residential waste and manages the disposal of both residential and <u>most commercial waste generated from</u> the Dunedin City area and environs.

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

The Council commenced <u>siting studies</u> for a new landfill location in the late 1980's and early 1990's and selected the Smooth Hill site in south-west Dunedin, shown in Figure 1 below, as the preferred <u>location</u>. At that time, the site was designated in the Dunedin District Plan, signalling and enabling its future use as a landfill site. The Council also secured an agreement with the <u>then current-landowner</u>, Fulton Hogan Ltd, to purchase the land <u>and the Council took</u> <u>ownership of the land in September 2020</u>. Since the 1990's the Council extended the life of Green Island Landfill and further development of the Smooth Hill site has been on hold.



Figure 1 Site location (Updated May 2021)

As part of the Waste Future's Project, the Council has reconfirmed the technical suitability of Smooth Hill for the disposal of waste <u>and</u>. <u>The Council has</u> proceeded to develop a concept design for the landfill and associated road upgrades. The concept design (the subject of this report) for the landfill has been developed by GHD Ltd (GHD) with technical input from Boffa Miskell and represents contemporary good practice landfill design that meets adopted New Zealand landfill design standards.

The Council lodged applications for resource consents for Smooth Hill landfill with both the Otago Regional Council and Dunedin City Council in August 2020. The applications included an earlier version of this report. This report has now been revised to reflect both the changes in the design and in response to s92 questions.

While being similar in many ways to the previous design, the key changes are summarised as follows:

- The landfill size has been reduced. The revised landfill lies within the footprint of Stage 1
 and Stage 2 of the original design, with the western Stages 3, 4 and 5 no longer included
 (for comparison see Drawings 12506381-01-C102 and C104). In overall terms:
 - the footprint of the landfill is reduced from 44.5 ha to 18.6 ha
 - landfill (gross) capacity is reduced from approximately 7.9-million m³ to 3.3-million m³
 - net waste capacity is reduced from 6.2-million m³ to 2.9-million m³
 - the predicted landfill life has reduced from 55-years to 40-years
- Practical adjustments to the general construction of the landfill, including:
 - Landfill staging and construction sequencing, to a more typical 'bottom-up' filling methodology, which improves the intermediate and overall landform stability of the new design (Drawing 12506381-01-C210 to C214)
 - Leachate containment and collection systems adjusted to reflect the revised construction sequencing
 - Construction phase systems for stormwater diversion, treatment and control
 - Relocation of the attenuation basin to the west of the revised landfill footprint rather than immediately downstream of the landfill toe.

1.2 **Project Overview**

The proposal includes the following key components:

- The staged construction, operation, and aftercare of a Class 1 landfill within the existing designated site to accept municipal solid waste. The landfill will have a capacity of approximately 6 million cubic metres (equivalent to 5 million tonnes), and expected life (at current Dunedin disposal rates) of approximately 55 years. The landfill will receive waste only from commercial waste companies or bulk loads-
- Infrastructure to safely collect, manage, and dispose of landfill leachate, gas, groundwater, and stormwater to avoid consequential adverse effects on the receiving environment.
- Facilities supporting the operation of the landfill, including staff and maintenance facilities.
- Environmental monitoring systems.
- Landscape and ecological mitigation, including planting-
- Upgrades to McLaren Gully Road including its intersection with State Highway 1, and Big Stone Road, to facilitate vehicle access to the site.

The proposed Smooth Hill landfill site is located approximately 23 km southwest of Dunedin City. The boundary of the proposed site is shown in Figure 2. The waste facility itself will operate within these boundaries.



Figure 2 Site Environs (Updated May 2021)

1.3 Scope of geotechnical investigation

This report presents the factual results of the geotechnical investigation along with published and Client supplied geotechnical data related to the proposed waste site development. The purpose of the investigation was to assess the subsurface geotechnical and hydrogeological conditions at the proposed Smooth Hill landfill site. The hydrogeology is reported separately.

This information in this report has been used to inform and support the landfill design and the Assessment of Environmental Effects (AEE) and resource consent applications.

2.1 Site description

The proposed site is bordered by Big Stone Road along its southern boundary. Access from State Highway 1 (SH1) is currently via McLaren Gully Road. The proposed site is bounded to the north and west by forestry land, and to the northeast by farmland. Figure 3 provides a closer view of the proposed site.



Figure 3 Proposed landfill site (base image sourced from Google Maps) (Updated May 2021)

The proposed site is located in a south to north trending gully, which is fed by smaller gullies from the east, west and south. The flow direction for water exiting the gully is from the south to the north. The slopes around the southern half of the site form a natural "amphitheatre" shape, which is bisected by a larger central ridge, and a smaller ridge in the south-western corner – both trending south to north.

The site was, until recently, covered by a Radiata Pine plantation, the site cover is now a mixture of scrub, bare earth, forestry waste and replanted pine. A number of existing forestry tracks provide access around the site.

The ground is typically wet and boggy in the base of the gullies where there is standing or seeping water.

2.2 Local geology

2.2.1 Published geology

A review of the available geological maps (Bishop [1994], and Bishop and Turnbull [1996]) covering the site shows that the main lithology expected to be encountered is the Henley Breccia unit. Although not shown on the geological map, it is expected that the Henley Breccia unit is overlain by several metres of loess deposits, and locally by alluvium and colluvium.





Figure 4 Excerpt from 1:50,000 Geology of the Milton Area (Bishop, 1994)

2.2.2 Expected lithologies

The basement rock in the proposed site area is expected to be Caples Terrane schist, textural zone IIIA (map symbol *IIIA*), which comprises well foliated quartzofeldspathic schist with prominent quartz veins. The schist was metamorphosed in the Jurassic period, and the metamorphic grade (textural zone) increases northward.

The schist basement is overlain unconformably by the Upper Cretaceous Henley Breccia (map symbol he) – a terrestrial sequence of piedmont breccias and conglomerates up to 1000 m thick. The breccia was derived from a high-standing schist block immediately west of the present-day Titri Fault. Henley Breccia was tilted before the formation of the Otago peneplain, which was cut across both it and the schist basement prior to the deposition of a relatively thin set of transgressive Upper Cretaceous to Tertiary terrestrial and shallow marine sediments (Bishop & Turnbull, 1996).

Taratu Formation (map symbol *ta*) is mapped as outcropping along the tops of several ridgelines to the south and east of the site, <u>but not on this site</u>. The Taratu Formation unconformably overlies the Henley Breccia and comprises yellow quartz sand and pebble conglomerate, with minor clay, carbonaceous siltstone and lignite, and limonite and silica cemented quartz conglomerate.

Bishop (1994), and Bishop & Turnbull (1996) have not mapped surficial materials such as loess, weathered bedrock or organic soils. However, the following description of loess soils in Otago is provided in Bishop & Turnbull (1996): "*In the Dunedin map area, such unmapped surficial materials are dominated by loess which, where remobilised, grades into loess colluvium… Loess forms a widespread blanket across most of eastern Otago, particularly near the coast… Loess typically forms a yellow-brown, massive layer or series of layers, mixed at the base with weathered bedrock and overlain by darker organic-rich soil. Columnar jointing and shrinkage cracks are common. Where loess mantles slopes, down-slope creep and alluvial processes have incorporated clasts of weathered underlying material, upslope material, and organic matter to form 'loess colluvium'.*"

Loess deposits mantle much of the site, being present predominantly on the slopes and ridges of the site, with loess colluvium predominantly in the valley bases. The thickness of loess varies.

In the bottom of the valleys, there is some alluvial material.

2.2.3 Nearby faults

There are a number of mapped faults in the Otago region. The known faults within close proximity to the landfill site are listed in Table 1. Fault data has been gathered from the GNS Active Faults Database website, and from Stirling, McVerry, et al (2012).

Active faults are defined by GNS and NZS 1170:2004 as faults with recurrence periods of less than 2000 years. On the basis of this definition the closest known active fault to the site is the Alpine Fault at a distance of approximately 240 km to the north-west, which is also classified as <u>a</u> 'Major Fault' by NZS 1170:2004.

Whilst the Alpine Fault is the closest "active fault" there has been recent research on the recurrence intervals of the Titri and Akatore faults. This new data will be included in the seismic hazard assessment of the site.

Fault Name	Approximate Distance from Site	Maximum Likely Magnitude, Mw	Average Recurrence Interval (years)
Titri Fault <u>*</u>	3 km NW	unknown	unknown
Akatore Fault	6 km SE	7.4	3,480
Maungatua Fault	10 km NW	unknown	unknown
North Taieri Fault	13 km N	unknown	unknown
Hyde Fault	47 km NNW	7.2	12,810
Billy's Ridge Fault	47 km NNE	7.1	9,470
Taieri Ridge Fault	50 km NNE	7.1	9,750
Fault #8894 (GNS)	50 km SW	unknown	unknown
Tuapeka Fault	56 km NW	unknown	unknown
Clifton Fault	56 km SW	unknown	5,000 - 10,000
Logan Burn Fault	60 km NW	unknown	3,500 - 5,000
Blue Mountain Fault	70 km W	7.3	12,690
Long Valley Fault	75 km NW	6.8	2,810
Gimmerburn Fault Zone	76 km N	7.2	5,850
Old Man Fault	85 km NW	7.4	362,150
Spylaw Fault	89 km W	7.3	12,440
Alpine Fault	240 km NW	8.1	340
* - Stirling et al 2012			

Table 1 Summary of known faults

2.3 Historic mining

Anecdotal evidence provided by a local resident indicates historic mining may have occurred in this area of Otago. A review of <u>publicly</u> available data with regard to historic mining has been carried out. The following sources were consulted:

- Regional geological maps (Benson [1968], McKellar [1990], Bishop [1994], and Bishop & Turnbull [1996]
- Historic aerial photographs, retrieved from the Retrolens historic imagery resource
- Mindat.org: <u>www.mindat.org</u>
- NZ Mine Plans website: <u>https://mineplans.nzpam.govt.nz</u>
- Appendices to the Journals of the House of Representatives, 1890 Session I, Section C: <u>https://atojs.natlib.govt.nz/cgi-bin/atojs?a=d&d=AJHR1890-I&e=10--1-0</u>

The sources consulted suggest that the geological unit containing a potential valuable commodity in this part of Otago is the Taratu Formation (also known as Taratu Coal Measure on older geological maps). The main commodity mined in the region appears to be coal/lignite.-In the vicinity of the proposed landfill, the Taratu Formation only occurs as a relatively thin layer at the top of the higher ridges on the eastern edge of the designation area and away from the proposed landfill footprint or appurtenant structures. Outcrops and boreholes associated with the Taratu Formation at the site do not show any lignite layers within these Taratu materials. It is considered highly unlikely that mining would have occurred within the designation area.

The only know abstraction on the site is a small borrow pit associated with the Taratu Formation deposits on the eastern edge of the designation area. Fulton Hogan have used this as a borrow site for gravel used to form logging tracks in the site vicinity.

2.4 **Previous investigations**

GHD is not aware of any previous investigations at the proposed landfill site, though an existing piezometer was found adjacent to the north-eastern site entrance.

3. Summary of Investigations

3.1 General

GHD carried out two phases of geotechnical investigations between 27 May to 17 June 2019 (Phase I), and between 24 October to 7 November 2019 (Phase II). McNeill Drilling was the drilling subcontractor used for the first phase, and Speight Drilling Ltd was the drilling subcontractor used for the second phase. The investigations comprised machine boreholes and test pits. All investigation works were carried out under the supervision of a GHD Engineering Geologist.

The second phase of investigations was designed to address gaps in the ground model data that were identified following the end of the first phase. Due to restrictions in place for the second phase (surveys of protected native lizards, and nesting native falcons), there were areas that could not be accessed for investigation and as a consequence a number of planned borehole and test pits were either re-located or not completed. These areas have since been excluded from the re-designed landfill footprint and therefore the requirement to undertake additional investigation in these areas is removed.

Shallow test pitting and sampling to confirm the distribution of loess and its properties will be part of the detailed design investigation, should a mineral liner be part of the liner system.

Materials recovered from the investigation were logged following the methods and procedures in the New Zealand Geotechnical Society's (NZGS) "*Guideline for the Field Description of Soil and Rock for Engineering Purposes*" (2005).

Shear vane testing was undertaken in accordance with NZGS's "*Guideline for Hand Held Shear Vane Test*" (2001). The peak and remoulded shear strength values shown on the attached logs (Appendix B) represent dial readings off the vane, adjusted using the BS 1377 calibration.

An investigation location plan is provided in Appendix A.

3.1.1 Logging Taratu Formation vs Henley Breccia

The Taratu Formation has not been previously mapped within the designated landfill area. It is known to occur along ridges south-east of the site. However, the presence of rounded quartz conglomerate in the recovererd core on site was interpreted in early versions of this report as the presence of the Taratu Formation on the ridges at the site. Upon further review, it is uncertain if what had earlier been logged as Taratu is actually Taratu, or in fact part of the Henley Breccia. On the Dunedin South map, the Henley Breccia does refer to quartz conglomerates which would fit with the logged cores. Given that the geological map does not include Taratu Formation on the ridge tops in the vicinity of the site, this material has been reclafssified as Henley Breccia.

Whilst of interest from a geological point of view, the geotechnical performance of the two units is very similar. For this reason, whether the unit is Taratu Formation or Henley Breccia is academic to the design of the landfill.

3.2 Machine boreholes

McNeill Drilling drilled ten machine boreholes (BH01 to BH10) between 27 May and 16 June 2019, using a truck mounted UDR600 rig. Speight Drilling Ltd drilled five machine boreholes (BH201 to BH203, BH209 and BH211) between 24 October and 7 November 2019, using a tracked, Maruka-mounted rig.

All boreholes were drilled from ground surface, with no hand or hydro-excavation carried out.

Core samples were retrieved by rotary drilling methods using PQ (96 mm diameter) triple tube drilling. BH201 and BH202 were cored to approximately 10.0 m <u>below ground level (bgl)</u>, and then wash drilled (no core recovered) to their termination depth.

Where practical, vane shear strengths were measured in the end of the core barrel with a hand held shear vane, using the techniques described in the NZGS guideline.

Table 2 summarises the details of the investigation machine boreholes. Borehole logs are provided in Appendix B.

The target depth of the boreholes was set during the concept phase and designed to provide a broad understanding of the geology and the intended structure, such that a ground model could be developed. The target depth of the test pits was to establish the depth to rock.

Test ID	Site Location	Commenced	Completed	Total Depth (m bgl)	Termination Reason	Piezometer
BH01	Attenuation Basin Foundation	6/06/2019	6/06/2019	15.0	Target Depth	Yes, x 2
BH02	Toe Bund Foundation	27/05/2019	28/05/2019	15.0	Target Depth	Yes, x 2
BH03	Toe Bund Foundation	28/05/2019	29/05/2019	20.0	Target Depth	Yes, x 2
BH04	Toe Bund Foundation	6/06/2019	7/06/2019	15.0	Target Depth	Yes, x 2
BH05	Central Ridge	29/05/2019	30/05/2019	30.0	Target Depth	Yes, x 2
BH06	Southwest Ridge	13/06/2019	14/06/2019	30.0	Target Depth	No
BH07	Central Ridge	30/05/2019	4/06/2019	20.0	Target Depth	Yes, x 2
BH08	Southeast Perimeter	11/06/2019	11/06/2019	20.0	Target Depth	No
BH09	Western Perimeter	12/06/2019	12/06/2019	16.5	Target Depth	Yes, x 1
BH10	Northeast Ridge	04/06/2019	05/06/2019	20.0	Target Depth	Yes, x 2
BH201	Southern Perimeter	28/10/2019	01/11/2019	61.0	Target Depth	Yes, x 1
BH202	Southern Perimeter	2/11/2019	4/11/2019	60.6	Target Depth	Yes, x 1
BH203	Southwest Perimeter	7/11/2019	7/11/2019	19.7	Target Depth	No
BH204	Western Ridge	Not completed				
BH209	Western Perimeter	24/10/2019	24/10/2019	10.0	Target Depth	No
BH210	Central gully base	Not completed				
BH211	Eastern Gully Base	4/11/2019	6/11/2019	25.2	Target Depth	Yes, x2

Table 2 Summary of machine boreholes

3.3 Piezometers

Piezometers were installed in selected boreholes to allow for permeability testing and follow-up groundwater measurements.

Groundwater was not encountered in BH06, BH08, BH203 or BH209 - therefore, no piezometers were installed.

Piezometers were typically nested, with two 32 mm PVC pipes installed in each borehole (except BH09, BH201 and BH202). The pipe was slotted over the targeted screened zone and surrounded by a coarse sand pack. Bentonite seals were placed above and below each screened zone. For borehole logs where double piezometers are installed (a and b) these are presented as a single log showing the double piezometer installation.

The piezometer details were provided by GHD hydrogeologists to suit the conditions encountered in each borehole. Table 3 summarises the piezometer details.

Borehole ID	Piezometer ID	Screened From (m bgl)	Screened To (m bgl)
BH01	BH01a	2.0	4.0
	BH01b	8.0	9.0
BH02	BH02a	3.0	5.0
	BH02b	7.0	9.0
BH03	BH03a	8.3	10.3
	BH03b	13.0	15.0
BH04	BH04a	4.5	6.5
	BH04b	12.0	16.0
BH05	BH05a	14.0	16.0
	BH05b	19.0	22.0
BH07	BH07a	11.5	14.5
	BH07b	16.8	19.8
BH09	BH09a	14.5	16.5
BH10	BH10a	13.5	15.5
	BH10b	18.0	20.0
BH201	BH201	54.0	60.0
BH202	BH202	54.0	60.0
BH211	BH211a	8.5	11.5
	BH211b	22.0	25.0

Table 3 Summary of piezometer details

3.4 Test pits

Under the supervision of GHD, Fulton Hogan excavated eleven test pits between 27 May 2019 and 12 June 2019, using a 22 tonne excavator.

Where practical and safe, vane shear strengths were measured in the base and sides of the excavation with a hand held shear vane, using the techniques described in the NZGS guideline.

Table 4 summarises the details of the test pits. Test pit logs are provided in Appendix B.

Table 4 Test pit summary

Test Pit ID	Site Location	Excavation Date	Termination Depth (m bgl)	Termination Reason	Materials Encountered
TP01	Manuka gully (stockpile area)	12/06/2019	2.5	Target Depth	Alluvium, HW rock, siltstone
TP02	Manuka gully (stockpile area)	12/06/2019	2.6	Target Depth	Colluvium, alluvium, buried topsoil, siltstone
TP03	Manuka gully (stockpile area)	12/06/2019	2.0	Target Depth	Alluvium, siltstone
TP05	Southwest gully base	13/06/2019	3.3	Target Depth	Colluvium, HW rock, siltstone
TP06	Gully east of central ridge	13/06/2019	2.5	Target Depth	Alluvium, siltstone
TP07	Southwest gully base	28/05/2019	2.5	Target Depth	Loess, siltstone, breccia
TP08	Gully between southern ridges	28/05/2019	4.5	End of reach	Fill, buried topsoil, loess
TP09	Southeast gully outflow	13/06/2019	3.0	Target Depth	Slip debris, buried topsoil, alluvium, sandstone
TP10	Future laydown area	10/06/2019	3.6	Target Depth	Loess, HW siltstone
TP11	Future laydown area	10/06/2019	3.8	Target Depth	Loess, HW siltstone
TP12	Future laydown area	10/06/2019	4.4	Target Depth	Fill, buried topsoil, loess, HW siltstone

*Note: TP04 was deleted from the field programme

3.5 Bulk samples

Bulk samples of loess and completely weathered (CW) rock were collected from shallow test pits on 7 and 13 November 2019. The shallow test pits were excavated by Fulton Hogan, with a 20 tonne excavator. The bulk sample details are summarised in Table 5.

Bulk Sample ID	Sample Date	Sample Depth	Sampled Material
BS01	7/11/2019	0.5 m bgl	Loess
BS02	7/11/2019	1.0 m bgl	Loess / CW rock
BS03	7/11/2019	0.7 m bgl	Loess
BS04	7/11/2019	1.5 m bgl	Loess / CW rock
BS05	13/11/2019	0.6 m bgl	Loess
BS06	13/11/2019	1.0 m bgl	Loess / CW rock
BS07	13/11/2019	0.5 m bgl	Loess
BS08	13/11/2019	0.6 m bgl	Loess
BS09	13/11/2019	1.2 m bgl	Loess / CW rock
BS10	13/11/2019	0.7 m bgl	Loess
BS11	13/11/2019	1.3 m bgl	Loess
BS12	13/11/2019	0.4 m bgl	Loess
BS13	13/11/2019	1.2 m bgl	Loess
BS14	13/11/2019	0.5 m bgl	Loess
BS15	13/11/2019	1.1 m bgl	Loess / CW rock

Table 5 Bulk sample summary

3.6 Groundwater

To monitor whether the groundwater had returned to a static level after drilling, manual groundwater measurements were taken on several occasions during the field investigation programme. This was because, groundwater levels noted during or immediately after drilling are typically in an elevated state due to the use of water during the drilling process, and therefore may not represent a static groundwater level. Groundwater levels may also fluctuate seasonally.

At the completion of drilling BH01, prior to piezometer installation, the drillers observed artesian groundwater, in that groundwater was flowing out of the top of the borehole; the subsequent level measured in <u>the shallow piezometer in BH01a</u> was also above ground level. However, since installation, the integrity of the shallow piezometer (BH01a) has been compromised and it is no longer possible to record a groundwater level, but groundwater can be observed leaking from around the edge of the installation indicating that artesian groundwater is present.

BH201 and BH202 were wash drilled to approximately 60 m to ensure interception of the groundwater table along the southern boundary.

An existing piezometer (comprising a single 50 mm PVC pipe, in a 100 mm diameter borehole) was discovered adjacent to the northeast site access. No information about this piezometer (drill date, target, etc.) is available. The base of this piezometer was measured at 42.50 m bgl.

In updating this report in May 2021, it has been decided that the groundwater level data is presented in the Groundwater Report¹ (GHD, 2021).

3.7 Investigation coordinates

Positions for machine boreholes and test pits were recorded by Woods Surveying. Coordinates are presented in the North Taieri Circuit (2000) projection, and elevation <u>Reduced Levels (RL)</u> are presented in terms of New Zealand Vertical Datum (2016).

¹ GHD, 2021, Smooth Hill Landfill Consenting – Groundwater Report

BH06, BH08 and all test pits were picked up with a cluster of points around the pads. The coordinates for the most central pickup point haves been selected to represent the test location. These points are marked with an asterisk (*) in the table below.

TP05, TP07, TP08, and all of the Phase II investigations have not yet been surveyed. Coordinates for these test locations have been estimated from Google Earth and are marked with a double asterisk (**) in the table below. Elevations for these points have been estimated from the Stantec contour map presented in Appendix A.

Table 6 summarises the position coordinates for all test locations.

Table 6 Summary of test location positions

Test Location ID	Easting	Northing	Elevation (m RL)
BH01	396465.49	788214.52	96.01
BH02	396358.59	788022.89	97.41
BH03	396428.38	787998.34	107.48
BH04	396563.60	788063.75	108.15
BH05	396459.76	787862.12	129.50
BH06	396168.25*	787593.98*	149.75*
BH07	396493.65	787671.87	139.73
BH08	396809.71*	787700.67*	143.89*
BH09	395951.84	788050.36	132.80
BH10	396788.26	788118.50	139.07
BH201	396596**	787540**	144**
BH202	396181**	787498**	144**
BH203	395779**	787672**	182**
BH209	395775**	788148**	132**
BH211	396598**	787965**	107**
TP01	395988.85	788077.23	121.20
TP02	396103.50	788056.91	110.40
TP03	396262.16	788048.16	102.61
TP05	396281**	787868**	105**
TP06	396585.70	787800.45	108.24
TP07	396182**	787790**	120**
TP08	396303**	787682**	115**
TP09	396577.97	787947.86	101.04
TP10	396820.11	788079.25	140.74
TP11	396907.03	788032.98	141.24
TP12	396956.93	787986.46	142.28
BS01 / BS02	396149**	787571**	150**
BS03 / BS04	396202**	787994**	135**
BS05 / BS06	396537**	787504**	152**
BS07	396500**	787616**	141**
BS08 / BS09	396490**	787771**	130**
BS10 / BS11	396441**	787922**	119**
BS12 / BS13	396382**	787582**	132**
BS14 / BS15	396366**	787738**	120**

3.8 Laboratory testing

3.8.1 Phase I test schedule

Selected samples obtained from Phase I of the geotechnical investigation were tested at the IANZ accredited Central Testing Services laboratory in Alexandra. Table 7 summarises the laboratory testing programme undertaken.



1



3.8.2 Phase II test schedule

On completion of Phase I of the geotechnical investigation a further suite of samples were tested by Central Testing Services in Alexandra. Two suites of lab testing were undertaken with the following purposes:

- To determine the suitability of the Loess soils for either lime or bentonite stabilisation as a method of reducing <u>erodibility</u>/ dispersivity. Eight (8) bulk samples were combined and divided into four sub-samples. The four sub-samples were then tested as outlined in Table 8.
- To determine suitability of CW-HW Henley Breccia Soils for use as engineered fill beneath the landfill liner. Two samples were tested as outlined in Table 9.

Sample Source	Sub-sample Number	Atterberg Limits - NZS 4402:1986, Test 2.2, 2.3 & 2.4	Lime demand test (NSW Transport; Roads & Maritime Services Test Method T144 (Not IANZ Accredited))	Atterberg Limits - NZS 4402:1986, Test 2.2, 2.3 & 2.4 (Stabilised Soil)	NZ Standard Compaction - NZS 4402:1986, Test 4.1.1	Shear Strength – Shear Vane – NZGS 2001	Pinhole Dispersion and Crumb Test - ASTM D4647 & ASTM
BS01 (0.5m) BS03 (0.7m)	Sub-sample #1	х	x	X (Lime Stabilised – 1 day curing)	х	х	х
BS07 (0.5m) BS08 (0.6m)	Sub-sample #2	x	x	X (Lime Stabilised – 7 day curing)	x	х	x
BS10 (0.7m) BS11 (1.3m)	Sub-sample #3	х		X (Bentonite Stabilised – 1 day curing)	х	х	x
BS12 (0.4m) BS13 (1.2m)	Sub-sample #4	х		X (Bentonite Stabilised- 7 day curing)	х	х	х

Table 8 Summary of geotechnical laboratory testing for stabilised soils.

Table 9 Summary of geotechnical laboratory testing for engineered fill

Sample Source	Depth From (m bgl)	Depth To (m bgl)	Atterberg Limits - NZS 4402:1986, Test 2.2, 2.3 & 2.4	NZ Standard Compaction - NZS 4402:1986, Test 4.1.1	Unconfined Compressive Strength of Soil, NZS 4402:1986: Test 6.3.1
BH05	2.7	7.2	Х	Х	Х
BH10	2.4	7.0	Х	Х	Х

3.8.3 Phase III test schedule

A third round of laboratory testing will be undertaken on the performance of the loess, should a mineral liner be included in the detailed design of the liner system. This will require fresh samples to be taken of the loess.

3.8.3<u>3.8.4</u> Phase I test results

Table 10 to Table 15 summarise the results of the laboratory testing outlined in Section 3.8.1. Detailed laboratory test results are presented in Appendix C.

Table 10 Summary of particle size distribution test results (NZS 4402:1986,Test 2.8.1 and 2.8.4)

Sample Source TP10		Percent Passing (%)									
Sample Source	Geological Unit	Gravel (2 to 60 mm)	Sand (0.06 to 2 mm)	Silt (0.002 to 0.06 mm)	Clay (<0.002 mm)						
TP10	Loess	6	13	72	9						
BH05/BH07	Loess	1	10	60	29						

Table 11 Summary of Atterberg limit test results (NZS 4402:1986, Test 2.1,2.2, 2.3 and 2.4)

Sample Source	Geological Unit	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
TP10	Loess	15.5	39	28	11
BH05/BH07	Loess	23.6	42	23	19

Table 12 Summary of NZ standard compaction test results (NZS 4402:1986,Test 2.1 and 4.1.1)

Sample Source	Geological Unit	Water Content – As Received (%)	Maximum Dry Density (t/m3)	Optimum Water Content (%)
TP10	Loess	15.5	1.71	16.0
BH05/BH07	Loess	23.6	1.70	17.5

Table 13 Summary of pinhole dispersion test results (ASTM D4647-13e1)

Sample Source	Geological Unit	Elapsed Time (min)	Flow Rate (ml/s)	Outflow Colour	Hole Diameter Pre-test	Hole Diameter Post-test	Classification
TP10	Loess	1	0.25	Slightly dark	1.0 mm	~2.0 mm	Dispersive
		5	0.27	Moderately dark		(4 mm at exit)	(D)
		10	0.31	Dark			
BH05 / BH07	Loess	1	0.25	Barely visible	1.0 mm	~2.0 mm	Dispersive (D)
		5	0.27	Moderately dark			
		10	0.49	Very dark			

Sample Source	Geological Unit	Elapsed Time	Estimated Slaking	Observations	Crumb Test Classification		
		2 min	~50%	ated ngObservationsC ClaMNo colloidal cloudPMDense colloidal cloud overDMModerate colloidal cloud overDMDense colloidal cloudPMDense colloidal cloud overDMDense colloidal cloud overDMDense colloidal cloud overDDDense colloidal cloud overD	Grade 4		
TP10	Loess	1 hr	~100%	Dense colloidal cloud over	(Highly Dispersive)		
	6 hr ~10	~100%	Moderate colloidal				
		2 min	~20%	No colloidal cloud			
BH05/BH07	Loess	1 hr	~100%	Dense colloidal cloud over	Grade 4 (Highly		
		6 hr	r ~100% Dense colloidal cloud over		Dispersive)		

Table 14 Summary of crumb test results (ASTM D6572-13e2 (Method B))

Table 15 Summary of triaxial permeability test results (ASTM D5084-16a)

Sample Source	Geological Unit	Cell Pressure (kPa)	Initial Permeability (m/s)	Final Permeability (m/s)
TP10	Loess	610	2.9 x 10 ⁻⁸	3.2 x 10 ⁻⁸
TP10	Loess	727	2.7 x 10 ⁻⁸	2.8 x 10 ⁻⁸
BH05/BH07	Loess	460	1.7 x 10 ⁻⁹	2.1 x 10 ⁻⁹
BH05/BH07	Loess	527	5.6 x 10 ⁻¹⁰	5.3 x 10 ⁻¹⁰

3.8.43.8.5 Phase II test results

Table 16 to Table 20 summarise the results of the laboratory testing outlined in Section 3.8.2. Detailed laboratory test results are presented in Appendix C.

Table 16 Summary of Atterberg limit test results (Natural Soils)

Sample	Geological Unit	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index
Sub-sample #1	Loess (untreated)	25	41	25	16
Sub-sample #2	Loess (untreated)	25	41	25	16
Sub-sample #3	Loess (untreated)	25	41	25	16
Sub-sample #4	Loess (untreated)	25	41	25	16

Sample	Geological Unit	pH 0 % added Lime	pH 1 % added Lime	pH 2 % added Lime	pH 3 % added Lime	pH 4 % added Lime	pH 5 % added Lime	pH 6 % added Lime	pH 7 % added Lime
Sub sample #1	Loess (untreated)	5.12	10.15	12.12	12.42	12.46	12.49	12.48	12.42
Sub- sample #1	Loess (untreated)	5.16	10.31	12.08	12.5	12.55	12.56	12.55	12.55

Table 17 Summary of lime demand test results

Table 18 Summary of Atterberg limit test results (Henley Breccia Formation)

Sample	Geological Unit	Liquid Limit	Plastic Limit	Plasticity Index
BH05 2.7 – 7.2 m	Henley Breccia – CW Siltstone	41	25	16
BH10 2.4 – 7.0 m	Henley Breccia – CW Siltstone / Sandstone	37	23	14

Table 19 Summary of NZ standard compaction test results (Henley BrecciaFormation)

Sample Source	Geological Unit	Maximum Dry Density (t/m3)	Optimum Water Content (%)
BH05 2.7 – 7.2 m	Henley Breccia – CW Siltstone	1.76	16.0
BH10 2.4 – 7.0 m	Henley Breccia – CW Siltstone / Sandstone	1.85	14.0

Table 20 Summary of unconfined compressive strength of re-compacted samples (Henley Breccia Formation)

Sample Source	Geological Unit	Unconfined Compressive Strength (kPa)
BH05 2.7 – 7.2 m	Henley Breccia – CW Siltstone	100
BH10 2.4 – 7.0 m	Henley Breccia – CW Siltstone / Sandstone	93

4. References

The following documents have been consulted in preparation of the guideline:

- Bishop, D.G. 1994, Geology of the Milton area. Scale 1:50,000, Institute of Geological & Nuclear Sciences geological map 9. 1 sheet + 32 p, Institute of Geological & Nuclear Sciences Ltd, Lower Hutt, New Zealand
- Bishop, D.G. Turnbull, I.M. (compilers) 1996, *Geology of the Dunedin Area. Institute of Geological and Nuclear Sciences 1:250,000 geological map 21. 1 sheet + 52 p,* Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited
- GNS Active Faults Database, http://maps.gns.cri.nz/website/af/viewer.htm
- New Zealand Geotechnical Society, 2001, Guideline for Handheld Shear Vane Test
- New Zealand Geotechnical Society, 2005, *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*
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- Stirling, McVerry, et al, 2010, *National Seismic Hazard Model for New Zealand: 2010 Update*. Bulletin of the Seismological Society of America, Vol. 102, No. 4, pp. 1514-1542, August 2012

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The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of vegetation and topography. As a result, not all relevant site features and conditions may have been identified in this report.

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Appendices

Appendix A – Plans





N:\NZ\Christchurch\Projects\51\12506381\GIS\Maps\Deliverables\Geo\12506381_Z001_Geo_InvestigationLocations.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and LINZ, Stantec, esri, Otago Regional Council) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason. Data source: Aerial imagery - Stantec, LINZ & esri (); General topo - LINZ 2019; Contours - Stantec Created by jrprice

Dunedin City Council Smooth Hill Landfill Geotechnical and Hydrogeological

Job Number | 12506381 Revision Date

А 17 Aug 2020

Investigation Location Plan Figure A1

Level 3, 138 Victoria Street, PO Box 13 468, Christchurch 8141, New Zealand T 64 3 378 0900 F 64 3 378 8001 E chcmail@ghd.com W www.ghd.com

Appendix B – Borehole and Test Pit Logs and Photographs

Project : Smooth Hill Landfill Consenting Hole No. Client : Dunedin City Council Sheet Site : Smooth Hill Dam foundation Hole Length Job Number: 12506381 Scale @ A4 Commenced: 6/06/2019 Completed: 6/06/2019							0. h 4	: BI : 1 of : 15.0 : 1:50 : MF	+01 2 00m									
Easting: 396465.49Northing: 788214.52System: TAIETM2000ProcessedRL: 96.01Datum: NZVD2016Checked							: HB : JS											
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	San Type	Result	Casing	Method	E Flush Return (%)	Weathering	www. www. Strength (MPa)	TCR SCR RQD (%)	◎ ◎ Defect ∞ Spacing (mm)	Instrumentation Installation	Water level
		× × × × × × × × × × × × × × × × × × ×	0.00 - 1.20 Fine to medium gravelly SILT, trace fine to c sand, trace clay; light yellow brown & orange brown. Stif moist, low plasticity. (COLLUVIUM?). Gravel clasts comprise quartz and schist, sub angular to rounded.	oarse f, o sub	COLLUVIUM	Μ	St				PQTT				77			
	2		1.20 - 2.70 Inferred CORELOSS. Possible slip base & stream alluvium lost? Driller said it "was so soft, it was like drilling nothing". Tri pushing down with no water or rotation, but still could no retrieve core. Same for next coreloss zone at 3.0 m to 3.	ied ot .9 m.	UVIUM						Ратт				20			
	329 22 329 2		2.70 - 2.90 Silty CLAY, trace fine sand; grey & orange b Soft to firm, moist, high plasticity. (ALLUVIUM?). 2.90 - 3.00 Silty fine to coarse SAND, trace organics; gr Poorly graded. (ALLUVIUM?). Note no moisture condition or density determined and lo 3.00 - 3.90 Inferred CORELOSS. Possible alluvium loss?	rown. ey. / gged. /	ALL	Μ	S-F "				PQTT				0			
	4.	· · · · · · · · · · · · · · · · · · ·	 3.90 - 4.40 Slightly weathered, light grey fine to coarse SANDSTONE; moderately strong to strong; well indurate defects. (HENLEY BRECCIA). 4.40 - 4.80 Slightly weathered, grey SILTSTONE; very w weak; poorly indurated, no defects. 	ed, no veak to							РОТТ		SW SW		100 22			
	5		 4.80 - 5.28 Slightly weathered, light grey fine to coarse SANDSTONE; very weak to weak; poorly indurated, no defects. 5.28 - 5.38 From 5.28 m, becomes moderately strong to strong, well indurated. 5.38 - 6.00 From 5.38 m, becomes very weak to weak, p indurated. 	poorly							РДТТ		sw \$\vvvv	ם	98 80			
	0 1	· · · · · · · · · · · · · · · · · · ·	 6.00 - 6.25 From 6.00 m, becomes moderately strong to strong, well indurated. 6.25 - 6.80 From 6.25 m, becomes very weak to weak, p indurated. 6.80 - 7.80 Slightly weathered, light vellow brown & reddition of the strong strong	poorly dish	RECCIA						ΡΩΤΤ		SW SW		100 97		·	
	7	× × × × × × × × × × × × × × × × × × ×	 6.80 - 7.80 Slightly weathered, light yellow brown & redebrown SILTSTONE; very weak to weak; poorly indurated defects. From 6.9 m, becomes light grey & reddish brown. From 7.05m, becomes light grey with purple-brown layer From 7.3 m to 7.4 m, becomes fin 		HENLEY B								SW	7				
	8.3		 avers fine to medium SANDSTONE; very weak to weak poorly indurated, no defects. 8.30 - 9.00 Inferred CORELOSS in gravel layer. Gravel present on ends of core abutting this zone. Fine to medium gravel, quartz and schist clasts, sub angular to srounded. 	to sub			"				PQTT		SW		53 53			
	0.2 9.5 9.5 9.5 9.5	 	9.00 - 9.50 Slightly weathered, grey and brown SILTSTC very weak to weak; poorly indurated, no defects.	DNE;							РДТТ		SW		100			
	-		layers fine to medium SANDSTONE; very weak to weak poorly indurated, no defects.	· · · · ·		,					-		SW					
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Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL - HB PROCESSING - KB EDITS.GPJ || Library: GHD - NZGD.GLB || Date: 9 March 2021

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	б. 									αττ Ρα		SW		100 97			- - - - - - - - - - - - 11 - -
		 11.30 - 13.10 Unweathered, grey BRECCIA; moderately strong to strong; fine to medium gravel size clasts, coars sand matrix, matrix supported, well indurated, no defects Clasts are quartz and schist, angular to sub rounded, 30 mm bedding. 	y se s.)0-600							ď				97			
	28 122 0 0 1	From 11.7 m: very few		ILEY BRECCIA						aп		MU		100			
13	∇ ∇ $\overline{\nabla}$ $\overline{\nabla}$ $\overline{\nabla}$ $\overline{\nabla}$	 13.10 - 15.00 From 13.1 m, becomes weak to moderate strong, fine to coarse gravel clasts, clast supported, moderate to well indurated. 	ely derate	HE						₫				100			- 13
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Project	Smooth Hill Landfill Consenting								
Client	Dunedin City Council								
Job number	12506381	Page 1 of 3							
Borehole ID	BH01								



Box 1 of 5: 0.00 m to 4.80 m



Box 2 of 5: 4.80 m to 7.20 m

CLIENTS PEOPLE PERFORMANCE

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D

Project	Smooth Hill Landfill Consenting								
Client	Dunedin City Council								
Job number	12506381	Page 2 of 3							
Borehole ID	BH01								



Box 3 of 5: 8.20 m to 10 .20 m



Box 4 of 5: 10.20 m to 12.40 m

CLIENTS PEOPLE PERFORMANCE

GHD

Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 3 of 3						
Borehole ID	BH01							



Box 5 of 5: 12.40 m to 15.00 m (EOH)

Project : Smooth Hill Landfill Consent Client : Dunedin City Council Site : Smooth Hill Toe bund Job Number: 12506381 Commenced: 27/05/2019 Easting: 396358.59 Northing: 788022.89	ting Com Syste	Hole No.: BH02Sheet: 1 of 2Hole Length: 15.00mScale @ A4: 1:50Logged: MFsystem: TAIETM2000ProcessedProcessed: HB													
KL: 97.41 Datum: N2VD2016 Material Description (i) i <tr< td=""><td></td><td>Geological Unit</td><td>Moisture condition</td><td>Consistancy / Relative density</td><td>Number / BA</td><td>Besult</td><td>Casing</td><td>Method</td><td>Flush Return (%)</td><td>Weathering</td><td>Strength (MPa)</td><td>TCR SCR RQD (%)</td><td>Defect Spacing (mm)</td><td>Instrumentation Installation Water level</td><td></td></tr<>		Geological Unit	Moisture condition	Consistancy / Relative density	Number / BA	Besult	Casing	Method	Flush Return (%)	Weathering	Strength (MPa)	TCR SCR RQD (%)	Defect Spacing (mm)	Instrumentation Installation Water level	
0.00 - 0.50 Inferred CORELOSS 0.50 - 1.50 SILT, minor clay, trace to minor fine sand; x grey & brown. Stiff to very stiff, moist, non plastic. Cor weathered spots & small (<50mm) lenses of Fe stainti (LOESS) 1 1.50 - 2.15 Inferred CORELOSS 1 1.50 - 2.00 Fine sandy SILT, trace clay, light grey. Fin non plastic 1 1.50 - 2.00 Fine sandy SILT grey. Very loose to loose? 2 20 - 3.35 Inferred CORELOSS 1 2.00 - 3.35 Inferred CORELOSS 1 1.20 - 3.35 Inferred CORELOSS 1 1.20 - 3.35 Inferred CORELOSS 1 1.50 - 5.00 GRAVEL: light grey. Very loose to loose? 2 3.35 - 3.70 GRAVEL: light grey. Very loose to loose? 3.70 - 3.95 Fine to coarse SAND, minor to subangular quartz 4 3.70 - 3.95 Fine to coarse SAND, minor to some fine grey. Very dense' soil or extremely weathered to very 4 3.70 - 3.95 Fine to coarse SAND, minor to some fine grey. Very dense' soil or extremely weathered to very 5 SANDSTONE & SILTSTONE: very weak; bedding 300 mm thick, uniform grainsiz	light ntains Fe ng. m, moist, m, moist, tent may lastic. gravel; fine 0 to 500 DER); high ne 0 to 500 DER); high ne 0 to 500 E; weak oderately uartz & ded.	HENLEY BRECCIA HISTORIC [PRE GLACIAL] ALLUVIUM LOESS	M M S M D D	" F VL-L F " VL-L VD VSt-H		SV@1.5m 42/5 SV@2.8m SV@4.3m UTP		РАТТ РАТТ РАТТ РАТТ РАТТ РАТТ РАТТ РАТТ		/ uw uw bw uw uw dw.rb		67 50 70 63 109 100 100 100 100 100 96 96			
1 2 2 Coarse SAND matrix. Lithified solid. Notes and Comments: End of Hole @ 15.00m, Target Depth. Groundwater SWL at 0.23 mbgl (31/05/2019). Refer to explanation sheets for abbreviation and symbols	Inclinati Contrac Equipm Shear V	ion: \ ctor: I lent: I /ane	 /ertic: McNe Moun Id: Gl	al ills ted Rig EO182	g 26	Ori	ientat	ion:			Grc	pund Wa	ter Lev Reading (mbgl)	el Hole depth (mbgl)	

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	Project : Smooth Hill Landfill Consenting									ŀ	Hole No. : BH02										
	Client : Dunedin City Council Site : Smooth Hill Toe bund										Sheet : 2 of 2 Hole Length : 15.00m										
								Scale @ A4 : 1:50													
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	<u>~ _</u>		9.80 - 11.00 From 9.8 m: clast size increased to coarse	е		2	02	ΖĤ	Υ.	<u>о</u>	M	25 50 75	5	M A S S S	(%)	20 60 800 2000		-10			
	11		11.00 - 11.80 From 11.0m: less lithified, weak to mode strong	erately							PQTT		UW UW	.	100			- - - - - - - - - - - - - - - - -			
	12		11.80 - 12.40 Clast size changes back to fine to mediu gravel, more matrix dominaed, moderately strong to str From 12.35 m: matric changes from coarse sand to SI minor to some clay (looks like fine powder of crushed r Clast size increases again, moderatel 12.40 - 13.50 From 12.4 m: becomes weak to moderat strong.	m ong. LT, ock). tely	HENLEY BRECCIA						PQTT				100 100						
3D.GLB Date: 9 March 2021	14		13.50 - 15.00 From: 13.35 m: matrix changes to coars sand/silt mix, harder lithification,, moderately strong to	e strong.						22mm	PQTT		NN		100 100			- - - - - - - - - - - - - - - - - - -			
- NZG		$+ \sim$	End of Hole @ 15.00m, Target Depth.		-					÷								- -15 -			
.OGS SMOOTH HILL - HB PROCESSING - KB EDITS.GPJ Library: GHD	16																	-116			
roject: 12506381 GINT	19 - - - - - - - - - - - - - - - - - - -																	- 			
G II P	Notes a	nd Con	iments:	Inclinat	ion: \	/ertic	al	I	Or	ientat	ion:	<u> </u>	1	Gro	ound Wa	ater Leve) 	-20			
AL_LC	End of H	lole @ 15	00m, Target Depth.	Contra	ctor: I	McNe	eills							Date	e Time	Reading (mbgl)	Hole depth (mbgl)				
ENER/	Groundw	ater SW	_ at 0.23 mbgl (31/05/2019).	Equipn	nent:	Mour	nted R	ig						27/05	/19 00:00		15				
ID: GE	Refer to	explanati	on sheets for abbreviation and symbols	Shear	Vane	ld: G	EO18	26													
Report			·																		
GH

Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 1 of 3						
Borehole ID	BH02							



Box 1 of 6: 0.0 m to 3.7 m



Box 2 of 6: 3.7 m to 5.8 m

GHI

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Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 2 of 3						
Borehole ID	BH02							



Box 3 of 6: 5.8 m to 8.25 m



Box 4 of 6: 8.25 m to 10.3 m

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Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 3 of 3						
Borehole ID	BH02							



Box 5 of 6: 10.3 m to 12.55 m



Box 6 of 6: 12.55 m to 15.0 m (EOH)

Project : Smooth Hill Landfill Consenting Hole No. Client : Dunedin City Council Sheet Site : Smooth Hill Toe bund/central ridge Hole Length Job Number: 12506381 Scale @ A4 Commenced: 28/05/2019 Completed: 29/05/2019										: Bh : 1 of : 20.0 : 1:50 : MF	+03 2 00m							
E	asting 10	: 3964 7 48	128.38 Northing: 787998.34 Datum: NZVD2016	Syste	em: ˈ	TAIE	TM20	00		Pi	roces heck	sed ed		: HB . JS				
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / type	Result	Casing	Method	8 Flush Return (%)	ر Weathering	*** ***Estimated **** Strength (MPa)	TCR SCR RQD (%)	™ Defect ™ Spacing (mm)	Instrumentation Installation	Water level
		x x x x x x x x x x x x x x x x x x x	0.00 - 0.20 TOPSOIL SILT, minor clay; light brown & grey. Very stiff, moist, low plasicity; organics mixed in soil. 0.20 - 1.90 Clayey SILT, trace fine sand, trace fine grave yellow brown & light grey. Very stiff to hard, moist, high plasticity. (LOESS).	N	LOESS TOPSOIL	M	VSt-H		SV@1.5m 140/		PATT				73			
	2-		 1.90 - 2.30 SILT, minor clay, minor fine sand; ligt grey & orange brown. Very stiff to hard, dry to moist, low plastic 2.30 - 2.60 SILT, minor fine sand, trace clay; light grey a 	ight ity. and		D-M	VSt-H 'H'				РОП				100			-2
	1 1 1 1	×	orange brown. Hard, dry, non plastic. Variable Fe stainin throughout core. 2.60 - 3.20 Inferred CORELOSS	g /			"											
	3		3.20 - 3.65 Silty, coarse sandy GRAVEL; brown. 'Very lo loose', moist, well graded (completely weathered rock? n lithified?), clasts angular to sub angular; quartz & schist. Moisture content may be influenced by drilling fluid in loc materials.	pose to lever ose	-	M D	VL-L D				ΡΩΤΤ				60			19-05-2019 2vel at the end of drilling - 1 4
	5	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	coarse sand; purple. 'Dense', dry, well graded (highy weathered rock?), sub angular to angular clasts; quartz & schist. End of shift 28/05/19 at 17:16.	&							ΡΩΤΤ				27			
	0 6 26 05 57		 5.70 - 6.05 Highly weathered, reddish grey BRECCIA Bo strength undetermined. 6.05 - 6.20 Fine to coarse GRAVEL, some silt, minor fin coarse sand; purple. 'Dense', dry, well graded (highy weathered rock?), sub angular to angular clasts; guart a 	oulder; e to	ECCIA	DM	D VSt				ΡΩΤΤ		MH		100			
	7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	× 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	 schist. (6.20 - 6.60 SILT, minor fine to medium sand, trave to mill (fine gravel; grey & yellow brown. Very stiff, moist, non play 6.60 - 7.50 (800 mm coreloss assumed this unit) Fine to medium GRAVEL; white & grey. ' Very loose to lo moist, well graded. Clasts are angular to sub angular quar schist. Any matrix has been washed away. Moisture com 	inor / astic. / iose', artz & tent	HENLEY BR	M	'VL-L'				PQTT				38			
	845 79 79	× × × × × × × × × × × × × × × × × × ×	may be influenced by drilling fluid in loose materials. 7.50 - 7.90 SILT, trace fine gravel; brown, grey, light pur Hard, dry, non plastic. (Transitions from hard silt to siltstone). 7.90 - 8.45 Unweathered, dark grey SILTSTONE; weak moderately strong; no obvious small scale bedding, no de	ple. to efects.	:		"				PQTT		MU W		100 100			
9 Image: Strategy strong; no obvious small scale bedding, no defects 8.90 - 9.20 Inferred CORELOSS (loose sand layer washed away?) 9 Image: Strategy strong; no obvious small scale bedded, alternating dark grey & strong; no obvious small scale bedded, alternating dark grey & strong; no obvious small scale bedding, no defects 9 Image: Strategy strong; no obvious small scale bedded, alternating dark grey & strong; no obvious small scale bedding, no defects. Image: Strategy strong; no obvious small scale bedding, no defects. Image: Strategy strong; no obvious small scale bedding, no defects. Image: Strategy strong; no obvious small scale bedding, no defects. Image: Strategy strong; no obvious small scale bedding, no defects. Image: Strategy strong; no obvious small scale bedding; no defects. Image: Strategy strong; no obvious small scale bedding; no defects. Image: Strategy strong; no obvious small scale bedding; no defects. Image: Strategy strong; no obvious small scale bedding; no defects. Image: Strategy strong; no obvious small scale bedding; no defects. Image: Strategy strong; no obvious small scale bedding; no defects. Image: Strategy strate								n n		73 69								
No	tes a	nd Con	nments:	Inclinatio	on: \	Vertic	al		Ori	entati	ion:		1	Gro	und Wa	ter Leve		10
End of Hole @ 20.00m, Target Depth. Contractor: McNeills Groundwater SWL at 3.9 mbgl during piezo install. Equipment: Mounted R					ills ted Pi	a						Date	Time	Reading (mbgl)	Hole dept (mbgl)	th		
Refer to explanation sheets for abbreviation and symbols						ld: G	EO182	9 26										

Project : Smooth Hill Landfill Consenting Hole No. Client : Dunedin City Council Sheet Site : Smooth Hill Toe bund/central ridge Hole Length Job Number: 12506381 Scale @ A4									O . th \4	: B : 2 o : 20. : 1:5	H03 f 2 00m 0																		
E	Commenced: 28/05/2019 Completed: 29/05/2019 Logged Easting: 396428.38 Northing: 787998.34 System: TAIETM2000 Processed											: MF : HB	: MF : HB																
R	L: 10	<u>. 7</u>	48					Dat	um: N	ZVD20	16			-	1				_ c	heck	ed		: JS	JS					
RL (m)	Depth (m)		Graphic					Mat	erial I	Descrij	ption			Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sau	Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR SCR RQD (%)	Defect	Spacing (mm)	Instrumentation Installation	Water level	
		7 10.1		10.1 SAN	0 - 10 DSTC	.70 U NE; v	Inwe very	athere weak	ed, gre to wea	y fine to ak; no c	o mediu lefects.	um		-							25 50 7	» M		123	20	200000000000000000000000000000000000000			
	- - 11 - - -	11.050.9 10.	× × × × * × ~ ×	10.7 mois 10.9 to we	0 - 10 it, non 0 - 11 eak; no	.90 S plast .05 U o defe	ILT, ic; lo Inwe ects.	minor ooks o athere	^r clay; organic ed, ligh	brown. in origi it grey \$	Very st in. (Bur SILTST	tiff to hard ied topsoi ONE; ver	l, dry to l?). y weak		D-M	VSt-H				PQT		wnwr		100		-			- - 11 - -
	- - - 12 -			11.0 mode medi coars	5 - 13 erately ium gr se sar	.65 U / stroi avel s nd ma	Inwe ng to size, atrix.	athere stror angu	ed, ligh ng; Cla lar to s	nt grey a asts; qu sub ang	& white ıartz & s jular. M	BRECCI schist, fin atrix supp	A; e to oorted,							ш				100		-	 		- - - - - - - - - - - - - - - - - - -
	-		∧. ∧ `.`.`. ∧. ∧																	PQ		ΝN		100					
	13	3.65																		L				94					13
	- - 14 - - -	14.2		13.6 mode From 14.2	5 - 14 erately 1 13.7 0 - 17	.20 U / stroi 9 to 1 .20 U	Inwe	athere stror 2 m: the athere	ed, lig ng; no nin SIL ed, ligh	ht grey defects T layer	fine SA , , stiff. & white	BRECCI	JE; A;	-						PQT		MU		94					-
	15			mode medi coars mm	erately ium gr se sar thick b	/ stroi avel s nd ma beds f	ng to size, atrix. for b	angu Distic oth gr	ig; Cla lar to s t beds ain siz	asts; qu sub ang of fine es.	Jartz & s jular. M & coars	scnist, fin latrix supp se clasts.	e to ported, 200	HENLEY BRECCIA						РДТТ		~		107 100	_	-			- - - - - - - - - -
	- - 16 - - - -																					Λ			-	-			- -
	- - - 17 - -	17.2	· · · · · · · · · · · · · · · · · · ·	47.0	0.17	00 5							4							ΡΩΤΤ		0		93 93		-			- - - -17
Image: Construction of the state of the												UW CW-R			-	-			- - - - - - -										
$ \begin{array}{c} \begin{array}{c} & & \\ & \\ & \\ & \\ & \\ & \\ & \\ & \\ & \\ $								M		107 100																			
$\begin{bmatrix} 19 \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ $									100 100					- 															
No	tes a	ano Hor			of Hol	e@2	20.0	0m,Ta	arget D	epth.			Inclinat	ion: \	/ertic	al		0	rienta	tion:			Gro	und W	ate	r Lev	el Hole de	pth	
Gi	ound	wat	e دو 20 er SW	L at 3.9	arget D mbgl di	epin. uring p	iezo i	nstall.					Contra Equipr	ctor: I nent:	vicNe Moun	ills ted Ri	q						29/05	9 11me	* ' 0	(mbgl) 3.9	(mbgl) 20)	
Refer to explanation sheets for abbreviation and symbols																													

GHD

Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 1 of 4						
Borehole ID	BH03							



Box 1 of 8: 0.0 m to 2.6 m



Box 2 of 8: 2.6 m to 6.25 m

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Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 2 of 4						
Borehole ID	BH03							



Box 3 of 8: 6.25 m to 9.25 m



Box 4 of 8: 9.25 m to 11.05 m





Box 5 of 8: 11.05 m to 13.3 m



Box 6 of 8: 13.3 m to 15.6 m

GHI

Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 4 of 4						
Borehole ID	BH03							



Box 7 of 8: 15.6 m to 17.7 m



Box 8 of 8: 17.7 m to 20.0 m (EOH)

Project : Smooth Hill Landfill Consenting Hole No. Client : Dunedin City Council Site : Smooth Hill Toe bund foundation Job Number: 12506381 Scale @ A4 Commenced: 6/06/2019 Completed: 7/06/2019 Logged Processed										: BI : 1 of : 15.0 : 1:50 : MF	+104 2 00m								
RI	.: 108	. 3903 8.15	003.0	Datum: NZVD2016	Syste	#TT.		TIVIZU	00		C	heck	ed		: JS				
RL (m)	Depth (m)	Graphic		Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sar	gesult	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR SCR RQD (%)	Defect Spacing (mm)	Instrumentation Installation	water level
	$\mathbf{q} \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} $		0.00 plast From 0.25 (root 0.60 strea 0.90 strea 0.90 strea 0.90 streat roum 1.40 very 1.50 GRA cont sub 2.45 2.80 findui char back 4.40 extreat findui char back 6.40 findui 7.40 7	 0.25 SILT, minor clay; dark grey. Firm, moist, low ticity. (TOPSOIL/FILL). n 0.2 m: some intermixing with underlying soil. 0.60 SILT, minor clay, trace fine sand, trace orgar (s); orange brown. Stiff, moist, low plasticity. (LOESS) 0.90 From 0.6m, becomes light grey with orange-aks, stiff to very stiff. 1.40 Silty fine to medium SAND; grey with orange aks. Density undetermined, moist, poorly graded. 1.1 m, becomes trace fine gravek, sub angular to sudded quartz and schist. 1.50 (BURIED TOPSOIL) SILT with roots; grey. S stiff, moist, non plastic. 2.45 Silty, fine to coarse sandy, fine to medium XVEL; orange brown. Density undetermined, moistur ent undetermined, well graded quartz and schist claa angular to sub rounded. (Heavily weathered rock?). 2.80 Inferred CORELOSS. 4.40 Moderately weathered, light grey & orange brom Gefects. Fe banding throughout. Fe bands ge angle downhole from sub horiztontal to sub vertic & back. Bedding 1-20 mm thick. (HENLEY BRECC) 4.70 Moderately weathered, CONGLOMERATE; emely weak to very weak; poorly indurated, well graded. 5.90 Inferred CORELOSS from this run. 5.90 Inferred CORELOSS from this run. 6.4.00 Inferred CORELOSS from this run. 7.40 From 7.0 m, becomes moderately strong to sindurated. 8.40 From 7.4 m, becomes moderately strong to sindurated. 8.40 From 7.4 m, becomes moderately strong to sindurated. 8.40 From 7.4 m, becomes moderately strong to sindurated. 8.40 From 7.4 m, becomes moderately strong to sindurated. 8.40 From 7.4 m, becomes moderately strong to sindurated. 	nics S). brown brown bitiff to re stss, / 		M M M M	St-VSt				ратт Ратт Ратт Ратт Ратт М		w bw sw sw sw sw sw sw ww mw m		(%) 100 73 100 100 100 20 0 69 69 69 69 69 100 75			
			8.85 SAN grad 9.60 stror	 9.60 Slightly weathered, light grey fine to coarse IDSTONE; very weak to weak; poorly indurated, poorled, no defects. 10.10 From 9.6 m, becomes moderately strong to no, well indurated. 	rly							РОТТ		SW		83 63			
No	es ar	nd Cor	nment	s:	Inclinatio	on: \	/ertic	al		Or	ientati	ion:			Gro	und Wa	ater Lev		
En	d of Ho	ole @ 1	5.00m, T	Farget Depth.	Contract	tor: I	McNie	ells							Date	Time	Reading (mbgl)	Hole depth (mbgl)	
Groundwater at 2.52 mbtoc (TOC 0.53 m agl) - corrected groundwater at 1.99 mbgl 07/06/2019. Refer to explanation sheets for abbreviation and symbols						ent: ane	Moun Id:	ted Ri	g										

Project : Smooth Hill Landfill Consenting Hole No. Client : Dunedin City Council Sheet Site : Smooth Hill Toe bund foundation Job Number: 12506381 Commenced: 6/06/2019 Completed: 7/06/2019										0. h 4	: 2 o : 2 o : 15. : 1:5 : MF	H04 f 2 00m 0					
Easting RL: 10	g: 3965 <u>8.15</u>	63.6 Northing: 788063.75 Datum: NZVD2016	Syste	m:	TAIE	TM20	00			roces heck	ed		: HB : JS				
RL (m) Depth (m)	Graphic	Material Description Moisture condition Moisture condition Solumber / Solution Solut							Casing	Method	Flush Return (%)	Weathering	w w Estimated sstrength (MPa)	TCR SCR RQD (%)	。 Defect 。。Spacing (mm)	Instrumentation Installation Water level	
<u> <u> <u> </u> <u> </u></u></u>		 10.10 - 10.60 Slightly weathered, grey BRECCIA; moders strong to strong; well indurated, fine to coarse sand matrix, matrix supported. Clasts are of & schist, sub rounded to angular. Very wide spaced defered 10.60 - 10.80 Slightly weathered, light grey fine to coarse SANDSTONE; very weak to weak; poorly indurated, no defects. 10.80 - 11.10 Slightly weathered, brown SILTSTONE; very weak to weak; poorly indurated, no defects. 11.10 - 11.50 Slightly weathered, light grey & pinkish gre BRECCIA; weak to moderately strong; moderate to well indurated, no defects, fine to coarse gravel clasts, fine to coarse sand matrix, clast supported. Clasts are quartz an schist sub angular to angular. Note: clast size dcreases with depth. 11.50 - 12.20 From 11.5 m, becomes moderately strong; well indurated fine to medium gravel clasts. 12.20 - 15.00 From 12.2 m, becomes weak to moderatel strong, moderate to well indurated, fine to coarse gravel. From 13.9sm: clasts mostly medium to coarse gravel. 	ately asts, juartz cts. e rry y nd g to y clasts.	HENLEY BRECCIA						Р <u>атт</u> Р <u>атт</u> Р <u>атт</u> Р <u>атт</u> Р <u>атт</u>		™ w w w w w w w w w w w w w w w w w w w		(%) 83 63 97 97 97 88 56 100 73			
																	- 20
Notes a		iments:		on: V	/ertica	al		Or	ientat	ion:			Gro	und Wa		Hole depth	
Groundv 07/06/20	vater at 2 119.	.52 mbtoc (TOC 0.53 m agl) - corrected groundwater at 1.99 mbgl	Equipme Shear Va	or: N ent: N ane I	viciNie Moun Id:	ted Ri	g						07/06	/19 00:00	(mbgl) 1.99	(mbgl) 15	
	SAPIGITAL	S. S. S. S. S. M. M. S. SHARN IN M. SYMDON															

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Project	Smooth Hill Landfill Consenting						
Client	Dunedin City Council						
Job number	12506381	Page 1 of 3					
Borehole ID	BH04						



Box 1 of 6: 0.0 m to 2.7 m



Box 2 of 6: 2.7 m to 5.9 m

GHD

Project	Smooth Hill Landfill Consenting							
Client	Dunedin City Council							
Job number	12506381	Page 2 of 3						
Borehole ID	BH04							



Box 3 of 6: 5.9 m to 8.7 m



Box 4 of 6: 8.7 m to 11.1 m

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Project	Smooth Hill Landfill Consei	nting
Client	Dunedin City Council	
Job number	12506381	Page 3 of 3
Borehole ID	BH04	



Box 5 of 6: 11.1 m to 13.5 m



Box 6 of 6: 13.5 m to 15.0 m (EOH)

ļ			Project : Smooth Hill Landfill Consentin	g						H	lole	e No	Э.	: Bl	H05]			
	G	Н	Site : Smooth Hill Central ridge							H	ole L cale (engt @ A	h 4	: 30.0	00m)						
			Commenced: 29/05/2019	Comp	lete	ed: 30)/05/2	2019		Lo	oggeo	d		: MF	-			_			
Ea	sting	3964	59.76 Northing: 787862.12	Syste	m: ⁻	TAIE	TM20	000		P	Processed				: HB						
RL	: 129	.5	Datum: NZVD2016					Sar	mnlo		heck	ed		: JS				_			
(m) -	epth (m)	raphic	Material Description		Geological Unit	oisture condition	onsistancy / elative density	Inder /	sult	asing	ethod	ilush Return (%)	eathering	istimated strength (MPa)	TCR SCR RQD	befect spacing (mm)	strumentation stallation ater level				
R	ă - P	<u>5</u> ×	0.00 - 0.80 Clayey SILT; grey & dark orange brown. Ver	v stiff,		Š M	ک مّک VSt	źΥ	ă.	Ö	Š	25 50 75	3		(%)		토토 >	-0			
			moist, high plaśtićity. (LÓĚSŚ).								Ц				400			-			
	1	× ;;	0.80 - 1.00 SILT, minor clay, trace fine sand; orange bro	own		м	VSt				ğ				100			-			
		×°× ×	1.00 - 1.50 Fine to medium gravelly SILT, trace clay; ora	ange		м	VSt									-		Ē			
	1.5	$\times - i$	brown & white. Very stiff, moist, low plasticity.						SV@1.5m									-			
	-	\mathbb{N}	Catcher did not grip sample.						UTP .									-			
	2-	ΙV	Note: No shear vane undertaken at 2.7 m due to no core	э.							αĦ				0			-2			
	-	$ /\rangle$									ē.							Ē			
	1 1 2	$\lfloor $																-			
	3		2.70 - 2.80 Fine to medium gravelly SILT, trace clay; ora brown & white. Very stiff, moist, low plasticity.	ange /		м	VSt "	1										-3			
		X	2.80 - 3.50 Inferred CORELOSS (Washed away2)															_			
	3.5		3.50 3.70 Eine to medium CRAV/EL: crosmy white								PQTT				53			-			
	3.88.7	$\frac{0}{x_0}$	Undetermined density, undetermined moisture condition	i, well		M	VSt											-			
	4-	×	\graded, quartz & schist gravel, angular to sub angular. 3.70 - 3.80 Fine to medium gravelly SILT, trace clay; ora	ange		D-M M	H VSt											-4 -			
	1 2	× x	brown & white. Very stiff, moist, low plasticity. Fe stainir	ngion														-			
	- 4	××	3.80 - 4.00 SILT, trace organics; light grey. Hard, dry to	moist,		D-M	н											-			
	-	×	4.00 - 4.45 Fine gravelly SILT, trace clay, trace organics] s;	SS						Ę				103			-			
		×	orange brown & light grey. Very stiff, moist, non plastic. Note no shear vane at 4.2 m due to material being too g	ravely.	LOE						ď							-			
	-		4.45 - 5.70 SILT, trace clay, trace organics; light grey w	ith												-		-			
	5.7	×	From 5.1 m, becomes orange brown with some light gre	ey.		м	St-VSt	t	SV@5.7m UTP									-			
	6-10.5	×××	From 5.35 m, 2-3 mm Fe "gravel" beds.	/		м	н	-										-6			
	-		5.70 - 5.90 Silty CLAY, trace fine sand, trace organics; to grev. Stiff to very stiff, moist, high plasticity.	brown							E										
	-	×××	5.90 - 6.50 SILT, trace clay, trace organics; light grey w	ith		м	Н				Pa				100			-			
	_	××	Note: Fe stained contact at 6.50 m.			D	н											-			
	1 22	×	6.50 - 6.80 SIL I, trace medium gravel (schist), brown to Hard, moist, non plastic.	o grey.														-7			
		IX Â	Note: dark orange brown Fe stained contact at 6.80 m. 6.80 - 7.20 SILT, trace organics; light grey & orange bro	wn,									Ŵ					-			
	1 1 1	· <u>···</u>	with black flecks. Hard, dry, non plastic, thin (<1mm) 'ru	isty'									Ň		100			-			
	8	$\begin{vmatrix} x & x \\ x & x \\ x & z \end{vmatrix}$	7.20 - 7.75 Moderately weathered, dark grey with black	streaks							Рат		2		87			-8			
	-	<u>````````</u> '×``×'	organic rich layers, defects 500-1000 mm spacing.	/									ž					-			
	-	× × <u>× //</u> × <u>×</u>	7.75 - 7.80 Moderately weathered, grey SANDSTONE; weak; 50 mm bedded layer within siltstone.	very									SW					Ē			
		××	7.80 - 8.50 Moderately weathered, dark grey with black	streaks									MS					-			
	9 1-6		organic rich layers, defects 500-1000 mm spacing.								L		Ĥ		03			-9 - -			
			At 8.2 m to 8.2 m to 8.2 m lignite layer.	L L D L L D L									SW		93						
	77 9.6	 × × ××.	At 0.32 m to 0.37 m; 50 mm lignite layer. At 8.42 m to 8.44 m; 20 mm lignite layer.										MS					È			
<u> </u>	-0	::::	8.50 - 8.70 From 8.5 m, becomes slightly weathered, li	gnite									SW		und 144			-10			
Not	es an	nd Cor	Iments: .00m. Target Depth.	Contract	on: V		al Ile		Ori	ientati	ion:			Gro Data		Reading	Hole depth	-			
~ 0	.5 m to	psoil st	ipped to make drill pad	Equipme	ent: I	Moun	ted Ri	ig							11116	(mbgl)	(mbgl)	-			
Gro	oundwa	ater SW	L at 16.4 mbgl during piezo install.	Shear Va	ane	ld: Gl	EO182	26													
Ref	er to e	xplanat	on sheets for abbreviation and symbols																		

Easting	: 3964	Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Smooth Hill Central ridge Job Number: 12506381 Commenced: 29/05/2019 59.76 Northing: 787862.12	ng Com Syste	plete em: ⁻	ed: 30)/05/2 TM20	2019 00		H S Lu P	Hole heet ole L cale (ogged roces	engt @_A d ssed	D. h 4	: BH : 2 of : 30.0 : 1:50 : MF : HB	105 3 00m			
RL: 129	9.5	Datum: NZVD2016		Ħ			Sar	nple		heck	ed		: JS				
RL (m) Depth (m)	Graphic	Material Description		Geological Un	Moisture conditio	Consistancy / Relative density	Number / Type	Result	Casing	Method	E Flush Return (%)	Weathering	w Estimated ™ Strength (MPa)	TCR SCR RQD (%)	∞ Defect ∞ Spacing (mm)	Instrumentation Installation	Water level
11		 layers gone but occassional organic rich layers remain. 8.70 - 9.10 From 8.7 m. becomes weak to moderately strong; fine sand to coarse gravel size grain: spaced defects, no organic content. 9.60 - 9.77 Slightly weathered, grey SANDSTONE; weak moderately strong; bedded siltstone layer in sandstone. 9.77 - 13.20 Slightly weathered, grey SANDSTONE; we moderately strong; fine sand to coarse gravel size grain: spaced defects, no organic content. From 10.2 m, becomes fine to coarse gravel size grain: spaced defects, no organic content. From 10.9 m, becomes fine to coarse sand, trace fine g (quartz & schist) grainsize. From 11.4 m, becomes fine to coarse sand, trace fine g (quartz & schist) grainsize. From 12.69 m to 12.73 m, organic rich 2 mm lignite layer. From 12.69 m to 12.73 m, organic rich 2 mm lignite layer each end. 13.20 - 14.10 From 13.20 m, becomes moderately strong strong. 14.10 - 14.60 Unweathered, massive, grey & white BRE moderately strong to strong; fine to coarse gravel size coarse sand matrix. Matrix supported. Clasts are angula sub angular quartz and schist, some clasts up to 100 m grainsize. 14.60 - 15.60 From 14.6 m, becomes weak to moderately strong. Softer matrix. 15.60 - 16.20 From 15.6 m, becomes moderately strong strong. Matrix more lithified. 16.20 - 16.60 From 16.20 m, becomes moderately strong. Matrix less lithified. 16.60 - 17.10 From 17.1 m, becomes weak to moderate strong. Matrix less lithified. 17.70 - 18.10 Inferred CORELOSS (weaker rock matrix resulted in lots of rock breakup during drilling/extraction tube. Note: do not think it is defect controlled or open in ground. 	trong. k to s, wide to tak to s, wide ravel al er at ng to ECCIA; lasts, ir to m in ely g to tely g to tely eg to tely ECCIA; asts, ir to m in ely g to tely for end for for for for for for for for	HENLEY BRECCIA						Ратт Ратт Ратт Ратт Ратт Ратт Ратт		UW UW UW UW UW UW UW W SW W UW UW W M M M M M M M M M M M M M M		97 97 97 100 100 100 93 87 67 100 93			
18.50 - 19.20 From 18.50 m, becomes moderately str strong. Matrix more lithified. 19.20 - 20.00 Slightly weathered, grey fine SANDST(very weak to weak; orange Fe stained layer every ~ 30										PQTT		SW		100 94			
Notes and Comments:				on: \	/ertic	al		Or	ientat	ion:			Grou	Ind Wa	ter Lev	/el	
End of Hole @ 30.00m, Target Depth.			Contractor: McNeills Date Time Reading (mbgl) Hole d								epth						
Notes and Comments: End of Hole @ 30.00m, Target Depth. ~ 0.5 m topsoil stripped to make drill pad Groundwater SWL at 16.4 mbgl during piezo install. Refer to explanation sheets for abbreviation and symbols				ent: l /ane	Moun Id: Gi	ted Ri EO182	g 26										

G	H	Project : Smooth Hill Landfill Conse Client : Dunedin City Council Site : Smooth Hill Central ridge Job Number: 12506381 Commenced: 29/05/2019	nting Com	plete	ed: 30)/05/2	2019		H S H S	lole heet ole L cale (engt @_A	0. h 4	: BI : 3 of : 30.0 : 1:50 : MF	+105 3 00m			
Easting	3964	159.76 Northing: 787862.12	Syste	em: ⁻	TAIE	TM20	00		P	roces	sed		: HB				
(E) -	raphic G.	Material Description		Geological Unit	oisture condition	onsistancy / elative density	San	nple	asing	ethod	ilush Return (%)	eathering	stimated strength (MPa)	TCR SCR RQD	befect spacing (mm)	strumentation stallation	ater level
rz a 21		Core breaks on Fe stained layers but unlikely layers in ground. The weakest plane is what breaks during The Fe stained layers probably indicate time gaps in depositional history. 20.00 - 20.55 From 20.0 m, very weak to weak, occ slightly weathered, grey siltstone layers (bedding) up mm. 20.55 - 20.65 From 20.55 m, becomes moderately st strong. 20.65 - 21.80 From 20.65 m, becomes very weak to 21.80 - 21.95 From 21.8 m, becomes weak to mode strong. 21.95 - 22.00 At 21.9 m: slightly weathered, grey SI (20 mm bedded layer). 22.40 - 24.10 Slightly weathered, grey pinkish white BRECCIA; moderately strong to strong; clast suppor coarse gravel size clasts, angular to sub angular qua schist clasts. From 23.8 m, becomes fine gravel size clasts with of coarse gravel clasts. 24.10 - 24.30 From 24.1 m, becomes moderately st strong. 24.65 - 24.75 From 24.65 m, becomes moderately st strong. 24.65 - 24.75 From 24.65 m, becomes moderately st strong. 24.65 - 24.75 From 24.65 m, becomes wery weak to matrix. 24.75 - 26.65 From 24.75 m, becomes moderately st strong. 24.65 - 27.20 Silty SAND; light grey. Very dense', d moderately graded. 27.30 - 27.30 From 27.2 m, becomes SILT brown. I non plastic. 27.30 - 27.30 From 27.3 m, becomes fine to mediu brown. Toense', dry, poorly graded. Breaks down fro completely weathered to residual, brown fine SANDSTONE; very weak. 27.80 - 27.30 From 27.3 m, becomes fine to mediu brown. Dense', dry, poorly graded. Breaks down fro completely usethered to residual, brown fine to mediu brown. Dense', dry, poorly graded. Breaks down fro completely weathered to residual, brown fine to mediu brown. SILTSTONE; very weak. 27.80 - 27.40 Singhtiy weathered, light brown, grey, BRECCIA; weak to moderately strong; clast support coarse gravel size quartz and schist clasts, angular angular. 28.40 - 30.00 From 28.4 m, becomes unweathered, moderately strong to strong, clast size increases.	are open handling. assional o to 50 strong to o weak. erately LTSTONE trong to pred, fine to artz and occassional weak. Soft trong to o weak. strong to o o o o o weak. strong to o o o o o o o o o o o o o o o o o o	HENLEY BRECCIA	D D D Vertic: WcNe			<u>ě</u> Ori	122mm	оо: Ратт Ратт Ратт Ратт Ратт Ратт Ратт Л		uw swistend swisted swiste		(%) 100 94 103 100 87 87 100 87 87 100 87 100 87 100	tter Lev Reading (mbgl)		21 - 2
~ 0.5 m to Groundwa	~ 0.5 m topsoil striped to make drill pad			Equipment: Mounted Rig 30/05/19 00:00 30													
Refer to e	Shear \	/ane	ld: Gl	EO182	26												

C D

Project	Smooth Hill Landfill Consei	nting
Client	Dunedin City Council	
Job number	12506381	Page 1 of 7
Borehole ID	BH05	



Box 1 of 14: 0.0 m to 3.8 m



Box 2 of 14: 3.8 m to 5.8 m

GH

Project	Smooth Hill Landfill Conse	nting
Client	Dunedin City Council	
Job number	12506381	Page 2 of 7
Borehole ID	BH05	



Box 3 of 14: 5.8 m to 7.88 m



Box 4 of 14: 7.88 m to 9.93 m

GH

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Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 3 of 7
Borehole ID	BH05	



Box 5 of 14: 9.93 m to 11.87 m



Box 6 of 14: 11.87 m to 13.9 m

GH

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Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 4 of 7
Borehole ID	BH05	



Box 7 of 14: 13.9 m to 15.87 m



Box 8 of 14: 15.87 m to 18.45 m

GH

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Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 5 of 7
Borehole ID	BH05	



Box 9 of 14: 18.45 m to 20.1 m



Box 10 of 14: 20.1 m to 22.08 m

GH

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Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 6 of 7
Borehole ID	BH05	



Box 11 of 14: 22.08 m to 24.5 m



Box 12 of 14: 24.5 m to 26.8 m

GH

Project	Smooth Hill Landfill Conse	nting						
Client	Dunedin City Council							
Job number	12506381	Page 7 of 7						
Borehole ID	D BH05							



Box 13 of 14: 26.8 m to 29.0 m



Box 14 of 14: 29.0 m to 30.0 m (EOH)

		G	ił	D	Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Southwest Ridge	ng						н К	lole heet lole L	engt	0. h	: E : 1 : 30	3H06 of 3).00m	;			
-	Ea	asting	g: 39	6168	Commenced: 13/06/2019 3.25 Northing: 787593.98	Corr Syst	nplete em: ⁻	ed: 14 TAIE	1/06/2 TM20	2 <u>019</u> 000		P	ogge	d ssed		: M : H	F B				
	RL (m)	Depth (m)	Graphic		Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sar	Besult	Casing	Method	E Flush Return (%)	Weathering	w Estimated		20	³⁰⁰ Defect ²⁰⁰ Spacing (mm)	Instrumentation Installation	Water level
		- 2	<u>, 1 / 1</u> 	<u>``</u>	Top 250 mm dug out for drill pad (TOPSOIL)		TS								,						
1,10			0 × × × × × × × × × × × × × × × × × × ×		SILT, trace to minor clay, trace fine to medium sand, tra gravel; grey and orange-brown. Very stiff, moist, low pla (LOESS)	ace fine asticity	LOESS	м	VSt				PQTT				83				- - - - - - - - - - - - - - - - - - -
			1.5 1.25	× × + \	Highly weathered, yellow-brown SILTSTONE; extremely no defects (HENLEY BRECCIA)	/ weak;															
		2			Highly weathered, thinly bedded, yellow-brown silty fine SANDSTONE; extremely weak; no defects; iron-staining layers and spots; trace organics throughout;	g in							PQTT				100 89				
	. / +!	3			2.70 m: 170 mm layer gravelly SANDSTONE								מדד		НW		93				
140	. 041 1	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		•									Ğ				75	_			
In 1 1 1		5			4.90 m: 200mm loose sand/pebbly layer; likely coreloss	depth	ECCIA						РОТТ				78 78 78				5
).GLB Date: 7 Au		6			5.50 - 5.70 m: Fine gravel (quartz and schist, angular to sub-angular) layer)	HENLEY BR						E				100				6
rary: GHD - NZGE		7	72		6.70 - 7.20 m: moderately weathered, very weak to wea	ık							PQI				100				
HILL.GPJ Lib			8		Moderately weathered, yellow-brown SILTSTONE; very to weak; very widely spaced defects 7.30 - 7.75 m: light grey with black flecks 7.75 m: orange-brown with black streaks; break on bede plane, dark iron-staining on face	weak ding							QTT				60 60				
I NOOTI				· \ \	Moderately weathered, grey, fine to coarse SANDSTON extremely weak to very weak	IE; '	ľ								MM						
SINT LOGS		9	8.7		Moderately weathered, fine to medium SANDSTONE; v weak to weak; widely spaced defects	 ery	+														
t: 12506381 (-			9.25 m: tight break, iron-stained face, staining decrease 50 mm above and below break	es for							РОП				100 87 87				
Projec		-		: 9	9.72 m: 15-20 mm dark brown layer	1															
90 ⁻	Notes and Comments:					Inclinat	tion: \	/ertic	al		Or	ientat	ion:			G	round \	Vate		Holo day	oth
RAL_L	End or Hole @ 30.00m, Target Depth. Groundwater not encountered.					Contra	ctor: I	McNe	ills	uek -	nountari	`				Da	ate Tir	ne	(mbgl)	(mbgl)	201
BNE						Shear V	vane	Id.	500 (tř	uck f	nounted)									
t ID: 0	Re	fer to	explar	nation	sheets for abbreviation and symbols		. and														
Repor																					

		G	H	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Southwest Ridge Job Number: 12506381 Commenced: 13/06/2019	Ig Com	g Completed: 14/06/2019						Hole Sheet Iole L Scale	e No engtr @ A). 1 4	: E : 2 (: 30 : 1::					
	Ea	asting	g: 3961	58.25 Northing: 787593.98	Syste	em: [·]	TAIE	TM2	000		F	Proces	ssed		: HE	: HB				
	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sar	Sesult	Casing	Method	Elush Return (%)	Weathering	***Estimated	TCR SCR RQD (%)	◎ ◎ Defect ◎◎ Spacing (mm)	Instrumentation Installation	Water level	
TH HILL.GPJ Library: GHD - NZGD.GLB Date: 7 August 2019	- 132' 133' 134' 135' 136' 136' 138' 138' 138' 138' 139' 7	$\mathbf{a} \begin{bmatrix} 12 \\ 13 \\ 14 \\ 15 \\ 16 \\ 17 \\ 18 \\ 18 \\ 18 \\ 18 \\ 18 \\ 18 \\ 18$		 9.75 m: tight break, iron stained face; core stained below break, but not above 10.00 - 10.20 m: with some fine rounded gravel 10.20 - 10.45 m: CORELOSS Moderately weathered, laminated to moderately thickly b light grey and orange-brown SANDSTONE; extremely to weak; poorly indurated; very widely spaced defects 10.75 m: 100 mm SILTSTONE, black basal contact 10.85 m: 60 mm light grey with black flecks, minor organinclusions 11.00 m: yellow-brown and orange-brown 11.10 m: 2-3 mm iron stained 'rusty' layer 11.55 m: 70 mm light grey interbed 12.00 JT, 45°, pl, r, CLAY, Iron stained clay infill. 12.25 m: 100 mm minor organics, orange-brown and black and schist 12.54 - 13.40 m: CORELOSS Moderately weathered grey and white CONGLOMERATT weak to weak; clasts, fine to medium, rounded to sub-roquartz and schist Slightly weathered, grey with occasional black, fine to me SANDSTONE; very weak to weak; no defects; occasional black, fine to medium, rounded to sub-roquartz and schist Slightly weathered, grey with occasional black SILTSTOI very weak to weak; no defects; occasional black, fine to me SANDSTONE; very weak to weak; no defects; occasional lignite 15.60 m: 100 mm SANDSTONE Slightly weathered, grey with occasional black fine to me SANDSTONE; very weak to weak; no defects; occasional lignite 16.40 - 16.60 m: minor fine gravel (quartz and schist) 'p conglomerate' 17.05 - 17.25 m: SILTSTONE Slightly weathered, light grey BRECCIA; extremely weak weak; no defects; clasts: quartz and schist, fine to mediugravel size, angular to sub-rounded; matrix supported; medius gravel size, angular to sub-rounded; matr	v / / / / / / / / / / / / / / / / / / /	HENLEY BRECCIA	W				3	Ратт Ратт Ратт Ратт Ратт М		SW MW W		 (%) 83 83 83 83 56 56 56 56 56 56 56 56 56 56 56 56 100 100 100 100 100 100 87 				
² roject: 12506381 GINT LOGS SMOO	130 131	19 19 19 19		18.00 - 18.20 m: CORELOSS Slightly weathered, light grey BRECCIA; extremely weak weak; no defects; clasts: quartz and schist, fine to mediu gravel size, angular to sub-rounded; matrix supported; m fine to coarse sand 19.10 - 19.20 m: unweathered, weak to moderately stron 19.20 - 19.40 m: moderately strong to strong, well indura Unweathered, light grey and black fine to medium SANDSTONE; very weak to weak; very widely spaced do with moderately widely spaced laminated very thin to thir	/ to um natrix: ng ated efects; n beds	<i>x</i>						РАТТ РАТТ		UW		87 63 63 93 65 47				
06 }	Not	tes a	nd Cor	iments:	Inclination: Vertical Orientation: Ground Wat						iter Lev	el								
RAL_L	End of Hole @ 30.00m, Target Depth. Groundwater not encountered.					ctor: I	McNe	eills	ruol: -	nounta-	`				Da	te Time	Reading (mbgl)	Hole depth (mbgl)	`	
Report ID: GENE	Refer to explanation sheets for abbreviation and symbols						Shear Vane Id:													

E	G	H) 1: 3961	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Southwest Ridge Job Number: 12506381 Commenced: 13/06/2019 58.25 Northing: 787593.98	Completed: 14/06/2019 System: TAIETM2000					H Si La Pi	heet ole Lo cale (oggeo roces	engt @A d	O. th \4	: E : 3 (: 30 : 1: : M : HE	3H06 of 3).00m 50 F 3						
RL (m)	Depth (m)	Graphic Graphic	Datum: NZVD2016 Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Igentiation International Internati	nple Kesnit	Casing	Method	E Flush Return (%)	, Weathering	*** *** Estimated *** Strength (MPa) ー		8	© Defect Spacing (mm)	Instrumentation Installation	Water level	
.0G Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 7 August 2019	21		of lignite and widely spaced moderately thin siltstone be Unweathered, light grey and black fine to medium SANDSTONE; very weak to weak; very widely spaced of with moderately widely spaced moderately thin siltstone be (continued from layer starting at 19.4 m) 20.20 m: fine to coarse sand 20.70 m: fine to medium sand 21.06 m: 230 mm siltstone interbed 21.70 m: very thinly bedded (2-10 mm) 22.20 m: moderately thickly bedded (~ 300 mm) 22.40 m: 150 mm siltstone interbed 22.75 m: laminated (2-10 mm) 22.75 m: laminated (2-10 mm) 22.75 m: laminated (2-10 mm) 22.840 m: 150 mm siltstone interbed 22.75 m: laminated (2-10 mm) 22.840 m: 150 mm siltstone interbed 22.75 m: laminated (2-10 mm)	eds Jefects; in beds eds eds eds eds eds eds eds eds eds	HENLEY BRECCIA	/ertic	al		Orie	entati	Patt Patt Patt Patt Patt Patt Patt Patt		UW	Gr	93 65 47 100 100 100 100 100 100 100 100 100 10		er Lev			
Report ID: GENERAL_L	End of Hole @ 30.00m, Target Depth. Groundwater not encountered. Refer to explanation sheets for abbreviation and symbols					VICNe UDRe Id:	ills 600 (tr	ruck n	nounted)					Da 14/0	te Tir 6/19 00	ne :00	Reading (mbgl)	Hole dep (mbgl) 30	oth	

GH

Project	Smooth Hill Landfill Conse	nting						
Client	Dunedin City Council							
Job number	12506381	Page 1 of 7						
Borehole ID	BH06							



Box 1 of 13: 0.0 m to 2.4 m



Box 2 of 13: 2.4 m to 4.6 m

GH

Project	Smooth Hill Landfill Conser	nting						
Client	Dunedin City Council							
Job number	12506381	Page 2 of 7						
Borehole ID	BH06							



Box 3 of 13: 4.6 m to 7.2 m



Box 4 of 13: 7.2 m to 10.0 m



Project	Smooth Hill Landfill Conse	enting
Client	Dunedin City Council	
Job number	12506381	Page 3 of 7
Borehole ID	BH06	



Box 5 of 13: 10.0 m to 13.2 m



Box 6 of 13: 13.2 m to 15.6 m

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Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 4 of 7
Borehole ID	BH06	



Box 7 of 13: 15.6 m to 17.7 m



Box 8 of 13: 17.7 m to 20.2 m

GH

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 5 of 7
Borehole ID	BH06	



Box 9 of 13: 20.2 m to 22.2 m



Box 10 of 13: 22.2 m to 24.7 m

GH

Project	Smooth Hill Landfill Conser	Smooth Hill Landfill Consenting										
Client	Dunedin City Council											
Job number	12506381	Page 6 of 7										
Borehole ID	BH06											



Box 11 of 13: 24.7 m to 27.0 m



Box 12 of 13: 27.0 m to 29.3 m

GH

Project	Smooth Hill Landfill Conse	Smooth Hill Landfill Consenting									
Client	Dunedin City Council										
Job number	12506381	Page 7 of 7									
Borehole ID	BH06										



Box 13 of 13: 29.3 m to 30.0 m (EOH)

	Project : Smooth Hill Landfill Consenting I Client : Dunedin City Council Site : Smooth Hill Central ridge Job Number: 12506381 Site : Smooth Hill Central ridge									F S F S	Hole iheet lole L icale oqqe	e No Lengt @ A	0. h √4	: B : 1 c : 20 : 1:5 : MF	H07 of 2 .00m 50				
-	Ea RI	sting	g: 3964 9 73	93.65 Northing: 787671.87 Datum: NZVD2016	Syst	em:	TAIE	TM20	000		P	roce: Check	ssed (ed		: HE	3			
	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / BS	Result	Casing	Method	Elush Return (%)	Weathering	**************************************	TCR SCR RQD (%)	™ © Defect ∞Spacing (mm)	Instrumentation Installation	Water level
		- - - - - - - - - - - - - - - - - - -	× × × × × × × × × × × × × × × × × × ×	0.00 - 1.40 SILT, minor clay, trace fine sand, trace orga light grey & orange brown. Very stiff, moist, low plasticit (LOESS). From 1.25 m to 1.30 m, 50 mm layer with minor to som "rusty" inclusions (red to brown).	anics; iy. ne Fe		М	St				PQTT		2		84			
		2	* × · · · · · · · · · · · · · · · · · ·	1.40 - 2.05 Fine sandy SILT, minor fine gravel; yellow b Hard, dry, non plastic. (Inferred CORELOSS 1.4-1.6 m).	prown.	SS	D	'H'	-			F							
			×· ×· × · × · ×	2.05 - 2.80 From 2.05 m, Fe staining in layers for 250 r	mm.	LOE	D	н	-			DA				85			
		3	· · · · · · · · · · · · · · · · · · ·	2.80 - 3.40 From 2.8 m, no gravel, Fe stained layers co	ommon.		D	н	-			E							
9 March 2021		4 303 75 3		 3.40 - 3.75 SILT, some clay; light grey & yellow brown vorange brown layers. Hard, dry, non plastic. Fe stained throughout. 3.75 - 3.90 Clayey SILT, trace fine sand, trace organics of the standard state of the standard state. 	with layers ; grey		D M D	H St-VS H	t			PQ				100			
Library: GHD - NZGD.GLB Date:		5	· · · · · · · · · · · · · · · · · · ·	 a. Solution of the start of the sta	with layers ayered, y ed, very							Patt		MW MW		100 100			
SSING - KB EDITS.GPJ		6	× × × × × × × × × × × × × × × × × × ×	Note at 5.17m: 2 x 5-8 mm organic rich layers. 5.95 - 7.20 Slightly weathered to moderately weathered grey & yellow brown BRECCIA; weak to moderately strc coarse sand matrix, matrix supported. Clasts are fine to gravel quartz and schist, angular to sub rounded.	d, light rong; o coarse	BRECCIA						Ратт		SW-MW		100 100			
OTH HILL - HB PROCE		 7.20 - 8.10 From 7.2 m, becomes very weak to moderate strong. Matric less indurated. 7.20 - 8.10 From 7.2 m, becomes very weak to moderate strong. Matric less indurated. 8.10 - 8.80 Slightly weathered to moderately weathered, grey & brown silty fine SANDSTONE; very weak to moderately weathered, grey & velow brown BRECCIA; weak to moderately strong. 8.80 - 9.33 Slightly weathered to moderately weathered, grey & yellow brown BRECCIA; weak to moderately strong. 				HENLEY						PQTT		WM-WS	-	100 93			
506381 GINT LOGS SMC						_						Ратт		WM-WS NW-WBW		100			
Project: 12	2 1000 100													SW-MW B				- - - 	
TOG	Notes and Comments: End of Hole @ 20.00m, Target Depth.						√ertic McNe	al ills		0	rientat	tion:			Gr Dat	ound Wa	Reading	Hole of	lepth
port ID: GENERAL	~ 300 mm topsoil & 100-200 mm loess stripped to make drill pad. Refer to explanation sheets for abbreviation and symbols					nent: √ane	Mour Id:	ited R	ig								(ingi)	(mgl	

Project : Smooth Hill Landfill Consenting Client : Dunedin City Council Site : Smooth Hill Central ridge Job Number: 12506381 commenced: 30/05/2019 Completed: 4/06/2019 Easting: 396493.65 Northing: 787671.87										Hole No. : BH07 Sheet : 2 of 2 Hole Length : 20.00m Scale @ A4 : 1:50 Logged : MF Processed : HB								
Lasting: South Stress RL: 139.73 Datum: NZVD2016								heck	ed		: JS	: JS						
(표) 2 제 1 전 1 Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	Besult	Casing	Method	88 Flush Return (%)	Weathering	₩ Estimated Strength (MPa)	TCR SCR RQD (%)	²⁰ ²⁰⁰ Defect ²⁰⁰ Spacing (mm)	Instrumentation Installation Water level	-10			
matrix more indurated, fine to coarse gravel clasts. 9.70 - 10.00 From 9.7 m, becomes fine to medium graval clasts. 10.00 - 10.10 Slightly weathered to moderately weather grey SLTSTONE; very weak to weak. 10.10 - 10.25 Slightly weathered to moderately weather grey SANDSTONE; very weak to weak. 10.25 - 10.65 Slightly weathered to moderately weather to medium grained, grey BRECCIA; very weak to weak. Note at 10.60 m: minor break on bedding plane, Fe stai 10.65 - 11.00 Slightly weathered, dark grey fine sandy SILTSTONE; very weak to weak; occassional organic la up to 10 mm thick. 11.00 - 13.00 From 11.0 m, becomes unweathered Note at 11.7 m: End of shift 30/05/2019. 13.00 - 13.30 Unweathered, CONGLOMERATE; weak moderately strong; fine gravel to coarse sand. 13.30 - 14.70 Unweathered, light grey & white fine to coarse sand. 13.30 - 14.70 Unweathered, grey SILTSTONE; very we weak; no defects. 14 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	vel size red, red, fine ining. ayers to oarse z and nedium eak to eak to sure of weak to	HENLEY BRECCIA		п				άττ Ράττ Ράττ Ράττ Ράττ Ράττ		UW		100 100 100 100 100 100 100 100 100 100						
 ⁴ △ 2 19.50 - 20.00 Unweathered; light grey, white & purple A. A. BRECCIA; weak to moderately strong; no defects. Coal sand matrix matrix supported modium to wall inductor 	rse	-						Б Р		NN		78			-			
1 Image: Sand matrix, matrix supported, medium to well indurated Notes and Comments: Notes and Comments: End of Hole @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported, medium to well indurated @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported, medium to well indurated @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported, medium to well indurated @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported, medium to well indurated @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported, medium to well indurated @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported, medium to well indurated @ 20.00m, Target Depth. Comments: Sand matrix, matrix supported to make drill pad. Refer to explanation sheets for abbreviation and symbols Sand Symbols	u. Inclinatio Contract Equipme Shear Va	on: V tor: N ent: I ane I	/ertica //cNe //oun Id:	ills ted Ri	g	Or	ientat	ion:			Gro Date	und Wa Time	ter Level	Hole depth (mbgl) 20				
Project	Smooth Hill Landfill Consei	nting																
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Client	Dunedin City Council																	
Job number	12506381	Page 1 of 4																
Borehole ID	BH07																	



Box 1 of 8: 0.0 m to 2.7 m



Box 2 of 8: 2.7 m to 4.8 m

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 2 of 4
Borehole ID	BH07	



Box 3 of 8: 4.8 m to 7.0 m



Box 4 of 8: 7.0 m to 9.1 m

G

Project	Smooth Hill Landfill Conse	nting
Client	Dunedin City Council	
Job number	12506381	Page 3 of 4
Borehole ID	BH07	



Box 5 of 8: 9.1 m to 11.2 m



Box 6 of 8: 11.2 m to 13.2 m

GH

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Project	Smooth Hill Landfill Conse	enting
Client	Dunedin City Council	
Job number	12506381	Page 4 of 4
Borehole ID	BH07	



Box 7 of 8: 13.2 m to 15.8 m



Box 8 of 8: 15.8 m to 20.0 m (EOH)

Project : Smooth Hill Landfill Consenting Hole No. : BH08 Client : Dunedin City Council Sheet : 1 of 2 Site : Big Stone Road Hole Length : 20.00m Job Number: 12506381 Scale @ A4 : 1:50																					
E	asti	ng:	3968	Commenced: 11/06/2019 09.71 Northing: 787700.67	Com Syste	plete em: ⁻	ed: 1 TAIE	1/06/2 TM20	<u>2019</u> 000		_ L	ogged : MF Processed : HB									
F	RL: 1	43	.89	Datum: NZVD2016				1	1		<u> </u> c	heck	ed		: JH	ş					
RL (m)	Denth (m)	(III) Indag	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	esult Result	Casing	Method	E Flush Return (%)	ر Weathering	www. Strength (MPa)	TCR SCR RQD (%)	²⁰ Defect	Spacing (mm)	Instrumentation Installation	Water level	0
F		25 0	<u>, , , , , , , , , , , , , , , , , , , </u>	TOPSOIL; silt, trace to minor clay, trace fine sand; dark g	grey oots	TS	М	VSt												Ē	J
1 1 143 ¹ 1			× × × × × × × × × × × × × × × × × × ×	SILT, trace clay, trace fine sand; grey mottled orange-bro Very stiff, moist, low plasticity (LOESS) 0.60 m: more orange-brown mottled grey	own.		Μ	VSt				PQTT				68					1
142	-	2	× * : × * : - × :	1.50 m: grey and brown mottled orange iron stained inclu	usions																
41 1 1 1	2-			1.84 - 2.86 m: CORE LOSS		LOESS						РОП				23				-2	2
	3 -	75 1 1 1 1 1 2.80	× × × × × × × × × × × × × × × × × × ×	Fine sandy SILT, trace clay; light grey-brown. Very stiff, o low plasticity 3.00 m: light grey and orange; iron stained laminations	dry,	+	D	VSt	-	SV@3m 194 kPa SV@3.5m UTP		PQTT				100				- 3	3
1 140	4 -	4.1 3.	× × × × ×	SILT, trace to minor clay, trace coarse sand (rusty); light and orange-brown. Very stiff to hard, moist, low plasticity SILT minor to some clay, brown with black floates and st	grey '		M	VSt-H	-			РОТТ				90				-4	4
-	-	4.4	. <u></u> 	Very stiff to hard, dry to moist, high plasticity; trace to mir organics (BURIED TOPSOIL)	nor	BTS	D-IVI	VOLI													
1 1 139	5 -	5.2 5	× × × × × ×	BRECCIA; very weak to weak; no defects; clasts: quartz schist, sub-angular to sub-rounded, fine gravel size; matr fine to coarse sand; matrix supported Highly weathered, grey and orange-brown SILTSTONE;	and rix:							РДТТ				100 100 100					5
138	6 -			\extremely weak to very weak; no defects Highly weathered, grey, orange-brown and yellow-brown BRECCIA; very weak to weak; no defects; clasts: quartz schist, sub-angular to sub-rounded, fine to medium grave	and el,									MH			-				6
1 1 1 2	-	6.2	<u>A_</u>	6.20 - 6.90 m: CORELOSS (inferred silty GRAVEL)		_						ДЦ				53 40					
- 1	7 -	7.4 7.1 6.9		Fine to medium GRAVEL; orange-brown, white, yellow-b and grey. Poorly graded; inferred silt matrix from minimal matrix recovery; gravel, quartz and schist, angular to sub-rounded	prown	LEY BRECCIA						P		MW		33				-7	7
1 1361	8 -	8.1 7.65	× × • • • • • • • • • • • • • • • •	Moderately weathered, grey, orange-brown and white BRECCIA; weak; gravel quartz and schist, angular to sub-rounded, fine to medium gravel; matrix: fine to coarse sand; matrix supported	e	E H H						атт С		SW		100 100					в
135	-			Slightly weathered, light grey fine to coarse SANDSTONE weak to weak; no defects Slightly weathered, light grey fine to coarse SANDSTONE weak to weak; no defects	E; very							A				100					~
341 1 1	9-			moderately strong; no defects; no visible bedding; matrix: to coarse sand, matrix supported; clasts: quartz and schis sub-rounded to angular, fine to medium gravel size 9.00 - 14.10 m: unweathered, fine to coarse gravel size o clast supported	: fine st, clasts,							PQTT		NN		93 93 93					9
É					Inclin-"	0001	/ort: .				iont-'	ion:					 ator			⊥ † 1	10
N F	otes nd of	an Hol	d Con e @ 20	1ments:	Contractor: McNeills						Hole dep	th									
G	round	dwa	ter not	encountered. No piezos were installed.	Equipm	ent:	UDR		ruck r	nounted)						(mbgl)	(mbgl)	-	
R	efer t	o ex	planati	on sheets for abbreviation and symbols	Shear V	/ane	ld: Gl	EO22	88												

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL.GPJ || LIbrary: GHD - NZGD.GLB || Date: 7 August 2019

		G	HI	Project : Smooth Hill Landfill Consenti Client : Dunedin City Council Site : Big Stone Road	ng						н Н	Hole Sheet Iole L	engt	D. h	: B : 2 c : 20	H08 of 2 .00m				
			-	Job Number: 12506381 Commenced: 11/06/2019	Corr	plete	ed: 1	1/06/2	2019		L	icale (ogged	<u>А @</u> d	4	: 1:5 : MF	50 =				
·	E	asting	: 3968	09.71 Northing: 787700.67	Syst	em:	TAIE	TM20	000		P	roces	sed		: HE	3				
	R	L: 143	3.89	Datum: NZVD2016		t t	_		Sai	mple	C	heck	ed		: JH	<u>s</u>				
	RL (m)	Depth (m)	Graphic	Material Description		Geological Uni	Moisture conditior	Consistancy / Relative density	Number / Type	Result	Casing	Method	Flush Return (%)	Weathering	<pre></pre>	TCR SCR RQD (%)	。 Defect Spacing (mm)	Instrumentation Installation	Water level	
HILL.GPJ Library: GHD - NZGD.GLB Date: 7 August 2019	126 121 122 128 129 130 131 132 133 133	$11 \qquad 12 \qquad 13 \qquad 14 \qquad 15 \qquad 16 \qquad 17 \qquad 17 \qquad 17 \qquad 17 \qquad 17 \qquad 17 \qquad 18 \qquad 17 \qquad 18 \qquad 18$		Slightly weathered, light grey and grey BRECCIA; weak moderately strong; no defects; no visible bedding; matri to coarse sand, matrix supported; clasts: quartz and scl sub-rounded to angular, fine to medium gravel size (con from layer starting at 8.1m) 11.20 m: fine to medium gravel sized clasts, moderately to strong 11.60 m: fine to coarse gravel clasts, weak to moderate strong 14.10 - 14.60 m: CORELOSS Unweathered, grey silty fine to medium SANDSTONE; weak to weak; no defects; no visible bedding 16.40 m: 100 mm breccia interbed Fine to coarse grained SANDSTONE, moderately stron strong, with very closely spaced very thin interbeded of sandstone; fine gravel.	to ix: fine hist, ntinued y strong ely 	HENLEY BRECCIA	Moist	Construction	Numt View View View View View View View View	Resu	Casir	Ратт Ратт Ратт Ратт Ратт Мень				RQD (%) 93 93 93 100 100 100 100 97		Insta	Wate	
3381 GINT LOGS SMOOTH	1 1251 1			strong to strong; no defects; no visible bedding; matrix: coarse sand; clasts: schist and quartz, angular to sub-r fine to coarse gravel size; clast supported 19.20 m: clasts predominantly medium to coarse grave	fine to ounded,							ΡΩΤΤ				100 100 100				- - - - - - - - - - - - - - - - - - -
oject: 1250t	124	19.5		Unweathered, light grey fine to coarse SANDSTONE; moderately strong to strong; no defects; well indurated; visible bedding	no	+						Рат				100 100 100				-
IG PI	Nc	ites ar	nd Con	End of Hole @ 20.00m,Target Depth.	Inclinat	ion: \	ı √ertic	al	I	Or	ientat	tion:			Gro	ound Wa	ater Lev	el		-26
AL_LC	Er	nd of Ho	ole @ 20	.00m, Target Depth.	Contra	ctor: I	McNe	eills							Dat	e Time	Reading (mbgl)	Hole der (mbgl)	pth	
ENER,	Gı	oundw	ater not	encountered. No piezos were installed.	Equipm	nent:	UDR	600 (ti	ruck r	nounted)				11/06	5/19 00:00		20)	
ID: GE	Re	efer to e	explanati	on sheets for abbreviation and symbols	Shear \	/ane	ld: G	EO22	88											
Report				·																

GHD

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 1 of 4
Borehole ID	BH08	



Box 1 of 8: 0.0 m to 3.7 m



Box 2 of 8: 3.7 m to 5.7 m

GH

Project	Smooth Hill Landfill Conse	enting
Client	Dunedin City Council	
Job number	12506381	Page 2 of 4
Borehole ID	BH08	



Box 3 of 8: 5.7 m to 8.7 m



Box 4 of 8: 8.7 m to 11.1 m

H

Project	Smooth Hill Landfill Conse	enting
Client	Dunedin City Council	
Job number	12506381	Page 3 of 4
Borehole ID	BH08	



Box 5 of 8: 11.1 m to 13.25 m



Box 6 of 8: 13.25 m to 15.9 m

GH

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 4 of 4
Borehole ID	BH08	



Box 7 of 8: 15.9 m to 18.0 m



Box 8 of 8: 18.0 m to 20.0 m (EOH)

		G	H	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Western Boundary Job Number: 12506381	g						н К	Hole heet lole L	eng @/	O . th	: 1 c : 1 c : 16 : 1:5	H09 of 2 .50m 50			
	F	sting	3950	Commenced: 12/06/2019	Com	plete	ed: 12	2/06/2 TM20	019 00			ogge	d ssed		: MF ; HF	. }			
	RI	.: 132	.8	Datum: NZVD2016	Oyon							heck	ed		: JH	S			_
	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / S	esult Besult	Casing	Method	E Flush Return (%)	ہ Weathering	<pre>*** Estimated *** Strength (MPa)</pre>	TCR SCR RQD (%)	。 befect Spacing (mm)	Instrumentation Installation Water Ievel	Water 1976.
	-			0.00 - 0.50 m: CORELOSS (FILL: reworked Loess)		FILL								2					
-	1132	1	× × × × × ×	SILT, trace to minor clay, trace fine to coarse sand, trace gravel; grey and orange-brown. Very stiff, moist, low plas gravel: angular, iron stained (LOESS) 0.90 m: brown	e fine sticity;	ESS	М	VSt				PQTT				67			
	-	1.1	×o × × v	Fine gravelly SILT, trace clay; yellow-brown and orange- Stiff to very stiff, moist, low plasticity	brown.	r O	м	St-VSt											
+	1131	2		1.50 - 2.40 m: CORELOSS *inferred Henley Breccia from minimal recovery															
-	-	2.4		Gravelly medium to coarse SAND; yellow-brown. Poorly		-						Рат				40			
-	- 1130 -	3 1 2.6	× ·× × ·×	graded; gravel: fine, quartz and schist, sub-angular to ro Sandy SILT, minor gravel, trace clay; yellow-brown, orange-brown and grey. Firm, moist, low plasticity. Grav to medium, guartz and schiet, angular to rounded. Sand	unded.	/ /	м	F											
-	129 - 1			to medium 10 - 9.10 m: CORELOSS *inferred gravelly sand (Henley Breccia) from minimal	/							μ				0			
	-	4		recovery		CIA						PG							- -4 -4
-	1128	-				NLEY BREC													
gust 2019	-	5				Ŧ						Рап				0			-5
Date: 7 Au	1127	6																	
IZGD.GLB	-		•••••••••••••••••••••••••••••••••••••••																
ary: GHD - N	1126	7-										PQT				0			7
.GPJ Libr	125																		
	-	8										атт				0			
T LOGS SM	124											<u>ш</u>							
06381 GIN	-	9.1		Slightly weathered, thinly laminated, grey silty fine SANDSTONE; very weak; very wide spaced defects		-										100			
^o roject: 125	123		· · · · · · · · · · · · · · · · · · ·									PQI		SW		93			
-0G F	No	es an	d Com	ments:	Inclinati	on: \	/ertic	al		Or	ientat	ion:			Gr	ound Wa		rel	
RAL_L	En	d of Ho	le @ 16	50m, Target Depth.	Contrac	tor: I	McNe	ills	uck ~	nountad	<u>،</u>				Dat	e Time	Keading (mbgl)	Hole depth (mbgl)	_
GENE					Shear V	ane	Id:	יייי (נו	uuk f	nounted)								
Report ID: (Re	fer to e	xplanatio	on sheets for abbreviation and symbols															

ting						н S	lole heet lole L cale	engti @ A). 1 4	: B : 2 c : 16 : 1:5	H09 of 2 .50m 50			
Com Syste	nplete em: ⁻	ed: 12 TAIE	2/06/2 TM20	2019 000		L	ogge roce:	d ssed		: Mf : He	= 3			
	Geological Unit	Moisture condition	Consistancy / Relative density	Vumber / ISA	gesnit	Casing	Method	Flush Return (%)	Neathering	Estimated Strength (MPa)	S TCR SCR RQD (%)	Defect Spacing (mm)	nstrumentation nstallation Mater level	
ıravel: 	HENLEY BRECCIA						ΡάΤΤ ΡάΤΤ ΡάΤΤ ΡάΤΤ ΡάΤΤ		SW SW		100 93 100 100 100 100 100 100 100 100 100			
Inclinat Contrac Equipm Shear V	ion: \ ctor: I ment: \ /ane	/ertic McNee UDR6	al iills	ruck n	Or	ientat	ion:			Gr Dat 12/00	pund Wa pound Wa re Time 3/19 00:00	ater Lev Reading (mbgl) 1 13.5	rel Hole depth (mbg)) 33 16.5	
	ing Com Syst Syst Inclinat Contrac Equipm Shear V	ing Complete System: 7 System: 7 System: 7 Shear Vane	ing Completed: 12 System: TAIE System: TAIE Inclination: Vertice Contractor: McNee Shear Vane Id:	ing Completed: 12/06/2 System: TAIETM20 System: TAIETM20 ing ing ing System: TAIETM20 ing ing ing System: TAIETM20 ing ing ing ing System: TAIETM20 ing ing ing ing ing ing ing ing	ing Completed: 12/06/2019 System: TAIETM2000 System: TAIETM2000 Inclination: Vertical Inclination: Vertical Inclination: Vertical Contractor: McNeills Equipment of the provided of	ing Completed: 12/06/2019 System: TAIETM2000 itin Sample itin itin itin itin iso itin iso itin itin iso iso iso itin iso itin iso iso iso iso iso iso iso ravel: iso iso iso iso iso iso iso uartz iso iso	ing H S Completed: 12/06/2019 L System: TAIETM2000 C Output N Suppose N Output N Output N Output N Output N Output N	ing Hole Sheet Hole L Scale Completed: 12/06/2019 System: TAIETM2000 Tarvel: uartz Holination: Vertical Inclination: Vertical Incl	ing Hole Na Sheet Hole Length Scale @ A Completed: 12/06/2019 Completed: 12/06/2019 System: TAIETM2000 Checked Travel: uartz uartz Hole Na Sample to the search to the s	ing Hole No. Sheet Hole Length Scale @ A4 Completed: 12/06/2019 Cogged Processed Checked Check	ing Hole No. : B Sheet : 2 C Hole Length : 16 Source Q A4 : 17 Logged : M Processed : HE Checked : JH	ing Hole No. : BH09 Sheet :	ing Hole No. : BH09 Sheet : : 2 of 2 Hole Length :: 16.0m Scale @ Ad :: 1:50 Completed:: 12/06/2019 System: TALETM2000 Processed : :HB Checked ::JHS image: state in the	ing Hole No. : BH09 Sheet :: 2 of 2 Hole Length :: 1:50 Completed: 12/06/2019 Logged :: HF System: TALETM2000 Processed :: HB Checked :: HB Table 0:: Some 0:: HB ::: Some 0:: Some

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 1 of 2
Borehole ID	BH09	



Box 1 of 3: 0.0 m to 9.6 m



Box 2 of 3: 9.6 m to 11.7 m

GHD

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 2 of 2
Borehole ID	BH09	



Box 3 of 3: 11.7 m to 16.5 m (EOH)

E	G	g: 39	D 6788.	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Smooth Hill Eastern ridge Job Number: 12506381 Commenced: 4/06/2019 8.26 Northing: 788118.5	IG Comp Syster	olete m: ⁻	ed: 5/	06/20 TM20) <u>19</u>)00		H S L P	Hole heet ole L cale ogge	eng @_/ d ssed	O . th ∖4	: B : 1 o : 20. : 1:5 : MF : HB	H10 f 3 00m 0				_
R (m) 1)epth (m)	10.02		Datum: NZVD2016 Material Description		Geological Unit	Aoisture condition	consistancy / telative density	Jumber / Sat	esult	asing C	Aethod Method	Flush Return (%)	Veathering	Estimated Strength (MPa)	TCR SCR RQD	Defect Spacing (mm)	nstrumentation	nstallation Vater level	-
2	- - - - - - - - - - - - - - - - - - -	0.25 0		0.00 - 0.25 SILT, trace fine sand, trace clay; brown. Firm stiff, moist, low plasticity. (TOPSOIL). 0.25 - 1.60 CORELOSS	n to /	TOPSOIL	<u>></u> M	F-St		22	0	PQTT	25 50 7	5 5		12	20 00 200 200			
	2-	6 2.4 × × × 1.6 	× 1 × 1 × n × 2	 1.60 - 2.40 Fine sandy SILT; light greyb& yellow brown. moist, low plasticity. 2.40 - 2.60 Completely weathered to residual soil, fine to 	Stiff,	OESS	M	St				РДТТ		w-RS		136				
	3	3.3 3.3 3.3 5.2 2. : x x x x x 0 . 0 . 0	C U 2 U 2 U (3 Y (3 Y (coarse SAND, minor silt; colour unspecified. Density unspecified, moist, poorly graded. (HENLEY BRECCIA). 2.60 - 3.30 High weathered, pebbly coarse SAND; colou unspecified. Density unspecified, moist, poorly graded. (Heavily weathered, very weak to weak rock?). 3.30 - 4.90 Moderately weathered, grey, orange brown & yellow brown SILTSTONE; very weak to weak, no defect (HENLEY BRECCIA).	 ır & ts.	ΓC	Μ					РАТТ		HW O	-	93 93				
	4	4.9 : :×××××××××××××××	$\begin{array}{c c} \times & \times \\ \times \\$	At 4.3 m, 300 mm SANDSTONE layer.	brown							атт		MW	-	86				-4
	6		fi Ii	fine SANDSTONE; very weak to weak; no defects. Occa lignite inclusions. At 5.5 m: 140 mm SILTSTONE layer.	asional	Henley Breccia						₫		MW		86				
	7-	7.05 6.6 ×××× 0 0 : : : :	C G 9 C C 8 X X X X	 6.60 - 7.05 Moderately weathered, orange brown, white grey, fine to medium pebbly CONGLOMERATE; very we weak; coarse sand matrix, matrix supported. Clasts are c & schist, sub angular to rounded. 7.05 - 7.60 Moderately weathered, light grey & orange brown and the section of the section of	& eak to quartz rown							Ραττ		MW WW	-	93 93				- - - - - - - - - - -
	8	9: <i>E</i> 7.7		SILTSTONE; very weak to weak; no defects noted. 7.60 - 7.72 Moderately weathered, orange brown, white grey, fine to medium pebbly CONGLOMERATE; very we weak; coarse sand matrix, matrix supported. Clasts are of & schist, sub angular to rounded. 7.72 - 8.80 Inferred CORELOSS. Offisiders dropped rod & bent end & it did not pick up con	& , eak to / quartz / / re.			n				ΡΩΤΤ		Λvψ		28 28				
	9-	9.55 9.1 8.8	8 C 9 C 9 S S S S S S S S S S S S S S S S S S S	 8.80 - 9.10 Inferred CORELOSS depth. 9.10 - 9.55 Moderately weathered, orange brown, white grey, fine to medium pebbly CONGLOMERATE; very we weak; coarse sand matrix, matrix supported. Clasts are of & schist, sub angular to rounded. 9.55 - 11.40 Slightly weathered, grey SANDSTONE; very 	& eak to quartz y weak			"				ΡΩΤΤ		SW MW		75 75				9
No	tes a	and C	Comm	nents:	Inclinatio	on: V	/ertica	al		Or	ientat	ion:			Gro	ound Wa		vel		$\begin{bmatrix} T \\ T \end{bmatrix}$
Er Ho	id of H ble ext	Hole @	20.00 to find	Um, Target Depth.	Contracte Equipme	or: N ent: I	McNe Moun	ills ted Ri	ig						Date	e Time	(mbgl)	y Hi (n	ne aepth 1bgl)	-
Gr Re	ound	water a	at 10.17	17 mbgi 07/06/2019. I sheets for abbreviation and symbols	Shear Va	ane	ld:		-											

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL - HB PROCESSING - KB EDITS.GPJ || Library: GHD - NZGD.GLB || Date: 9 March 2021

G	3967	Project : Smooth Hill Landfill Consenting Client : Dunedin City Council Site : Smooth Hill Eastern ridge Job Number: 12506381 Commenced: 4/06/2019 88.26 Northing: 788118.5	g Comj Svste	plete	ed: 5/	06/20)19		H S L P	Hole heet lole L cale ogged	engt @_A d	0. h 4	: E : 2 (: 20 : 1:: : MI : HE	5H10 of 3 .00m 50 =			
RL: 139	.07	Datum: NZVD2016			1	1	-			heck	ed		: JS				
RL (m) Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Jype	esult generation with the second seco	Casing	Method	Flush Return (%)	Weathering	*Estimated Strength (MPa)	TCR SCR RQD (%)	Defect Spacing (mm)	nstrumentation installation Mater level	
		to weak; thinly bedded (1-10 mm). Only artificial breaks. Occasional lignite.								_	25 50 75	5			200000000000000000000000000000000000000		10
- - - - - - - - - - - - - - -		From 10.4 m, becomes yellow brown, fine to coarse SANDSTONE.								Ратт		SW		106 81			- - - - - - - - - - - -
12		strong. 11.60 - 17.40 From 11.6 m, becomes very weak to weak												114			- - - - - - - - - - - - -
13		Note: From 15.5 m: lignite content increases. From 15.6 m: 40 mm lignite. From 15.8 m: 100 mm lignite rich layer.								PQT				96			- - - - - - - - - - - - - - - - - - -
14										ΡΩΤΤ				92 92			- - - - - - - - - - - - -
15				ey Breccia						PQTT				89			- - - - - - - - - - -
16 - - - - - - - -	· · · · · · · · · · · · · · · · · · ·			Hen													- - - - - - -
17 - - - - - - -	· · · · · · · · · · · · · · · · · · ·	17.40 - 17.65 From 17.4 m, becomes moderately strong	to							Ратт				103 100			- - - - - - - - -
- - - - - - - - - - -		strong, well indurated. 17.65 - 19.20 From 17.65 m, becomes very weak to wea poorly indurated.	ık,														- - - - - - - - -
										ΡQΠ				100			- - - - - - 19 -
	· · · · · · · · · · · · · · · · · · ·	strong, moderate to well indurated.	У							PQTT				100 100			
-	::::	19.80 - 20.00 From 19.8 m, becomes moderately strong	to Inclination	on [.] \	/ertic	 al		Or	 ientət	ion [.]			 Gr	 ound Wa	iiiii Pc ater Level		-20-
End of Ho	u Con le @ 20	0.00m, Target Depth.	Contrac	tor: I	McNe	ills		0	ionidi				Da	te Time	Reading	Hole depth	1
Hole exter Groundwa	ided to the ter at 10	find groundwater. 0.17 mbgl 07/06/2019.	Equipmo Shear V	ent: 'ane	Moun Id:	ted Ri	g						07/0	6/19 00:00	10.17	20	
	au																

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL - HB PROCESSING - KB EDITS.GPJ || Library: GHD - NZGD.GLB || Date: 9 March 2021

Project : Smooth Hill Landfill Consecution Client : Dunedin City Council Site : Smooth Hill Eastern ridge Job Number: 12506381 Commenced: 4/06/2019 Easting: 396788.26 RL: 139.07 Datum: NZVD2016						ill Conser ncil rn ridge	nting <u>Com</u> Syste	Ing Hole No. : BH10 Sheet : 3 of 3 Hole Length : 20.00m Scale @ A4 : 1:50 Completed: 5/06/2019 Logged : MF System: Processed : HB													-		
RL: 139	.07			D	atum: Nz	VD2016	6		1					_ c	heck	ed		: JS					_
RL (m) Depth (m)	Graphic			М	laterial D	escripti	on		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	esult Besult	Casing	Method	E Flush Return (%)	Weathering	w ^w Estimated Strength (MPa)	TCR SCR RQD (%)	∞ ◎ Defect ∞ Spacing (mm)	Instrumentation Installation	Water level	
21 22 23 24 25 26 27 28 28 29		End	g, well Indi of Hole @ :	urated. 20.00m,	Target D	epth.																	-21 -22 -23 -24 -25 -26 -27
-																							- 30
Notes an	d Con	nments	S:					Inclinat	ion: \	/ertica	al		Or	ientat	ion:			Gro	und Wa	ater Lev	el	- 41-	30
End of Hole @ 20.00m, Target Depth. Hole extended to find groundwater.						Contractor: McNeills Date Time							Reading (mbgl)	Hole depth (mbgl)									
Groundwater at 10.17 mbgl 07/06/2019.					Equipment: Mounted Rig																		
Refer to ex	Refer to explanation sheets for abbreviation and symbols					Snear	, ane	ıu.															

GH

Project	Smooth Hill Landfill Conse	nting
Client	Dunedin City Council	
Job number	12506381	Page 1 of 4
Borehole ID	BH10	



Box 1 of 8: 0.0 m to 3.2 m



Box 2 of 8: 3.2 m to 5.8 m

GH

Project	Smooth Hill Landfill Conse	nting
Client	Dunedin City Council	
Job number	12506381	Page 2 of 4
Borehole ID	BH10	



Box 3 of 8: 5.8 m to 9.2 m



Box 4 of 8: 9.2 m to 11.6 m

Project	Smooth Hill Landfill Conser	nting
Client	Dunedin City Council	
Job number	12506381	Page 3 of 4
Borehole ID	BH10	



Box 5 of 8: 11.6 m to 13.8 m



Box 6 of 8: 13.8 m to 16.0 m

Project	Smooth Hill Landfill Conse	enting
Client	Dunedin City Council	
Job number	12506381	Page 4 of 4
Borehole ID	BH10	



Box 7 of 8: 16.0 m to 18.4 m



Box 8 of 8: 18.4 m to 20.0 m (EOH)

E	G	H 9: 3959	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Manuka Gully (Stockpile Area Job Number: 12506381 Commenced: 12/06/2019 88.85 Northing: 788077.23	Hole No. : TP01 Sheet : 1 of 1 Hole Area) Hole Length : 2.50m Completed: 12/06/2019 Logged : 11:25 System: TAIETM2000 Processed : HB Checked : ME														
R	L: 12	1.2	Datum: NZVD2016			1	1	Sam			heck	ed		: MF				
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	Besult	Casing	Method	E Flush Return (%)	Weathering	www. ww. Strength (MPa)	TCR SCR RQD (%)	™ Defect ™ Spacing (mm)	Instrumentation Installation	Water level
54	-	<u>, , , , , , , , , , , , , , , , , , , </u>	SILT, trace to minor clay; dark grey-brown. Firm, wet, lo plasticity; minor to some organics/roots (TOPSOIL)	WC	TS	W	F					Ĩ	, 					-
-	-0		SILT, trace clay, trace fine to medium sand; light grey w orange streaks. Stiff to very stiff, moist, low plasticity; iron-stained organics throughout (ALLUVIUM)	vith	ALLUVIUM	м	St-VS	t										-
-		× × × × × × × × × × × × × × × × × × ×	Gravelly SILT, minor clay, minor fine to coarse sand; orange-brown. Very stiff, moist to wet, low plasticity; gra fine to medium, quartz and schist, sub-angular to round highly weathered rock (HENLEY BRECCIA)	avel: led;		M-W	VSt											1
1 1120		× × × × × × × × × × × × × × × × × × ×	1.10 m: grey with some orange-brown		HENLEY BRECCIA								MH					-
1119	2-	$ \begin{array}{c} \overset{x_1}{\longrightarrow} \\ & \overset{x_2}{\longrightarrow} \\ & \overset{x_3}{\longrightarrow} \\ & \overset{x_4}{\longrightarrow} \\ & \overset{x_5}{\longrightarrow} \\ & \overset{x_5}{\longrightarrow} \\ & \overset{x_6}{\longrightarrow} \\ & \overset{x_7}{\longrightarrow} \\ & \overset{x_7}{\longrightarrow$	Slightly weathered, grey with black streaks SILTSTONE weak; ripped easily with toothed excavator bucket	E; very	_								SW					-2
			End of Hole @ 2.50m, Target Depth.															
1 117 1	4																	-4 4
╞	_																	
				Inclination	on: \	/ortic	 		0-	 iontat	ion:			Gro		ter I av	<u> </u>	-5
NO Er	nd of F	na Con Iole @ 2.	imenis: 50m, Target Depth.	Contrac	tor: I	Fultor	n Hoa	an	U	ond	юп.			Date	Time	Reading	Hole dep	oth
Sc Gr Re	oils too oundv	gravelly vater see	for shear vane. bage into test pit at 1.0 mbgl on sheets for abbreviation and symbols	Equipmo Shear V	ent: : ane	22t ex Id:	- ع kcavat	or - to	oothed b	ucket						(IIIDGI)	(TIDDI)	
2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 2 X × 0 3 X × 0 3 X × 0 3 X × 0 4 X × 0 5 X × 0 4 X × 0 5 X × 0 4 X × 0 5 X × 0 4 X × 0 4 X × 0 4 X × 0 4 X × 0 4 X × 0 5 X × 0 4 X × 0 5 X × 0 5 X × 0 5 X × 0 5 X × 0 4 X × 0 5 X × 0 5 X × 0 5 X ×																		

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL.GPJ || Library: GHD - NZGD.GLB || Date: 29 July 2019

			Project : Smooth Hill Landfill Consentin	ng						H	lole	e N	0.	: ٦	P02	2			
	C	łΤ	Site : Manuka Gully (Stockpile Are	a)						H	lole L	_engt	h	: 1	60m				
		-	Job Number: 12506381	Com	nlata	d. 11		0010		S	cale	<u>@</u>	\ 4	: 1: • M	25				
E	asting	g: 3961	Commenced: 12/06/2019 03.5 Northing: 788056.91	Syste	piele em: ⁻	TAIE	Z/06/2 TM20	000		- L	roce	:u ssed		: H	В				
R	L: 11	0.4	Datum: NZVD2016			[1			_ c	heck	ked		: M	F				
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Ispe	elqn Resnt	Casing	Method	Flush Return (%)	Weathering	* Estimated	SC SC RC	R R D 6)	。 Defect Spacing (mm)	Instrumentation Installation	Water level
110	-		SILT, trace to minor fine sand, trace to minor clay; brow Firm, moist, low plasticity; minor organics/roots (TOPS)	vn. OIL)	TOPSOIL	М	F		SV@0.3m 65/17 kPa			26 50 7	5	w > 5 8 3			20 00 00 00 00 00 00 00 00 00 00 00 00 0		12-06-2019 12-06-2019 geopage into test pit at 0.4 mbgl
109 1 1 1			Silty SAND, trace clay; light grey with orange-brown stru 'Loose to medium dense', poorly graded; sand: fine (COLLUVIUM)	eaks.	COLLUVIUM		'L-MD'												Groundwaters
-			SILT, minor clay, trace to minor fine sand; brown. Firm, low plasticity; wood fragments throughout layer, most a (BURIED TOPSOIL)	, moist, t top	BURIED TOPSOIL	Μ	F		SV@1.8m 90/33 kPa										
108		××× ××××××××××××××××××××××××××××××××××	Gravelly SILT; grey. Wet, well graded; gravel: fine to co (ALLUVIUM) Slightly weathered, grey SILTSTONE; ripped easily with toothed bucket (HENLEY BRECCIA)	harse	HB ALLUVIUM	W							SW	-					
	3		End of Hole @ 2.60m, Target Depth.																
	otes a	and Con tole @ 2.0	ments: 0m, Target Depth.	Inclinati Contrac	on: V tor: F	/ertica Fultor	al n Hoga	an	Ori	ientat	ion:			G	round	Wat	er Lev Reading (mbgl)	el Hole de (mbgl)	pth
	roundw efer to	vater seep explanati	age into test pit at 0.4 mbgl.	Equipm Shear V	ent: 2 ′ane	22t ex ld: Gl	kcavat EO228	or - te 38	oothed b	ucket	:			12/	D6/19 C	00:00	0.4	2.	6

		G		Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Manuka Gully (Stockpile Area	ng a)						H s	Hole	e No	0. h	: TI	P 03 f 1 0m			
		2		Job Number: 12506381	.,	nlet	d. 11	DIDEI	2010		S		<u>@</u> A	4	: 1:2	5			
	Eas	sting	: 3962	62.16 Northing: 788048.16	Syste	piete em: [·]	TAIE	TM20	2019			Proce	ssed		: HB				
-	RL	102	2.61	Datum: NZVD2016			_		Sar	nple	c	heck	ked		: MF				
()		Depth (m)	Graphic	Material Description		Geological Uni	Moisture conditior	Consistancy / Relative density	Number / Type	Result	Casing	Method	Elush Return (%)	Weathering	™ ™Estimated Strength (MPa)	TCR SCR RQD (%)	²⁰ ²⁰⁰ Defect ²⁰⁰ Spacing (mm)	Instrumentation Installation	Water level
				SILT, trace to minor fine sand, trace to minor clay; brow Soft, moist to wet, low plasticity; minor organics/roots (TOPSOIL)	/n.	TOPSOIL	M-W	S											
-			× · · × · · ×	Silty SAND, trace clay; light grey with brown streaks. Mo poorly graded; sand is fine (ALLUVIUM)	oist,	MUIN	М												▲ 2019 5-2019 untered at 1.2 mbgl.
101			x x x x x x x x x x x x x x x x x x x	Gravelly SILT; grey. Wet to saturated, well graded; grav- to coarse	el: fine	ALLU	W - S												12-0 Groundwater enco
-		2	(Slightly weathered, grey SILISTONE; extremely to very no defects - ripped easily (HENLEY BRECCIA)	weak;	또								SW					
ן ד נטפ נו	lote	es ar	nd Con	nments:	Inclinati	on: \	/ertica	al		Or	iental	tion:	I	-1	Gro	ound Wa	ter Lev	rel Hole de	pth
	Test	t pit s undw	ides too ater enc	soft to get shear vane readings. suntered at 1.2 mbgl.	Equipm	ent: 1	-uitor 22t e>	i Hoga kcavat	an tor - to	oothed b	ucket	t			12/06	= 11me /19 00:00	(mbgl) 1.2	(mbgl) 2	
Report ID: Gi	Refe	er to e	explanati	on sheets for abbreviation and symbols	Shear ∖	/ane	Id:												

F	C		39628	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Southwest Gully Base Job Number: 12506381 Commenced: 13/06/2019	ng Com	plete	ed: 1;	3/06/2	<u>2019</u>		H S L	Hole heet ole L cale ogge	e No Lengt @ A d	0. h 4	: T : 1 (: 3.) : 1); : M : H	P05 of 1 30m 25 =			
גר (m) אר בי	L: 1:	25	Braphic	Datum: NZVD2016 Material Description		Geological Unit	Aoisture condition	Consistancy / Relative density	Jumber / Sa	mple	asing	Vethod	Flush Return (%)	Veathering	Estimated Strength (MPa)	TCR SCR RQD	Defect Spacing (mm)	nstrumentation nstallation	Vater level
-	-			SILT, minor clay; brown. Soft, wet to saturated, low plas minor organics throughout (TOPSOIL)	ticity;	TOPSOIL	W-S	S	2 F			2	25 50 7	5 >	EW W W M 8		20 00 00 20 20 20 20 20 20 20 20 20 20 2		>
24 I	-	0.7	× . × × .	Silty fine to medium SAND; grey and yellow-brown. 'Loo wet, poorly graded (COLLUVIUM)	ose',		w	'L'	-										
_	1 - -			Fine to coarse SAND, minor to some silt; grey with black streaks. 'Loose', saturated, poorly graded; organics through the streak	k ughout		S	"L"	-										
-	-			Tree trunks and branches with some gravel. Groundwate outflow from base of layer	er	Ō													into pit.
	- 2 - - - - - -		<pre></pre>	SILT, minor clay, trace fine sand; grey with yellow-brown streaks. Stiff, moist, low plasticity; highly weathered rock (HENLEY BRECCIA)	ח ג	ENLEY BRECCIA	М	St	-					MH					13-06-2019 Groundwater flowing
1122	- 3- -	2	× × × × × × × × × × × × × × × × × × ×	Slightly weathered, SILTSTONE; ripped easily										SW					
121		-	× × .	End of Hole @ 3.30m,Target Depth.															
120 1 1 1	-																		
No E	nd of	And Hole	d Com e @ 3.3 planatio	on sheets for abbreviation and symbols	Inclinati Contrac Equipm Shear \	ion: \ ctor: I ient: : /ane	/ertic Fultor 22t e: Id:	al n Hoga kcavat	an tor - ti	O oothed I	rientat	ion:			Gr Da 13/0	ound W te Time 6/19 00:00	ater Lev Reading (mbgl) 0 1.9	Hole de (mbgl) 3.	pth .3

E	G	H) 1: 3965	Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Gully East of Central Ridge Job Number: 12506381 Commenced: 13/06/2019 35.7 Northing: 787800.45	1g Com Syste	plete em: ⁻	ed: 1; TAIE	3/06/2 TM20	<u>2019</u>)00		H S L P	Hole heet ole L cale ogge roce	e No Lengtl @ A id ssed	D. h 4	: T : 1 c : 2.5 : 1:2 : MF : HB	P06 of 1 00m 25			
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Paral International I	Sesult	Casing	Method	Elush Return (%)	Weathering	* Estimated	TCR SCR RQD (%)	° ∞ Defect ∞ Spacing (mm)	Instrumentation Installation	Water level
1 108			Organic SILT, minor clay; dark brown-grey. Firm, moist plasticity; minor to some roots (TOPSOIL)	, low	TOPSOIL	м	F					25 50 75				2002		
106 1 1 1 1 107 1 1 1		x x x x x x x x x x x x x x x x x x x	SILT, minor clay, light grey with orange-brown streaks. moist, low plasticity; minor organic inclusions (ALLUVIU	Stiff, JM)	ALLUVIUM	М	St	-										
		× × × × × × × × ×	SILTSTONE; difficult to rip (HENLEY BRECCIA) End of Hole @ 2.50m, Target Depth.		뚝													
1 1 105 1 1																		
1 1 1 104	4			1														
Re	tes and of He	nd Con ole @ 2.: explanati	iments: i0m, Target Depth. on sheets for abbreviation and symbols	Inclinati Contrac Equipm Shear V	on: \ etor: F ent: 2 /ane	/ertic ⁼ ultor 22t e: Id:	al n Hog xcava	an tor - to	Or	rientat	ion:			0 Gro	e Time	eter Lev Reading (mbgl)	Hole de (mbgl) 2.	5

	G	H	Project : Smooth Hill Landfill Consenti Client : Dunedin City Council Site : Southwest Gully Base Job Number: 12506381 Commenced: 28/05/2019	ng	plete	ad: 28	3/05/2	2019		H S H S	Hole heet lole L icale	e N _eng @/	O . th \4	: 2	TF 1 of 2.50 1:25 MF	P07 1 0m 5			
Ea RL	stin	g: 3961 20	82 Northing: 787790 Datum: NZVD2016	Syste	em:	TAIE	TM20	000		P C	roce heck	ssed ked	I	: H : N	HB MF				
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Salary	esult Besult	Casing	Method	Flush Return (%)	Weathering	Estimated	strength (MPa)	TCR SCR RQD (%)	。 befect Spacing (mm)	Instrumentation Installation	Water level
-	-	0 <u>24 12</u> 2 17 24 12 24 24 24 24 24 24 24 24 24 24 24 24 24	SILT/organic matter, brown. Soft, moist to saturated, fil non plastic (TOPSOIL)	brous,	TOPSOIL	M-W	S					25 50 1	2				N 0 N 0 N		
-			SILT, minor clay, trace fine sand; light grey and yellow- Stiff to very stiff, moist, low plasticity (LOESS)	brown.	ROESS	М	St-VS	t			TP								19
	2-	4 ××××××××××××××××××××××××××××××××××××	Slightly weathered, grey SILTSTONE; weak to moderat strong; no defects (HENLEY BRECCIA)	tely	HENLEY BRECCIA														28-02-201
	3-		BRECCIA End of Hole @ 2.50m,Target Depth.																
2	4																		
- <u>2</u> Not	es a	and Cor Hole @ 2	nments: 50m, Target Depth.	Inclinati Contrac	on: \	/ertica Fultor	al 1 Hog	an	Or	ientat	ion:				Grou	und Wa	ater Lev Reading (mbgl)	/el Hole de (mbgl)	epth
Ref	er to	explanat	on sheets for abbreviation and symbols	Equipm Shear V	ent: /ane	22t ex Id:	cava	tor - s	mooth b	oucket				28	3/05/1	19 00:00	1.4	2	.5

		H	Project : Smooth Hill Landfill Consenti Client : Dunedin City Council Site : Gully Between Southern Rid Job Number: 12506381 Commenced: 28/05/2019	ing Iges Comp	olete	ed: 28	3/05/2	2019		 	Hole iheet lole l icale ogge	e N ∟eng @/	O. th \\4	: T : 1 : 4. : 1: : M	P08 of 1 50m 25 F			
R	astii L: 1	ng: 396 15	303 Northing: 787682 Datum: NZVD2016	Syste	m: ⁻	TAIE	TM20	000		P	roce hecl	ssec (ed		: HI : M	B F			
RL (m)	Denth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sa Type	mple tesnt	Casing	Method	Elush Return (%)	Weathering	™ ‴Estimated sstrength (MPa)	TCR SCR RQD (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
-			SILT, minor clay, trace fine sand; dark grey. Firm to sti moist, low plasticity;, minor organic matter (FILL)	iff,	FILL	M	F-St											
114	1-		 SILT, minor clay, trace fine sand; dark grey. Firm to still low plasticity; trace to minor organics (BURIED TOPSC) Silt is a strategy of the still strategy of the s	iff, wet, OIL)	BURIED TOPSOIL	W	F-St	-										
113 1 1 1	2-		SILT, minor to some clay, trace fine sand; light grey an yellow-brown. Stiff to very stiff, moist, low plasticity; tra organics (LOESS)	nd ace		M	St-VSI	t										
1 1 1 1 1 1	3-				LOESS													
1111	- - - - - - - - - - - - - - - - - - -		SILT, some coarse sand, minor fine gravel; light grey. S very stiff, moist, non-plastic; gravel comprises quartz ar schist; highly weathered rock (HENLEY BRECCIA)	Stiff to ind	HENLEY BRECCIA	M	St-VS1	t					MH					
110			End of Hole @ 4.50m,End of Reach.						I									
No Er	tes nd of	and C Hole @	4.50m, End of Reach. ation sheets for abbreviation and symbols	Inclination Contract Equipme Shear V	on: \ tor: f ent: 2 ane	/ertica Fultor 22t e> Id:	al n Hoga kcavat	an tor - s	O smooth I	riental	tion:			Gr Da 28/0	round W tte Time 15/19 00:00	Reading (mbgl)	Vel Hole de (mbgl) 4.	pth

	0		H	Project : Smooth Hill Landfill Consenti Client : Dunedin City Council Site : South East Gully Outflow Job Number: 12506381	ng				0040		н s	lole heet ole L cale	engt	0. h 4	: TI : 1 o : 3.0 : 1:2	P09 f 1 0m 5			
E	Eastir RI · 1	ng: 01	3965 04	7.97 Northing: 787947.86	Syst	em: [·]	TAIE	TM20	2019 000		P	roce heck	u ssed æd		: MF				
RL (m)	Denth (m)		Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / BS	Sesult	Casing	Method	Flush Return (%)	Weathering	**************************************	TCR SCR RQD (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
-	-		× × × × × × × × × × × × × × × × × × ×	SILT, minor fine to coarse gravel; yellow-brown and gre moist, low plasticity; minor organic content (SLIP DEBI	ey. Stiff, RIS)	LIP DEBRIS	м	St					- 49 50 7	,			n e n e n		
-	-	.7 0.5 0.4	× × × × × × × × × × × × × ×	Branches and grass (BURIED VEGETATION) SILT, minor clay; brown. Firm to stiff, moist, low plastic (BURIED TOPSOIL)	city	BTS	м	F-St	-										
100	- - 1- -		x o x	Gravelly silty SAND; orange-brown. Moist, poorly grade gravel is fine; sand is fine to coarse (ALLUVIUM) 1.00 m: light grey and orange-brown	ed;		м												
-	-		× • × • × • × • ×	1.30 m: light grey with orange-brown streaks		ALLUVIUM													
	2 - - - - -																		
98	- 	57		Fine SANDSTONE; easily ripped (HENLEY BRECCIA))	ΗB													
	-	-		Eng of Hole @ 3.00m, rarget Depth.															
	- 4 - - -	-																	
	-	-																	
	otes ind of	and Hol	d Con le @ 3.	ments: I0m, Target Depth.	Inclinat	ion: \	/ertic	al		O	rientat	ion:			Gro	ound Wa	Reading	vel Hole de	epth
	est pil	t du	g to sic	e of gully base - too boggy in gully base to excavate	Equipm Shear \	ient: /ane	22t E Id:	xcava	tor								(mbgl)	(mbgl)	

			Project : Smooth Hill Landfill Consenting Client : Dunedin City Council)						ŀ	lole	e No	Э.	: TI	P10			
	G	Н	Site : Future Laydown Area							H	ole L	.engtl	n	: 3.6	0m			
		-	Job Number: 12506381	Comp	loto	d. 10	06/2	010		S	cale	<u>@ A</u> d	4	: 1:2 · MF	5			
Ea	asting	: 3968	20.11 Northing: 788079.25	Syster	m: 1	TAIE	ГМ20	00		P	roce	ssed		: HB				
RL	_: 140).74	Datum: NZVD2016							c	heck	ed		: MF	1			
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	eldu	Casing	Method	Elush Return (%)	Weathering	w wEstimated ssStrength (MPa)	TCR SCR RQD (%)	° Defect ∞Spacing (mm)	Instrumentation Installation	Water level
_		$\frac{\sum_{i=1}^{n} \frac{1}{2} \cdot \sum_{i=1}^{n} \frac{1}{2}}{\sum_{i=1}^{n} \frac{1}{2} \cdot \sum_{i=1}^{n} \frac{1}{2}$	SILT, trace to minor clay, trace fine sand; dark grey. Very moist, low plasticity; tree roots throughout (TOPSOIL)	^r stiff,	TOPSOIL	М	VSt					20010						
1 140 1	- 7 0 - - - - - - - - - - - - -	× × × × × × × × × × × × × × × × × × ×	SILT, minor clay; light grey and yellow-brown. Very stiff, n low plasticity; root webs throughout (LOESS)	noist,		М	VSt		SV@0.5m 136/62 kPa SV@1m									
-			SILT, minor fine sand, trace clay; orange-brown and light Very stiff, dry, low plasticity	grey.	-	D	VSt		194 kPa									
139	-				LOESS				SV@1.5m 194 kPa									
-	2 - 2		SILT, minor fine sand, trace clay; orange-brown. Very stif low plasticity; iron-stained horizon	ff, dry,	-	D	VSt	220	SV@2m 194 kPa									
-	-	× × × × × ×	SILT; orange-brown and grey alternating. Very stiff, dry, non-plastic			D	VSt	00000000	SV@2.5m UTP									
1 138								21010101010	SV@3m									-
-	-	* * * * * * * * * * * *	Highly weathered SILTSTONE (HENLEY BRECCIA) 3.00 - 3.60 m: hard, root webs visible in places		HENLEY BRECCIA		Н	00000000000	UTP SV@3.5m				МН					
1 137			End of Hole @ 3.60m, Target Depth.					3.60										
_	4																	
136 İ	-																	
Ļ																		
Not	tes ar	nd Cor	Inments:	Inclinatio	on: V	ertica	al	I	Or	ientat	ion:	I		Gro	ound Wa	ater Leve	el	
En	d of Ho	ole @ 3.	60m, Target Depth.	Contracto	or: F	ulton	Hoga	an						Date	e Time	Reading (mbgl)	Hole dept (mbgl)	th
EC Gro	OH at 3 oundw	.6 mbgl ater not	too hard to dig/end of reach. encountered.	Equipme	ent: 2	22t ex	cavat	or										
Refer to explanation sheets for abbreviation and symbols																		

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL.GPJ || Library: GHD - NZGD.GLB || Date: 29 July 2019

	0	iH	D	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Future Laydown Area Job Number: 12506381	ng				0.45		н S	heet lole L	engt	0. h 4	: T : 1 c : 3.6 : 1:2	P11 of 1 30m 25			
F	Eastii RL: 1	ng: 39 41.24	96907.0	D3 Northing: 788032.98 Datum: NZVD2016	Syste	em: ⁻	TAIE	TM20	2019 000		- - P C	roce heck	u ssed æd		: IVII : HE : MI	3 =			
RL (m)		Cepui (m) Granhic		Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sa	Bldu	Casing	Method	E Flush Return (%)	Weathering	w wEstimated ∞Strength (MPa)	TCR SCR RQD (%)	²⁰ Defect ²⁰⁰ Spacing (mm)	Instrumentation Installation	Water level
1 141 1	•		SI or to	LT, trace to minor clay, trace fine sand; dark grey and ange-brown. Very stiff, moist, low plasticity; tree roots approximately 1.2 m bgl (TOPSOIL)	extend	TOPSOIL	м	VSt		SV@0.5m				>					
-			× i SI × i Ve × i × i	LT, trace to minor clay; grey with orange-brown streatery stiff, moist, low plasticity (LOESS)	(S.		м	VSt		140/36 kPa									
140	1-	× ×	× ; × ; × ;							SV@1m 194 kPa									
+	- - -		× SI dr × th	LT, trace clay; light grey/white and orange-brown. Ver y, low plasticity; powdery when crumbled, iron-staining roughout; strength increases with depth	y stiff, J	LOESS	D	VSt	1.50	SV@1.5m 194 kPa									
1 139 1	2 -		× 1. × 2. × 2. × .	80 m: 50-100 mm iron-stained layer. 00 m: 50-100 mm iron-stained layer.					0;0;0;0;0;0;0;0;0;0;0;0	SV@2m UTP									
	3-	26 ××××××××××××××××××××××××××××××××××××	Hi XX Hi XX BI XX 2. XX	ighly weathered, orange-brown SILTSTONE (HENLEY RECCIA) 70 m: light grey and orange-brown 00 m: grey and orange-brown.	/	HENLEY BRECCIA			3.50 1010101010101010101010101010101	SV@2.8m UTP SV@3.7m UTP				MH					
roject: 12506381 GINT LUGS SMUU IH HILL.GP.	4 -	- X 	Er	nd of Hole @ 3.80m,Target Depth.						<u> </u>									
N_LLOG r	otes End of	and C	Comme 3.80m,	ents: Target Depth.	Inclinati Contrac	ion: \ tor: F	/ertica =ultor	al n Hoga	an	Ori	entat	ion:	I		Gr Da	ound Wa	Reading (mbgl)	/el Hole de (mbgl)	pth
Report ID: GENER/	EOH a Ground Refer t	tt 3.08 r dwater	nbgl, too not enco nation sl) hard to excavate. ountered. heets for abbreviation and symbols	Equipm Shear \	ient: : /ane	22t e> ld: Gl	xcavat EO228	tor 88						10/0	6/19 00:00		3.	8

E	G	H g: 3965	Project : Smooth Hill Landfill Consenti Client : Dunedin City Council Site : Future Laydown Area Job Number: 12506381 Commenced: 10/06/2019 96.93 Northing: 787986.46	ng Com Svste	plete	ed: 1()/06/2 TM20	<u>2019</u>)00		H S L L P	Hole heet lole L cale ogge	engt @ d ssed	O. h \4	: 1 : 4. : 1: : M : H	P12 of 1 40m 25 F B			
F	RL: 14	12.28	Datum: NZVD2016	Cycle						С	heck	ked		: M	F			
RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Salaria	Besult	Casing	Method	Elush Return (%)	Weathering	w w Estimated ∞ Strength (MPa)	TCR SCR RQD (%)	²⁰ ²⁰⁰ Defect ²⁰⁰ Spacing (mm)	Instrumentation Installation	Water level
142	-		SILT, minor clay, trace fine sand, dark grey and brown. very stiff, moist, low plasticity. Trace to minor roots (FIL	Stiff to L)	FILL	М	St-VSI	t	SV@0.4m 139/44 kPa									
-			Sandy SILT, grey. Very stiff, dry, non-plastic; some larg extend to approximately 1.2 m bgl; trace organics; sand (BURIED TOPSOIL).	ge roots I is fine	BTS	D	VSt	1.00	0.404-									
1 141 1	- - - - - -	* * * * * * * * * * * * * * * * * * *	Sandy SILT; light grey, light yellow-brown and orange-b Very stiff, dry, non-plastic; sand is fine; occasional roots m bgl; strength increases with depth (LOESS)	orown. s to 1.2		D	VSt		UTP									
		* * * * * * * * * * * * * * * * * * *	2.50 m: 50-100 mm iron-stained layer		LOESS				SV@2m UTP SV@2.9m UTP									
	3	4 ×××; × × × × × × × × × × × × × × × × ×	3.60 m: 50-100 mm iron-stained layer Highly weathered, SILTSTONE (HENLEY BRECCIA)					4.00 b101010101010101010101010101010										
1 LUGG JW		× × × × × × × ×	End of Hole @ 4.40m Target Depth		뛰				SV@4.4m				H					
	-																	
n N	otes a	and Con	iments:	Inclinati	on: \	/ertic	al		Or	ientat	ion:			G	round W	ater Le	vel	
	OH at OH at Found	Hole @ 4. 4.4 mbgl, water not	i0m, Target Depth. deepest excavator could excavate soil. nncountered. on sheets for abbreviation and symbols	Contrac Equipm Shear V	tor: F ent: 2 /ane	=ultor 22t e: Id: G	n Hoga kcavat EO228	an tor 88						Da 10/0	ate Tim 06/19 00:0	e Reading (mbgl)	g Hole de (mbgl) 4	epth .4

-	Fa	G	H	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Southern Boundary Job Number: 12506381 Commenced: 29/10/2019	g Com	plete	ed: 1/	<u>11/20</u>)19		H S L P	Hole heet ole L cale ogge	engt @ A d	D. h 4	: B : 1 c : 61. : 1:5 : MF	H201 f 7 00m 0		
	RL	.: 14	4	Datum: NZVD2016	- Office						c	heck	ed		: JH	ş		
-	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	mple Kesnit	Casing	Method	8 용 Flush Return (%)	Weathering	™ ™Estimated Strength (MPa)	TCR SCR RQD (%)	™ Defect ™Spacing (mm)	Instrumentation Installation Water level
-	-		0 <u>11 18</u>	Clayey SILT, trace fine sand; dark grey. Soft, moist to we high plasticity; minor to some organic matter, reducing w	et, <i>i</i> ith	1S	M-W	S										
- - - - - - - - - - - - - - - - - - -	12			depth (TOPSOIL) SILT, minor clay, trace fine sand; grey and orange-brown stiff, moist, low plasticity (LOESS) 1.00 - 1.90 m: grey and brown	n. Very	LOESS	Μ	VSt				PQTT				100		
+		2-		SILT, trace clay; light grey with orange-brown streaks. V stiff, moist, non-plastic; completely weathered (HENLEY BRECCIA)	ery		М	VSt				ΡΩΤΤ		M		96		
ł	141	3		SILT, some clay to clayey; red-brown, orange-brown and Firm to stiff, moist, high plasticity; minor rock fragments;	l grey.		М	F-St						Ö				
			34 34 34 34 34 34 34 34 34 34	Completely weathered SILT, trace to minor clay; red-brown. Very stiff to hard, n low plasticity; completely weathered Moderately weathered, grey and yellow-brown, moderate thickly bedded, fine to medium grained SANDSTONE; we weak; very widely spaced defects 4.20 - 5.00 m: fine to coarse sand	noist, ely ery		Μ	VSt-H				PQTT				100 62		
3 Date: 4 December 2019	1138' ' ' 1139' '	5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		 4.60 BP, 10°, pl, r, Fe-stained, black 4.90 - 5.00 m: grades into breccia Moderately weathered, brown, grey, orange-brown and red-brown BRECCIA; extremely to very weak; very widel spaced defects; matrix supported; fine sandy silt matrix; are angular to subrounded, quartz and schist, fine to coa gravel. Soil description: fine to coarse gravelly, fine sand 	y clasts arse ly silt	EY BRECCIA						PQTT		MW		88 34		
3PJ Library: GHD - NZGD.GLF		7		 6.12 JT, 15°, pl, r, clean 6.15 JT, 85°, pl, r, clean 6.17 JT, 20°, pl, r, clean 6.30 - 6.45 m: transition from moderately to slightly weat Slightly weathered, grey and light grey BRECCIA; very w weak; no defects; matrix supported; fine sand matrix; cla are angular to subrounded, quartz and schist, fine to coat 	thered /eak to ists arse	HEN						PQTT				100 70		
506381 GINT LOGS SMOOTH HILL.(1351 1 1361	9 9 9		gravel 7.00 - 7.90 m: weak to moderately strong 7.20 - 7.90 m: clast supported 7.50 - 7.90 m: medium to coarse gravel Slightly weathered, grey and light grey BRECCIA; extrem very weak; no defects; matrix supported; fine to medium matrix; clasts are angular to subrounded, quartz and sch fine to coarse gravel. Soil description: fine to coarse grav fine sandy silt Slightly weathered, grey and light grey BRECCIA; weak to moderately strong; no defects; matrix supported; fine to	nely to sand iist, /elly, to	/						т Ратт		SW		100 48		
ject: 12(-			meaium sand matrix; clasts are angular to subrounded, of and schist, fine to coarse gravel 9.10 - 9.35 m: 250 mm light grev, fine grained SANDST	quartz ONE							PQT				29		
G Pro	ೆ Not	es a	⊔∆ ∆ Ind Con	Iments:	Inclinati	l on: \	/ertica	 al		 Or	 rientat	ion:			Gro	l ound Wa	ter Lev	oî ŀ⊒ I el
AL_LO	En	d of ⊦	lole @ 61	.00m, Target Depth.	Contrac	tor: S	Speig	ht Dril	ling						Dat	e Time	Reading (mbgl)	Hole depth (mbgl)
eport ID: GENER/	0.0 10. Ref	e - 10. 8 - 61 fer to	8 m PQT I.0 m was explanati	T coring sh drilling on sheets for abbreviation and symbols	Equipm Shear V	ent: ⁻ ′ane	Track ld:	Mour	nted F	₹ig								

		6		Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Southern Boundary	ng						F s	lole	e N	ю.	: 2	BH 2 of	1201 7			
		2		Job Number: 12506381							S	iole L icale	@ /	A4	: *	1:50				
	E	asting	q: 3965	Commenced: 29/10/2019 96 Northing: 787540	Com Syste	iplete em: ⁻	ed: 1/ TAIE	'11/20 TM20	019 000		L P	ogge roce:	d ssec	ł	ו : ו :	MF MF				
	R	L: 14	4	Datum: NZVD2016							_ c	heck	ed		:.	JHS				
	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	npie Kesult	Casing	Method	⊮ ⊮ Flush Return (%)	Weathering	*** Estimated	👷 Strength (MPa)	TCR SCR RQD (%)	Defect Defect Spacing (mm)	Instrumentation Installation	
	-			Slightly weathered, grey and light grey BRECCIA; weak moderately strong; no defects; matrix supported; fine to medium sand matrix; clasts are angular to subrounded, and schist, fine to coarse gravel (<i>continued from layer</i> s	to quartz starting							Ратт		SW			100 29			
	133	11		at 8.6m) 10.8 m to 61.0 m: Wash drilling																- - 11
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ecember 2019	1 1 12	15	2222222222									ish drilled								- - - - -
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- LOG	Nc Er	o tes a nd of H	nd Cor ole @ 6 [.]	n ments: .00m, Target Depth.	Contrac	ton: N	vertic Speig	aı ht Dri	lling	Oi	rentat	ion:				JIOL Date	Time	Reading (mbal)	Hole depth (mbgl)	
ENERAL	0. 10	0 - 10.8).8 - 61	3 m PQT .0 m wa	Г coring h drilling	Equipm	ient: ⁻	Track	(Mou	nted F	Rig										
oort ID: GE	Re	efer to	explanat	on sheets for abbreviation and symbols	Shear ∖	/ane	ld:													
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	E: R	asting L: 144	: 3965 1	96		No Da	orthing: 7 atum: NZ	87540 VD2016		Syst	em:	TAIE	TM20	000		F	roces heck	ssed ed		: MF : JH	= IS				
											Unit	tion		Sa	mple	$\frac{1}{1}$		(%							
	RL (m)	Depth (m)	Graphic			Ma	aterial D	escriptio	on		Geological I	Moisture condit	Consistancy / Relative density	Number / Type	Result	Casing	Method	Elush Return (Weathering	w ≝Estimated Strength (MPa)	TCR SCR RQD (%)	⁸⁰ Defect ⁸⁰⁰ Spacing (mm)	Instrumentation Installation	Water level	
	_			10.8 m to at 10.8m)	61.0 m)	n: Wash	drilling (continue	d from layer	starting									2						20
	23	-																							
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t ID: GEI	Re	Refer to explanation sheets for abbreviation and symbols								Shear	Vane	ld:													
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	RL (m)	Depth (m)	Graphic		Material Desc	ription		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	Besult	Casing	Method	Flush Return (%)	Weathering	"Estimated Strength (MPa)		CR CR QD %)	Defect Spacing (mm)	Instrumentation Installation	Water level	
	-	-		10.8 m to 61.0 m at 10.8m)	: Wash drilling (cont	inued from layer st	tarting								25 50 75	5 - 1				20 00 20		-	30
381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 4 December 2019		31 32 33 34 35 36 37 38 39												Wash drilled									-31 -32 -33 -34 -35 -36 -37 -38
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0G P	No	tes ar	nd Con	nments:		-	Inclinati	on: V	/ertica	al	1	Or	ientat	ion:			G	ound	Wat	er Lev	el		-40
ERAL_L	Er 0.0	nd of Ho 0 - 10.8	ole @ 61	.00m, Target Depth. T coring			Contrac Equipm	tor: S	Speigl Track	nt Dril Mour	ling nted F	Ria					Da	ite 1	Time	(mbgl)	(mbgl))	
GENE	10.8 - 61.0 m wasn drilling 2 Refer to explanation sheets for abbreviation and symbols							/ane	ld:			5											
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		G	H	Project Client Site	: Smooth Hill Landfill Consenti : Dunedin City Council : Southern Boundary	ng						H	lole heet ole L	engt	O.	: B : 5 c : 61	H201 of 7 .00m						
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				JOD NUR Commene	nber: 12506381 ced: 29/10/2019	Corr	plete	ed: 1/	/11/20	019		L	cale (oggeo	<u>a</u> d	4	: 1:5 : MF	=						
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	RL (m)	Depth (m)	Graphic		Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Part Ison	esult Besult	Casing	Method	Elush Return (%)	st Weathering	w Estimated Strength (MPa)	TCR SCR RQD (%)	20 20 20 20 20 20 20 20 20 20	Instrumentation Installation	Water level			
Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 4 December 2019	• 94 ' ' ' 195 ' ' ' 196 ' ' ' 197 ' ' ' 198 ' ' ' 198 ' ' ' 199 ' ' ' 100' ' ' 100' ' ' 100' ' ' 100' ' ' 100' •			10.8 m to 61.0 r at 10.8m)	n: Wash drilling <i>(continued from layer</i>)	Incline							Wash drilled			Gru							
LOG	No En	tes ar	nd Con ple @ 61	n ments: .00m, Target Depth.		Inclinat Contra	ion: \ ctor: \$	/ertic Speig	al ht Dril	lling	Or	ientat	ion:			Gro Dat	ound Wa		/el	pth			
ENERAL	0.0 10	0 - 10.8 9.8 - 61.	m PQT 0 m was	T coring sh drilling		Equipm	nent:	Track	(Mour	nted F	Rig							((
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	RL (m)	Depth (m)	Graphic		Mate	erial Descri	ption		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	Besult	Casing	Method	Elush Return (%)	Weathering	<pre>***Estimated ***Strength (MPa)</pre>	TCI SCI RQ (%	R R R R	⁸⁰ Defect ⁸⁰⁰ Spacing (mm)	Instrumentation Installation	Water level	
Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 4 December 2019	84 I I 185 I I 186 I I 187 I I 188 I I 188 I I 189 I I 190 I I 191 I I 192 I I 193 I I 1	51 51 52 53 54 55 56 57 58 59		10.8 m to 61.0 at 10.8m)	m: Wash d	rilling <i>(contin</i>	ued from layer s	starting							Wash drilled									0 1 i2 i3 i4 i5 i6 i7 i8 i8 59 50
TOG II	No	otes ar						Inclinati	ion: V	/ertica	al		Or	ientat	ion:			Gr	ound	Wate		el Hole der	pth	J
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		G	H	D	Project Client Site Job Nur	: Smoot : Duned : South nber: 12	th Hill La lin City C ern Bou 506381	andfill Coi Council ndary	nsentin	g						H S	Hole heet lole L	ength @ A). 1 4	: F : 7 : 6 ⁻ : 1:	3 H20 of 7 .00m 50	1			
-	E	astino	g: 396! 4	596	Commenc	xed: 29/10/ Norti	2019 hing: 7875 um: NZVD	540		Com Syst	iplete em: [·]	ed: 1/ TAIE	<u>11/20</u> TM20)19)00		_ L P	ogge roce:	d ssed		: M : M	F				
-	RL (m)	Depth (m)	Graphic			Mate	erial Desc	ription			Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	esult	Casing	Method	E Flush Return (%)	Weathering	<pre>*** Estimated *** Strength (MPa)</pre>	TCR SCR RQD (%)	²⁰ Defect ⁰⁰ Spacing (mm)		Instrumentation Installation	Water level
-	83			10.8 at 10	m to 61.0 r 0. <i>8m)</i>	n: Wash dr	illing <i>(con</i>	tinued from	n layer st	tarting							Wash drilled								
: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 4 December 2019				End	of Hole @ 6	31.00m,Tar	get Depth	·																	
DG Project:	- ≵ Nc	tes a	Ind Co	mment	s:					Inclinat	ion: \	/ertic	al		Or	ientat	ion:			Gi	ound W	/ater L	evel		70
Report ID: GENERAL_LC	Er 0.1 10	nd of H 0 - 10. 0.8 - 61 efer to	lole @ 6 8 m PQ I.0 m wa	1.00m, 1 IT coring ash drillin tion shee	arget Depth. g ets for abbrevia	tion and symb	pols			Contrac Equipm Shear \	ctor: { nent: ` /ane	Speig Track Id:	ht Dril Mour	ling nted R	Rig					Da	te Tim	e Read (mb	ding ogl)	Hole dep (mbgl)	th



Project	Waste Futures WS3 – Smooth Hill	Commenced	28/10/2019 Completed	01/11/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.8 m	



Box 1 of 5: 0.00 m to 2.30 m



Box 2 of 5: 2.30 m to 4.50 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	28/10/2019 Completed	01/11/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.8 m	



Box 3 of 5: 4.50 m to 6.80 m



Box 4 of 5: 6.80 m to 9.00 m



Report of Photographs Site Identification: BH201

Project	Waste Futures WS3 – Smooth Hill	Commenced	28/10/2019 Completed	01/11/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.8 m	



Box 5 of 5: 9.00 m to 10.80 m

10.80 m to 61.00 m (EOH) – Wash drilled, no core recovered

E		G ting	H) : 3961	Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Southern Boundary Job Number: 12506381 Commenced: 2/11/2019 81 Northing: 787498 Datum: NZVD2016	g Com Syste	plete em: ⁻	ed: 4/	(<u>11/20</u> TM20	0 <u>19</u> 000		H S L P C	Hole heet lole L cale ogge roces	engt @_A d ssed ed	0. h 4	: B : 1 c : 60. : 1:5 : MF : MF : JH	H202 of 7 .60m 50 = - -			
RL (m)		Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sa Type	mple Kesnt	Casing	Method	B Flush Return (%)	Weathering	w w Strength (MPa)	TCR SCR RQD (%)	。 Defect Spacing (mm)	Instrumentation Installation	Water level
206381 GINT LOGS SMOOTH HILL. GPJ Library: GHD - NZGD.GLB Date: 6 November 2019 1 1 1 ₁₃₅ 1 1 1 1 ₁₃₆ 1 1 1 1 ₁₃₂ 1 1 1 1 ₁₃₃ 1 1 1 1 ₁₃₈ 1 1 1 1 ₁₃₈ 1 1 1 1 ₁₄₀ 1 1 1 1 ₁₄₁ 1 1 1 1 ₁₄₂ 1 1 1 1 ₁₄₃ 1 1 1 1 1 1	1 2 3 4 5 6 7 8 9			SILT, trace to minor clay; grey and orange-brown. Firm t moist, low plasticity (FILL/COLLUV/UM?) 0.30 - 0.80 m: brown and grey, very stiff 0.80 - 0.90 m: trace clay, grey, stiff, minor to some organ matter (roots) 0.90 - 1.20 m: grey and brown, very stiff, trace iron-oxide nodules, "chaotic" texture 1.20 - 1.60 minor iron-oxide nodules SILT, trace to minor clay; dark brown. Very stiff, moist, lo plasticity; small branches (BURIED TOPSOIL) SILT, trace clay; orange-brown and grey; Very stiff to ha moist, non-plastic; trace iron-oxide nodules; completely weathered (HENLEY BRECCIA) 2.60 - 2.80 m: minor to some iron-oxide nodules - increa with depth Gravelly, sandy SILT; orange-brown, brown and grey; Ve to hard, moist, non-plastic; sand is medium to coarse; gr fine to medium, angular to subrounded, quartz and schis completely weathered 4.10 - 4.50 m: CORE LOSS 4.50 - 5.70 m: CORE LOSS 4.50 - 5.70 m: CORE LOSS Gravelly, sandy SILT; orange-brown, brown and grey; Ve to hard, moist, non-plastic; sand is medium to coarse; gr fine to medium, angular to subrounded, quartz and schis completely weathered 5.17, trace to minor clay; grey and brown. Very stiff to hi moist, non-plastic; completely weathered Gravelly, sitly SAND; orange-brown. Moist; well sorted; s fine to coarse; gravel is fine to medium, angular to subrounded, quartz and schist; completely weathered Gravelly, sandy SILT; orange-brown and grey. Firm, moi on-plastic; sand is fine to medium, angular to subrounded, quartz and schist; completely weathered Gravelly, sandy SILT; orange-brown and grey. Firm, moi on-plastic; sand is fine to medium, angular to subrounded, quartz and schist; completely weathered Gravelly, sandy SILT; orange-brown and grey. Firm, moi on-plastic; sand is fine to coarse; gravel is fine to mediu angular to subrounded, quartz and schist; completely weathered Highly weathered, light grey, fine to coarse grained SANDSTONE; very weak; no defects; trace to minor lighte Moderately weathered, light grey, fine to coarse grained SANDSTONE; very weak;	o stiff, nic a nic a nic a nic a a ow rd, ases ard,	HENLEY BRECCIA	M M M M M	F-St VSt VSt-H VSt-H VSt-H				Ράττ Ράττ Ράττ Ράττ Ράττ Ράττ Ράττ Ράττ		SW MW HW CW		100 100 94 0 100 95 100 83 100 90		<u>, öva öva öva öva öva öva öva öva öva öva</u>	
Project: 12	-4	-		weak; no defects; occasional lignite layers 8.60 - 8.85 m: fine to coarse sand 8.99 - 9.02 m: 30 mm lignite	Inclinati	on: \	/ertic	al			ientat	ion:			Gr	ound Wa	ater Lev		
Report ID: GENERAL_LOG	ote: ind c .0 - 0.6	s ar of Ho 10.6 - 60.	nd Con ole @ 60 6 m PQT .6 m was	nments: .60m, Target Depth. T coring sh drilling on sheets for abbreviation and symbols	Contrac Equipm Shear V	ent: ` /ane	Speig Track Id:	ما ht Dril ۲ mour	lling nted	rig		.011.			Dat	e Time	Reading (mbgl)	Hole de (mbgl)	pth

		G	H	Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Southern Boundary Job Number: 12506381	ng						H S	Hole heet lole L	eng @_/	lO. jth A4	:	BH 2 of 60.6 1:50	1202 7 60m			
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	R	L: 144	l 	Datum: NZVD2016					Sar	nnle		heck	ed		:	JHS				
	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / D	Result	Casing	Method	⊮ ⊮ Flush Return (%)	Weathering	™ www.Estimated	🐹 Strength (MPa)	TCR SCR RQD (%)	 Defect Spacing (mm) 	Instrumentation Installation	Water level
	 	10.6	· · · · · · · · · · · · · · · · · · ·	9.84 - 9.89 m: 50 mm lignite Slightly weathered, light grey and grey, thinly to moderal thickly bedded, fine to medium grained SANDSTONE; v weak; no defects; occasional lignite layers (continued fr layer starting at 8 5m)	tely very rom	,						Рап		SW		-	100 90			
	133	- - 11 - -		10.60 m to 60.60 m: Wash drilled	/															- - - - - - -
•	132	12																		
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•	130	- - - - 14 - - -	· · · · · · · · · · · · · · · · · · ·																	
nber 2019	129	- - - 15 - - -				VLEY BRECCIA						drilling								
GLB Date: 6 Nover	128	16	***********			Ŧ						Wash								- - - - - - - - - - - - - - - - - - -
ibrary: GHD - NZGD	127	- - - - - - 17 - - - -																		
OOTH HILL.GPJ L	126		•••••																	
381 GINT LOGS SM	125	- - - - 19 - - -																		- - - - - - - - - - - - - - - - - - -
Project: 12506	124																			
-06 F	No	tes ar	nd Con	iments:	Inclinat	ion: \	/ertic	al		Or	ientat	ion:			1	Grou	und Wa	ter Le		
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Report ID: GEN	Re	efer to e	explanati	on sheets for abbreviation and symbols	Shear \	/ane	ld:			-										

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·			0004	Commer	iced: 2	2/11/2019	9			Com	plete	ed: 4/	11/20	019		L	ogge	d		: M	IF				
	Ea: RL	sung: .: 144	3961	81		Datum:	9: 78749 NZVD20	8)16		Syste	em:						heck	ked		: JI	HS				
	RL (m)	Depth (m)	Graphic			Materia	I Descri	ption			Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	mple Kesnt	Casing	Method	e Elush Return (%)	ज Weathering	w w Strenath (MPa)		TCR SCR RQD (%)	20 © Defect © Spacing (mm)	Instrumentation Installation	Water level
-OG Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 6 November 2019	1 1 1 1 1 1 1 1 1 1	22 23 24 25 26 26 27 28 28	nd Com	10.60 m to 60.6 starting at 10.6	60 m: m)	Wash dr	illed <i>(con</i>	tinued from	layer	Inclinati	HENLEY BRECCIA	/ertica	al		0	rientat	Wash drilling			G	roun	nd Wa			
RAL_LC	Enc 0.0	d of Ho - 10.6	ole @ 60 m PQT	.60m, Target Depth. T coring						Contrac	ctor: S	Speig	ht Dri	lling	ia					Da	ate	Time	Reading (mbgl)	g Hole de (mbgl)	≄pth
ort ID: GENEF	10.6 Ref	6 - 60.	6 m was	on sheets for abbrevi	ation ai	nd symbols			;	⊏quipm Shear \	ient: /ane	i rack ld:	. moui	nied r	ıg										
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		G	H	D	Project Client Site Job Num	: Smooth H : Dunedin (: Southern ber: 12506	lill Landfill Co City Council Boundary 381	onsentinç	3	blat	vd. 4	14/01	10		 S + S	Hole sheet lole L scale	e N _engt @ A	0. h \4	: E : 4 (: 60 : 1:	3H202 of 7 0.60m 50	2			
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	RL (m)	Depth (m)	Graphic			Material	Description			Geological Unit	Moisture condition	Consistancy / Relative density	Number / Salary	Sesult	Casing	Method	≝ Elush Return (%)	∾ Weathering	w Estimated Strength (MPa)	TCR SCR RQD (%)	Defect	Instrumentation	Water level	
ort ID: GENERAL_LOG Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 6 November 2019	и 100 ш X 104 1105 1005 1107 1008 1008 1109 1110 1111 1112 1113 В 100 ш X 104 1111 1112 1113	31 32 33 34 35 36 37 38 38 38 38 39 1 1 1 1 1 1 1 1 1 1 1 1 1	nd Co ole @ 6 5 m PQ 1.6 m w	mment 0.60m, Tr coring sh drillin	ts: Target Depth. g ng ets for abbreviati	on and symbols	ed (continued f	from layer	Inclinati Contrac Equipm Shear \	HENTEA BRECCIA	/ertic Speig Tracł	al ht Dri	lling	Or	ienta	Mash drilling			Gr	ound W te Time	ater Le			-31 -32 -32 -33 -34 -35 -36 -37 -38 -38 -38 -38 -39 -39 -38 -39 -39 -39 -39 -39 -39 -39 -39 -39 -39
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	RL (m)	Depth (m)	Graphic		Material D	Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	Bldm Result	Casing	Method	Elush Return (%)	∾ Weathering	^{ww} Strength (MPa)	TCR SCR RQD (%)	∞ ∞Spacing (mm)	Instrumentation Installation	Water level
_LOG Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 6 November 2019	щ Z [941 1 1 1 195 1 1 1 196 1 1 1 197 1 1 1 198 1 1 1 199 1 1 1 100 1 1 1 100 1 1 1 100 1 1 1 1	41 42 43 44 45 46 47 48 49 49 49 49 49	nd Com	10.60 m to 60.60 starting at 10.6n) m: Wash driller	d (continued from lay	Inclinat Contrac	HENLEY BRECCIA	/ertic:	al		Or	ientat	Wash drilling			Gr	ound W:		[■]	-41 -41 -41 -41 -41 -41 -41 -41 -42 -43 -43 -44 -43 -44 -44 -44 -44 -44 -44
ERAL_I	Er	a of Ho 0 - 10.6	m PQT	Loum, Target Depth. T coring			Contrac Equipm	etor: \$	Speig Track	nt Dril (mour	lling nted r	ig					Da	te Time	(mbgl)	(mbgl)	Pu1
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	L (m)	Depth (m)	Graphic +	Materia	al Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	Besult	Casing	Method	E Flush Return (%)	Weathering	™Estimated ™Strength (MPa)		CR CR QD %)	Defect Second Spacing (mm) Second Second Secon	Instrumentation Installation Water level	- 50
0G Project: 12506381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 6 November 2019	Z 84 185 186 87 88 88 189 190 191 192 193 193 193 193 194 195 195 195 195	51 52 53 54 55 56 57 58 59 59	nd Cor	10.60 m to 60.60 m: Wash dr starting at 10.6m)	illed (continued from layer	Inclinat	HENLEY BRECCIA	/ertic			Ori	entat	Wash drilling			Gr	ounc	JWat		רון	
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	RL (m)	Depth (m)	Graphic					Mat	erial C	Descri	ption			Geological Unit	Moisture condition	Consistancy / Relative density	Number / Type	uple Kesult	Casing	Method	ช ⊮ Flush Return (%)	Weathering	***Estimated ***Strength (MPa)	TCR SCR RQD (%)	™ ™ Defect ™ Spacing (mm)	Instrumentation Installation	. Water level	-60
-	-				10.60 r <i>starting</i>	n to 60.6 1 <i>at 10.6</i>	80 m: <i>m)</i>	Was	h drille	d <i>(con</i>	tinued fi	rom layei	r															,
381 GINT LOGS SMOOTH HILL. GPJ Library: GHD - NZGD.GLB Date: 6 November 2019					End of	Hole @	60.60	Dm,Ta	arget D	epth.																		-61 -62 -63 -64 -64 -65 -66 -66 -66 -66 -66 -66 -66 -66 -66
Project: 1250	74 1 1																											-70
LOG	No Er	o tes a	and C _{Hole} @	omn 0.60	nents: i0m, Taro	et Depth.							Inclinat	tion: \	/ertic	al ht Dri	lling	0	rienta	tion:			Gro			/el	epth	
GENERAL_	0.0 10	0 - 10).6 - 6	.6 m P 0.6 m	QTT o wash	coring drilling	- 640							Equipm	nent: Vane	Track	(mou	nted r	ig					Date		(mbgl)	(mbgl)		
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Project	Waste Futures WS3 – Smooth Hill	Commenced	02/11/2019 Completed	04/11/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.6 m	



Box 1 of 4: 0.00 m to 2.30 m



Box 2 of 4: 2.30 m to 6.10 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	02/11/2019 Completed	04/11/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.6 m	



Box 3 of 4: 6.10 m to 8.30 m



Box 4 of 4: 8.30 m to 10.60 m



Report of Photographs Site Identification: BH202

Project	Waste Futures WS3 – Smooth Hill	Commenced	02/11/2019 Completed	04/11/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.6 m	

10.60 m to 60.60 m (EOH) - Wash drilled, no core recovered

				Project : Smooth Hill Landfill Consenti	ng						ŀ	lole	e No) .	: B	H203			
	1	2	T	Client : Dunedin City Council							S В	heet	onati	-	:1c	of 2 70m			
		4		Job Number: 12506381							s	cale	@ A	4	: 1:5	50			
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-	RL	.: 18	2	Datum: NZVD2009		ţ	c		Sa	mple		песк	ea		: JH	<u> </u>			
	RL (m)	Jepth (m)	Graphic	Material Description		Geological Un	Moisture conditio	Consistancy / Relative density	Number /	Result	Casing	Method	Flush Return (%)	Veathering	Estimated Strength (MPa)	TCR SCR RQD (%)	Defect Spacing (mm)	nstrumentation nstallation	Nater level
				Highly weathered, cream, orange-brown and yellow-bro CONGLOMERATE; extremely weak; no defects; matrix supported; matrix is fine to coarse sandy silt; clasts are rounded to subrounded, quartz and schist gravel. So description: gravelly sandy silt (Henley Breccia)	own, k fine, il		2	012	ZF	~	0	PQTT	25 50 75	N M		96 85	20 00 00 00 00 00 00 00 00 00 00 00 00 0		
	1180	2		Highly weathered, orange-brown and grey, laminated to moderately thickly bedded SILTSTONE; extremely wea defects. Soil description: Silt, minor fine to medium sar	o k; no nd, hard onal											97			
		3	X.X.	orange-brown Grades into: moderately weathered, grey with occasion orange-brown, laminated to moderately thickly bedded, fine grained SANDSTONE; extremely weak; no defects description: silty fine sand	al silty S. Soil	CIA						PQT				76			
		3 		bedded CONGLOMERATE; very weak to weak; no def matrix supported; matrix is fine to coarse sand; clasts a rounded to subangular, quartz and schist gravel	ects; are fine,	HENLEY BREC						РОП				100 66			
:: 28 November 2019				Moderately weathered, brown and grey, BRECCIA; ver no defects; matrix supported; matrix is silty fine sand; c are fine to medium, angular to subrounded, quartz and gravel (HENLEY BRECCIA)	y weak; lasts schist	_						РОП		MW		98 58			
ary: GHD - NZGD.GLB Date	11/6	6 – " 		5.80 - 6.00 m: CORE LOSS BRECCIA (continued from 4.8 m) 6.10 - 6.40 m: iron staining, orange-brown		cciA						РАП				82 28			
LOGS SMOOTH HILL.GPJ LIb		8 8 8	$ \begin{array}{c} \bigtriangleup & \bigtriangleup \\ & \bigtriangleup \\ & \swarrow \\ & \times \\ \\ & \times \\ $	Moderately weathered, orange-brown, very thinly to mo thickly bedded SILTSTONE; very weak; no defects; mo widely spaced lignite layers 5-20 mm thick 7.90 - 11.15 m: slightly weathered, grey	derately derately	HENLEY BRE						Ратт				100 89			
Project: 12506381 GINT	1/2 11/3	9	****		1							РОП		SW		100 87			
LOG	Not	es a	nd Cor	Iments:	Inclinat	ion: ۱	/ertic	al		Or	rientat	ion:			Gro	ound Wa		/el	epth
RAL_I	⊑n Gro	u ot H oundw	vater not	.rom, ranget beptit. encountered	Contra	ctor:	Speig Traci	nt Dri	iling	ria					Dat	e lime	(mbgl)	(mbgl)	
Report ID: GENE	Rei	fer to	explanat	on sheets for abbreviation and symbols	Shear V	/ane	Id:	, mou	neu	''Y									

		6		Project : Smooth Hill Landfill Consentin Client : Dunedin City Council Site : Southwest Boundary	ng						F s	HOL iheet	N eng	0.	: E	3H2 of 2	203				
		-		Job Number: 12506381	_						S	icale	<u>@</u> /	44	: 1:	:50					
	E	astin	ng: 3957	Commenced: 7/11/2019 79 Northing: 787672	Com Syst	iplete em: [†]	ed: 7/ TAIE	(11/20 TM20	019 000		L P	ogge Proce	a ssed	l	: M : M	IF IF					
	R	L: 18	82	Datum: NZVD2009		-			Sa	mple	c	heck	ed		: JI	HS					
	RL (m)	Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / 1	Result	Casing	Method	E Flush Return (%)	* Weathering	w w Estimated ∞ Strenath (MPa)		TCR SCR RQD (%)	⁵⁰⁰ Defect ⁵⁰⁰ Spacing (mm)	Instrumentation Installation	Water level	
+	1 1 1 1 12	- - - - - - - - - - - - - - - - - - -	15 × × × × × × × × × × × × × × × ×	Moderately weathered, orange-brown, very thinly to mo thickly bedded SILTSTONE; very weak; no defects; mo widely spaced lignite layers 5-20 mm thick (continued f layer starting at 7.5m) 10.00 - 10.10 m: fine SANDSTONE	derately derately rom							РОТТ		SW			100 87				
+		- - - - - - - - - - - - - - - - - - -		Unweathered, light grey, laminated to moderately thickly bedded, fine grained SANDSTONE; very weak; no defe moderately widely spaced lignite layers 5-30 mm thick	y cts;							PQTT					100 53				- 12
+ + + + +	1168 1 1 169	13 — - - - - - - - - - - - - - - - - - - -										РОП		~			100				- -13 - - - - - - - - - - - - - - - - -
ovember 2019	1 1 1921 1 1	- - - 15 - - - - -	15.4 7 ○ ○ 7 ○ ○ 7 ○ ○ 7 ○ ○	14.45 - 14.55 m: grades into BRECCIA Unweathered, light grey, BRECCIA; weak to moderately strong; no defects; clast supported; matrix is fine to coa sand; clasts are fine, quartz and schist, angular to suba gravel	y Irse Ingular	HENLEY BRECCIA						PQTT		Э			100 81				- - - - - - - - - - -
ZGD.GLB Date: 28 No	1 166 1			bedded, fine grained SANDSTONE; very weak to weak; defects 16.00 - 16.15 m: moderately strong	y ; no							PQTT					100 92				- - - - - - - -
PJ Library: GHD - N	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	- - - - - - - - - - - - - - - - - - -	77.6	17.30 - 17.60 m: grades into BRECCIA								PQTT					97 75				- - - - - -
DCS SMOOTH HILL.G	194	- - - - - - - - - - - - - - -		strong to strong; no defects; clast supported; matrix is f coarse sand; clasts are fine to coarse, angular to subro quartz and schist gravel	unded,									SW							-
ct: 12506381 GINT LC	1 1031	- - - - - - - - - - - - - - - - - - -										PQTT					83 19				-
II Proje	162- 162-	tec			Inclinat	 ion [.] \	/ertic	 al		0	ientat	l tion:			G	roun	d Wat	erLev	/el		- -20
L_LOG	Er	nd of	Hole @ 19	ווופותs. .70m, Target Depth.	Contrac	ctor:	Speig	ht Dri	lling		.ond				Da	ate	Time	Reading (mbgl)	Hole de (mbgl)	pth	
ENERA	Gr	round	water not	encountered	Equipm	nent:	Tracl	(mou	nted ı	ig											
rt ID: Gt	Re	efer to	explanati	on sheets for abbreviation and symbols	Shear \	/ane	ld:														
Repo																					



Project	Waste Futures WS3 – Smooth Hill	Commenced	07/11/2019 Completed	07/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 19.7 m	



0.00 m to 2.30 m



2.30 m to 4.60 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	07/11/2019 Completed	07/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 19.7 m	



4.60 m to 6.90 m



6.90 m to 9.20 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	07/11/2019 Completed	07/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 19.7 m	



9.20 m to 11.30 m



11.30 m to 13.40 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	07/11/2019 Completed	07/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 19.7 m	



13.40 m to 15.60 m



15.60 m to 17.90 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	07/11/2019 Completed	07/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 19.7 m	



17.90 m to 19.70 m (EOH)

Ea	G	H	Project : Smooth Hill Landfill Consenting Client : Dunedin City Council Site : Western Boundary Job Number: 12506381 Commenced: 24/10/2019	Comple	eted: :	24/10/2	2019		H S H L P	Hole heet ole L cale o oggeo	engt @ d	O . th \\4	: B : 1 c : 10. : 1:5 : MF	H209 f 1 00m 0			
RL	.: 132	<u>2</u>	Datum:	Cystern					С	heck	ed		: JH	ş			
RL (m)	Depth (m)	Graphic	Material Description	Coological Link	Moisture condition	Consistancy / Relative density	Number / Salary	Beldu	Casing	Method	Flush Return (%)	Weathering	™ ™Estimated Strength (MPa)	TCR SCR RQD (%)	° © Defect ∞Spacing (mm)	Instrumentation Installation	Water level
	9		Intermixed: clayey SILT, sandy SILT, and SILT with minor c grey and brown. Soft to firm, moist to wet, low to high plasticity; wood fragments throughout (FILL)	clay;	M-\	V S-F				E	25 50 7	>					
		× × × × × × ×	SILT, minor clay, trace find sand; light grey and orange-brow Very stiff, moist, low plasticity; trace fine gravel sized iron of nodules (LOESS) 0.80 - 3.15 m: grey-brown and orange-brown	wn. xide	M	VSt				ГØЧ				92			
	2	× × × × × × × × × × × × × × × × × × ×		LOESS						ΡΩΤΤ				100			
	1 3.6 3.15 3.15	x x x x x x x x x x x x x x x x x x x	Gravelly SILT; grey, cream and brown. Very stiff to hard, dr moist, non-plastic; gravel is fine to medium, rounded to subangular quartz and schist; highly weathered (Henley Breccia) SILT, minor to some clay; grey with orange-brown streaks	ry to	D-I	и VSt-F F-St	-			РОП		ММ		96			
	4 - 1	· · · · · · · · · · · · · · · · · · ·	Firm to stiff, moist, high plasticity Moderately weathered, orange-brown, very thinly to moderately thickly bedded fine-grained SANDSTONE; ve weak; no defects	ery						PQTT				100 86			
	9 1 1 1 1 1 1 1 2 5.9 5.3 1 1		Moderately weathered, brown and orange-brown CONGLOMERATE; extremely weak; no defects; matrix supported; clasts are fine to medium, rounded to subangula quartz and schist gravel; silty sand matrix. Soil description: oravelly silty sand	ar,						РОП		MM		100 60			
			Moderately weathered, orange-brown, very thinly to modera thickly bedded fine-grained SANDSTONE; very weak; no defects Slightly weathered, grey, laminated to moderately thinly bed fine-grained SANDSTONE; very weak; no defects	ately dded						QTT				100			
	8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	 	Slightly weathered, brown with occasional orange-brown an white, moderately thinly to moderately thickly bedded, fine to medium-grained SANDSTONE; very weak; no defects; mine fine quartz and schist gravel	nd :o ior						<u>د</u>				100			
			Slightly weathered, brown and orange-brown CONGLOMERATE; extremely weak; no defects; clast supported; silty sand matrix; clasts are fine to coarse, round to subangular, quartz and schist gravel. Soil description: silt sandy, fine to coarse gravel	ded ty,						PQTT		SW		100 0			
	9									PQTT				94 0			
	10 -		End of Hole @ 10.00m, Target Depth.					L									ШĒ
Not	es ar	nd Con	Internet Depth	clination	: Vert	cal		Or	ientat	ion:			Gro	ound Wa		Hole de	nth
En	a ot Ho oundw	oie @ 10 ater not	encountered	ontractor	:: Spe	ght Dri	Iling						Dat	e Time	(mbgl)	(mbgl)	
Re	er to e	explanati	on sheets for abbreviation and symbols	near Van	ie ld:		я										

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL.GPJ || Library: GHD - NZGD.GLB || Date: 30 October 2019

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Project	Waste Futures WS3 – Smooth Hill	Commenced	24/10/2019 Completed	24/10/2019
Site	Western Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.0 m	



Box 1 of 5: 0.00 m to 2.40 m



Box 2 of 5: 2.40 m to 4.70 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	24/10/2019 Completed	24/10/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.0 m	



Box 3 of 5: 4.70 m to 7.15 m



Box 4 of 5: 7.15 m to 9.20 m

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Project	Waste Futures WS3 – Smooth Hill	Commenced	24/10/2019 Completed	24/10/2019
Site	Southern Boundary	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 10.0 m	



Box 5 of 5: 9.20 m to 10.0 m (EOH)

				Pro	oject	: Sm	ooth H	Hill Lar	ndfill Co	onsentin	ng						ŀ	Hole	e N	0.	: E	3H21	1			
		G	H) Site	enii e	: Ea	istern (gully b	ase								-	ineet Iole L	eng	th	: 1 : 25	of 3 5.20m				
			-		o Nur	nber: :ed: 4/	12506 11/2019	5381			Com	plete	ed: 6/	11/20)19		S L	cale	<u>@</u> / d	44	: 1: : M	50 F				
	Ea	stinę	g: 396	598		l <u>iou. </u>	Northing	g: 78790	65		Syste	em:	TAIE	TM20	000		F	roce	ssed	I	: M	F				
_	RL	: 10	7			[Datum:	NZVD2	009						60	mnlo		heck	ked		: Jŀ	is I		1		
	кг (ш)	Depth (m)	Graphic			ľ	A ateria	l Descr	iption			Geological Unit	Moisture condition	Consistancy / Relative density	Number / 5	Result	Casing	Method	E Flush Return (%)	Weathering	w weter weter (MPa) weter wet	TCR SCR RQD (%)	Defect Spacing (mm)	Instrumentation	Installation	Water level
		-	مارينا م	0.00 - 0.3	5 m: C	ORE L	_OSS (ii	nferred	at top of	run)														A . 7	N. P.	
				SILT, min orange-br moist, low	or fine own ar plasti	to me nd dark city (FI	dium sa grey in LL)	nd, trac termixe	e clay; gi d. Stiff to	rey, o very stiff			M	St-VS	- t			Ĕ				78				
100	-	- 1- - - -	× × × × × ×	SILT, trac orange-br iron-oxide	e to m own. V nodule	inor fin ′ery sti es (LO	ie to me ff, moist ESS)	dium sa t, low pl	and; grey asticity; t	/ and trace to m	ninor	LOESS						PG						<u> </u>		
105	3	2	x x 1.951.8 1.6 x x x	1.60 - 1.8 SILT (con	0 m: C	ORE L	OSS (ii 0.7 m)	nferred	depth)			+ + 		VSt L				ТТС				75				
			× × × × × × × × × × × × × × × × × × ×	Sandy SIL stiff to har is angular breccia (H 2.40 - 2.8	. I , mir d, moi to rou IENLE 0 m: fi	ior fine st, nor nded q Y BRE rm to s	e gravel; i-plastic juartz ar CCIA) stiff	orange ; sand i nd schis	e-brown a s fine to i st; comple	and grey. medium; etely wea	Very gravel thered		IVI	F-St				Б Б								
101	-	3-	× × × × × · ×	2.80 - 3.2	0 m: v	ery stif	f 					-		VSt				PQTT				62		<u>], , , , , , </u>		
																				>						
100	-	4		SILT; dark weathered	c grey. I siltsto	Firm to one	o stiff, n	noist, lo	w plastic	city; comp	letely		М	F-St	-			атт		Ö		100				
-	J		4 0 · · · ·	Gravelly S fine, angu weathered 4.60 - 5.2	SAND; lar to s l <u>brecc</u> 0 m: C	grey. N subrou sia ORE L	/loist; sa nded, qu 	and is fi uartz ar — — —	ne to coa nd schist; 	arse; grav ; complete 	el is ∋ly - <i></i> ∕	-	м	VSt-H									-	<u></u>		
021	-	5-																								
larch 2(-	40 10 10 10 10 10	Gravelly S	AND (athere	contin d, oran	ued fror ge-brov	n 4.2 m vn and g	ı) grey, moo	derately tl	hickly	+	м	VSt-H				PQTT				59 25				
LB Date: 9 M	-	6		 bedded Bl supported medium, a description 	RECCI ; matri angula n: grav	A; extr x is fin r to rou elly sa	e to coa Inded, c nd	veak; no irse sar juartz a	o defects nd; clasts nd schist	; matrix are fine t t gravel. S	to Soil	LEY BRECCIA								MH						
- NZGD.G				Slightly we bedded Sl	eathero	ed, ligh DNE; v	it grey a ery wea	nd whit Ik to we	e, moder ak; no de	rately thic efects	kly	HEN													- - - -	
3PJ Library: GHC	-	7		 Slightly we moderatel coarse sa quartz and 	eathere y stror nd; cla d schis	ed, ligh ıg; no o sts are t grave	It grey a defects; e fine to el	nd whit clast si coarse,	e BREC0 upported; , angular	CIA; weak ; matrix is to subrou	< to fine to unded,							PQTT				100 93				
	2	8 8																PQTT		SW		100 70	_			
	2	9		8.80 - 9.9	0 m: v	ery we	ak to we	eak										PQTT				100 79				
Project: 1	5			4																						
00 II F	Not	es a	and Co	mments:							Inclinat	ion: \	/ertic	al	i	Ċ)rienta	tion:	<u></u>		G	ound W	ater Le	evel	<u></u>	
RAL_L	End Gro	d of H oundv	lole @ : vater at	25.20m, Target [2.81 m bgl in sh	Depth. allow pi	ezo (25/	11/19)				Contrac	tor:	Speig Track	ht Dri	lling nted i	ria					Da	te Tim	e Readir (mbgl	ig)	nole de mbgl)	ນໃN
sport ID: GENE	Ref	er to	explana	tion sheets for a	bbrevia	tion and	symbols				Shear \	/ane	ld:			.9										

	G	H	Project : Smooth Hill Landfill Consentir Client : Dunedin City Council Site : Eastern gully base Job Number: 12506381 Commenced: 4/11/2019	ng Com	plete	ed: 6/	11/20	19		F S H S	Hole heet lole L cale (engt @_A	0. h 4	: BI : 2 of : 25.2 : 1:50 : MF	H211 f 3 20m 0			
	Easting): 3965 7	98 Northing: 787965	Syste	em: -	TAIE	TM20	00		P	roces	sed		: MF	-			
	RL (m) Depth (m)	Graphic	Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Sar	Besult	Casing	Method	E Flush Return (%)	Weathering	*** Estimated	TCR SCR RQD (%)	∞ ∞ Defect ∞Spacing (mm)	Instrumentation Installation	Water level
			 9.90 - 11.80 m: weak to moderately strong Slightly weathered, light grey and white BRECCIA; weal moderately strong; no defects; clast supported; matrix is coarse sand; clasts are fine to coarse, angular to subron quartz and schist gravel (continued from layer starting a) Slightly weathered, grey SILTSTONE; very weak; no de trace to minor fine gravel, content decreases with depth Slightly weathered, brown, SILTSTONE; very weak; no defects; possible lithified topsoil 13.50 - 13.65 m: grey Slightly weathered, grey, fine to coarse grained SANDS very weak to weak; no defects Slightly weathered, grey and white BRECCIA; weak to moderately strong; no defects; matrix supported; matrix to coarse sand; clasts are fine to coarse, angular to subrounded, quartz and schist gravel 	k to s fine to unded, at 6.8m fects; TONE; is fine	HENLEY BRECCIA						ΡάΤΤ ΡάΤΤ ΡάΤΤ ΡάΤΤ ΡάΤΤ		SW		100 92 100 60 97 90 100 87 100 46 100 35			
•	$ \begin{array}{ccccccccccccccccccccccccccccccccc$		Slightly weathered, grey, fine to coarse grained SANDS very weak; no defects Slightly weathered, grey and white BRECCIA; very weal defects; matrix supported; matrix is fine to coarse sand; are fine to medium, angular to subrounded, quartz and gravel	TONE; k; no clasts schist	-						Ραττ				100 84			
			Slightly weathered, grey, fine to medium grained SANDSTONE; very weak; no defects		-						PQTT				100 86			- - - - - - - - - - - - - - - - - - -
			Slightly weathered, grey and white BRECCIA; moderate strong to strong; no defects; clast supported; fine to coa sand matrix; clasts are fine to medium, angular to subro quartz and schist gravel Slightly weathered, grey and white BRECCIA; very weal weak; no defects; matrix supported; matrix is fine to coa sand; clasts are fine to coarse, angular to subrounded, and schist gravel	ely arse bunded, k to arse quartz	-						Ратт				100 71			
	Notes a	nd Cor	Iments:	Inclinati	ion: \	/ertic	al ht D.::	lin -	Ori	ientat	ion:			Gro	und Wa		/el	
-	Groundw Refer to	explanat	81 m bgl in shallow piezo (25/11/19) on sheets for abbreviation and symbols	Contrac Equipm Shear V	or: S lent: ⁻ /ane	speig Track ld:	nt Dril	nted r	ig						9 Time	(mbgl)	(mbgl)	

Report ID: GENERAL_LOG || Project: 12506381 GINT LOGS SMOOTH HILL.GPJ || Library: GHD - NZGD.GLB || Date: 9 March 2021

	Ea	G	H)	Project : Smooth Hill Landfill Consenting Client : Dunedin City Council Site : Eastern gully base Job Number: 12506381 Commenced: 4/11/2019 Completed: 6/11/2019 Completed: 6/11/2019 Completed: 6/11/2019 Logge Datum: NZVD2009 Check						Hole No. : BH211 Sheet : 3 of 3 tole Length : 25.20m Scale @ A4 : 1:50 Logged : MF Processed : MF									
	RI (m)	L: 107	Graphic	Datum: NZVD2009 Material Description		Geological Unit	Moisture condition	Consistancy / Relative density	Number / Land Land Land Land Land Land Land Land	Besult	Casing	Method	E Flush Return (%)	Weathering	<pre>*** Estimated *** Strength (MPa) H </pre>	S TCR SCR RQD (%)	© © Defect ∞ Spacing (mm)	Instrumentation Installation Water level	-
Project: 12566381 GINT LOGS SMOOTH HILL.GPJ Library: GHD - NZGD.GLB Date: 9 March 2021		21 22 23 24 25 26 27 28 29		Slightly weathered, grey and white BRECCIA; very weak weak; no defects; matrix supported; matrix is fine to coarse, angular to subrounded, q and schist gravel <i>(continued from layer starting at 19.1n</i> 21.00 - 25.20 m: occasional cobble-sized clast 22.00 - 25.20 m: clast supported 22.65 - 23.00 m: moderately strong to strong 24.00 - 24.40 m: moderately strong to strong End of Hole @ 25.20m,Target Depth.	to se uartz 1)	HENLEY BRECCIA						PATT PATT PATT PATT		SW		96 51 100 63 100 36 92 68			-210
RAL_LOG	No En Gr	Notes and Comments: End of Hole @ 25.20m, Target Depth. Groundwater at 2.81 m bgl in shallow piezo (25/11/19)		Inclination: Vertical Or Contractor: Speight Drilling				ientation:			Gro	ound Wa	Reading (mbgl)	Hole depth (mbgl)					
Report ID: GENEI	Groundwater at 2.81 m bgl in shallow piezo (25/11/19) Refer to explanation sheets for abbreviation and symbols			on sheets for abbreviation and symbols	Equipment: Track mounted rig Shear Vane Id:														

CIP



Project	Waste Futures WS3 – Smooth Hill	Commenced	04/11/2019 Completed	06/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m – 25.2 m	



0.00 m to 2.80 m



2.80 m to 6.20 m

GHD



Project	Waste Futures WS3 – Smooth Hill	Commenced	04/11/2019 Completed	06/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 25.2 m	



6.20 m to 8.50 m



8.50 m to 10.70 m



Report of Photographs Site Identification: BH211

Project	Waste Futures WS3 – Smooth Hill	Commenced	04/11/2019 Completed	06/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 25.2 m	



10.70 m to 12.80 m



12.80 m to 14.90 m



Report of Photographs

Site Identification: BH211

Project	Waste Futures WS3 – Smooth Hill	Commenced	04/11/2019 Completed	06/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 25.2 m	



14.90 m to 17.20 m



17.20 m to 19.50 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	04/11/2019 Completed	06/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 25.2 m	



19.50 m to 21.70 m



21.70 m to 23.90 m



Project	Waste Futures WS3 – Smooth Hill	Commenced	04/11/2019 Completed	06/11/2019
Site	Smooth Hill	Logged By	MF	
Job #	12506381	Checked By		
Client	Dunedin City Council	Core Depth	0.0 m to 25.2 m	



23.90 m to 25.20 m (EOH)
Appendix C – Laboratory Testing Results



18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: <u>www.centraltesting.co.nz</u>, E: info@centraltesting.co.nz Page 1 of 6 Pages Reference No: 19/1963

Date: 23 July 2019

TEST REPORT: DCC SMOOTH HILL INVESTIGATIONS

Client Dotaila		CHD I ava	12	120	Viet	oria	C+-	-004		hri	tob	111-14-	ob							A	tto	nt:	or	,	т	¢.	11141	hwe	rth			—
In Details:		DCC Smoo	13, 111	Hill Landfill Investigations																												
Sample Description:	on•		T -	vith	SOM-		nd -	mi	nor		J Vol	an	d •	nin	or	clar	v	C	lie	nt T	[oh	No	•		1	250)63	81				
Sample Source:	011.	TP10/01	11 1	viun	som	l sai	iu, i			gra	ivei	an	u		01	ciaj	y	S	am	nle	De	ntł	<u>.</u> 1:		2	$\frac{230}{2m}$	1 to	3.6	m			
Date & Time San	npled:	10-Jun-19																S	am	nle	d R	v:			Ň	1. F	- to Fitz	mai	uric	e		
Sample Method:	ipicui	Test Pit / B	ore	hole	*													D	ate	Re	cei	vec	1:		2	26-Jun-19						
PARTICLE S (NZS 4402:1986,	IZE AN Test 2.	NALYSIS 8.1 & 2.8.4)		100	T				11	0.063 0.075 0.150 0.212 0.212 0.212 0.212 0.212 0.200 0.60						1.18 2.300 2.300 2.300 2.300 2.300 1.18 2.300 1.18 1.18 1.18 1.18 1.18 1.18 1.18 1.						53.0 63.0	75.0	150								
Test Sieve	%	Passing																			+	1										
(mm)	()	by mass)		90	+						+					+	+															Щ
37.5		100											6															1	ГР1	10/	01	
26.5		98		80	+			++		_	+	1				++	+		_													┯╢
19.0		98										8																				
13.2		98		70	+					_	1								_													
9.50		98																														
4.75		97	ass	60	-						4					+			_													
2.36		95	v m																													
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20 µm		55			CLA	1			SILT							SANI	D						GR	AVEL				совь	LES	BOU.	LDEN	
6 µm		23		í	The sa	mple	was	rec	eive	d in	a na	iture	al si	tate.	The	e per	rcen	tag	e pa	ssin	g th	e 63	βµm	ı test	sie	ve w	as o	obtai	nedl	by dif	ferei	nce.
2 μm		9		1	the pl	I of t	he h	ydr	ome	ter si	uspe	ensia	on v	was 9	9.5.	Sodi	เนท	he:	xam	ietaj	phos	spha	ite v	vas i	isea	l as	a dı	spers	sant.			
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Description		Fraction Ra	nge		%	Wit	thir	ı R	ang	ge			D	escr	ript	ion	1			Fı	raci	tioı	ı R	ang	ge		0	% V	Vith	in F	Ran	ge
Coarse Gravel	6	0.0mm to 20.	0m	m			2						F	ine	Sa	nd				20	0 µ	m t	to 6	50 µ	m					9		
Medium Grave	1 2	20.0mm to 6.0)mn	n			1						С	oar	se S	Silt				60) μr	n t	o 2	0 μī	m					26		
Fine Gravel	6	6.0mm to 2.00	m	n			3						M	ediı	um	Sil	t			2	0 µ	m t	to (6 μn	n					32		
Coarse Sand	2	2.00mm to 60	0 μı	n			3]	Fine	e Si	ilt				6	jμr	n t	0 2	μm						14		
Medium Sand	(600 µm to 200) µn	n			1							C	lay						<	< 2	μn	1						9		
	WAT	ER CONTEN	TT A	& PI	LAST	ICI	TY	IN	IDF	XI	RES	SUI	Л	S - 1	NZ	S 4	402	2:1	980	5, T	est	2.1	1,2	.2.	2.3	&	2.4			٦		
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Liquid	Limit:	(LL)																	3	9												
Plastic	Limit:	(PL)					_												2	8												
Plasticity Index: (PI) 11																																
Note: Th	he sampl	e was received i	in a	natu	ral st	ate. T	The p	plas	stici	ty in	dex	: ma	ter	ial t	este	ed w	as t	he	fra	ction	n pa	issi	ng i	the 4	425	μm	tes	t sie	ve.			
Note: Inform. Guideli This rej	ation cor nes 2005 port may	ntained in this r 5, the sample ma 1 not be reprodu	epoi etho ced	rt wh d * a excej	ich is nd sa pt in j	Not mplii full.	IAN ng.	NZ /	4 <i>ccı</i>	redit	ed r	elat	tes	to th	he si	amp	ole d	leso	crip	tion	ns bu	ased	l or	ı NZ	Z Go	eote	chn	nical	Soc	iety		
fested By: L. Checked By:	T. Smit	h 			Dat	e:	4	to	15-	Jul	-19						T N a t	fest lot . outsi he l	s in Acc ide 1 abo	dicat redi the s rato	ted a ted a cop ry's	as are e of				٥				Ζ		

Specialist Quality Assurance Service in Aggregate, Concrete and Soils Testing

accreditation

ACCREDITED LABORATORY Accreditation No: 434



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Date: 23 July 2019

TEST REPORT: DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – SILT with some sand, minor gravel and minor clay	Client Job No:	12506381
Sample Source:	TP10/01	Sample Depth:	2.2m to 3.6m
Date & Time Sampled:	10-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Test Pit / Borehole *	Date Received:	26-Jun-19



Note:

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Tested By: L.

L.T. Smith

Date: 4 to 15-Jul-19

Checked By: In

emplus

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Date: 23 July 2019

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Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – SILT with some sand, minor gravel and minor clay	Client Job No:	12506381
Sample Source:	TP10/01	Sample Depth:	2.2m to 3.6m
Date & Time Sampled:	10-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Test Pit / Borehole *	Date Received:	26-Jun-19

		PINHOLE DISPE	CRSION TEST: ASTM D4647-13e1
Head	Elapsed Time	Flow Rate	Colour of Outflow
(mm)	(min)	(ml/s)	(Cloudiness)
50	1	0.25	Slightly Dark
50	5	0.27	Moderately Dark
50	10	0.31	Dark
Diameter of Hole a	it Start of Test:		1.0mm
Diameter of Hole a	it End of Test:		≈ 2.0mm (4.0mm at exit)
Water Content Pri	ior to Test:		16.2 %
Dry Density of Sar	nple Tested:		1.63 t/m ³
l			

Pinhole Dispersion Classification – Method B:

Dispersive (D)

CR	UMB TEST: ASTM D6572-13e2	(Method B)	
Elapsed Time	Estimated Slaking	Observations Recorded	LabServe - 255
2 min	≈ 50 %	No colloidal cloud	600 mL -100 - 400
1 hr	≈ 100%	Dense colloidal cloud over	10 200 300
6 hr	≈ 100 %	Moderate colloidal cloud over	300 - 200
Crumb Test Classification	n:	Grade 4 (Highly Dispersive)	/ 400 - 100

Note:

• Distilled water was used in the pinhole dispersion and crumb test. Both tests were carried out on remoulded samples.

• The pinhole dispersion sample was compacted to 95% NZ standard compaction.

• Photograph at completion of the crumb test.

• The sample tested was the fraction passing the 2.00mm sieve.

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L.T. Smith

Date: 4 to 15-Jul-19

Checked By:

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Date: 23 July 2019

TEST REPORT: DCC SMOOTH HILL INVESTIGATIONS

Client De	etails:		GHD, Leve	13,	138	Victori	a Str	eet.	Chr	istch	urcl	h					A	tten	tio	n:	J	. So	uth	iwo	rth			
Job Desc	ription:		DCC Smoo	th I	Hill	Landfil	I Inv	estig	atio	ns											1							
Sample I	Description	:	Loess - Silt	y C	LAY	Y with r	nino	r sai	nd a	nd tr	ace	of g	grav	el	C	ient	: Jol	b No):		1	250	638	81				
Sample S	Source:		BH5 @ 0.01	m to) 1.2	2m & B	H7 (a	0.0	m to	1.4r	n			-	Sa	mp	le D	eptl	1:		(lom	bin	led	(0.0	m to	1.4	m)
Date & T	ime Samp	led:	21-Jun-19												Sa	mp	led	By:			N	1. F	'itzı	ma	uric	e		,
Sample N	Method:		Test Pit / B	ore	hole	*									D	ate 1	Rece	eiveo	d:		2	6-J	un-	19				
				1																								
PART (NZS 44	FICLE SIZ 02:1986, T	E ANA est 2.8	ALYSIS .1 & 2.8.4)		100						0.063	c/ N.N	$0.150 \\ 0.212$	0.30	0.60	1.18	2.00	2.36	4.75	9.50	13.2 19.0	37.5	53.0	75.0	106	200		
Test S	Sieve	%	Passing		100								<u> </u>	-	-++				1									
(m	im)	(by	(mass)								Þ	\parallel																
37.	5		,		90	, <u> </u>					/																	
26.	5				80						/																	ЦЦ
19.	0				00	'				4											BH	5 @) ()	0m	- 1.	2m (&	
13.	2				70																Bl	H7 (<u>a</u> (0.01	m - 1	1.4m	1	
9.5	0			1	/0	'				1									$ \top$								$ \top$	
4 7	5		100	ass)	60					/																		
2.3	6		99	v m	00	1			/												IT					[T	
2.5	0		00	(q)	50				4																			
2.0	Q		00	sing	50	' [,	/						$ ^{-}$													
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0.0	0		20 07	%	40			1																				
0.3			<u>۶/</u>	-	30	0																			Ш			
0.21	12		<u>9/</u>	-	50	-																						
0.15	50		96	-	20																							Щ
0.07	75		92	4	20																							
0.06	53		90	1	10																							Щ
Fract	tion	Interr	olated %	1	10																							
Siz	e	Pa	assing		0																							
60 u	ım		89	1		0.001	T :-	0.	01	c		0.1				1		r.,		10		6		10	0			1000
20 u	ım		62	1		CLAY	rme	Me	ILT	Coars	e	rme		SAN	ш D	Coars	e	rme		GRAV	TEL	Coar	se	COB	BLES	BOU	LDER	s
6.0	m		39	1	1	The samp	le was	recei	ived i	ı a na	tural	state	e. Th	e pei	rcent	age p	assii	ng the	e 63	um t	est si	eve v	was	obta	ined	by dif	ferei	nce.
2	m		29	1	1	The pH of	the h	ydroi	neter	suspe	nsion	was	s 8.5.	Sod	ium	hexa	meta	phos	pha	te wa	s use	ed as	a di	ispe	rsant			
μ	PARTI	ICLE S	SIZE ANAL	YSI	[S &	HYDR	OM	ETF	ER A	NAI	YS	IS F	RES	UL	TS	- N7	ZS 4	402:	:19	86. '	Test	2.8	3.1 4	& 2	.8.4			
Desc	ription		Fraction Rai	nge		% W	ithir	1 Ra	nge		I	Des	crip	tion	1		F	rac	tion	1 Ra	inge))		%	Wi	thin	Rar	ige
Coars	e Gravel	60	.0mm to 20.0	0mi	n		-		3-			Fin	ie Sa	and			20	00 μ	m t	to 6	<u>в</u> 0 µr	n				8		8
Mediu	m Gravel	20	0.0mm to 6.0)mn	n		-				(Coa	arse	Silt	t		6	i0 ui	n te	o 20) µn	1	Τ			27		
Fine	Gravel	6.	0mm to 2.00	mr	n		1				Ν	/led	lium	n Sil	lt		-	20 μ	m t	to 6	μm					23		
Coar	se Sand	2.0	00mm to 600) μr	n		1					Fi	ne S	Silt				<u>б</u> дл	n te	o 2	μm					10		
Mediu	ım Sand	60	00 µm to 200) μn	1		1						Clay	Y					< 2	μm						29		
]	l I	WATE	R CONTEN	T &	k PI	LASTIC	CITY	IN	DEX	RES	UL	ТS	- N2	ZS 4	1402	2:19	86. '	Test	2.1	1, 2.	2, 2	.3 8	z 2.	4				
	Water Co	ontent:	("All In" A	s R	ecei	ved)			_	~		-				23	.6 º	6		, .	,							
	Liquid Li	imit: (]	(LL))											42	-										
	Plastic Li	imit: (I	PL)														23											
	Plasticity	Index	: (PI)														19											
	Note: The	sample	was received i	in a	natu	ral state.	The	plast	icity	index	mate	erial	l test	ed w	vas t	he fr	actio	on pa	issi	ng ti	ne 42	25 μ	m te	est s	ieve.			
Note:		1							·							5				0			-	-				
•	Informati	on cont	ained in this r	epoi	rt wh	ich is No	ot IAN	VZ A	ccrea	ited r	elate	s to	the s	sam	ple a	lescr	iptio	ns b	ased	l on	NZ	Geo	tech	nic	al So	ciety		
	Guideline	s 2005,	the sample me	etho	d*a	ind samp	ling.							-												-		
•	This repo	rt may n	ot be reprodu	ced	exce	pt in full	•																					

Tested By:

L.T. Smith

4 to 15-Jul-19 Date:

Checked By:

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Specialist Quality Assurance Service in Aggregate, Concrete and Soils Testing



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Date: 23 July 2019

TEST REPORT: DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – Silty CLAY with minor sand and trace of gravel	Client Job No:	12506381
Sample Source:	BH5 @ 0.0m to 1.2m & BH7 @ 0.0m to 1.4m	Sample Depth:	Combined (0.0m to 1.4m)
Date & Time Sampled:	21-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Test Pit / Borehole *	Date Received:	26-Jun-19



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Sample Source:	BH5 @ 0.0m to 1.2m & BH7 @ 0.0m to 1.4m	Sample Depth:	Combined (0.0m to 1.4m)
Date & Time Sampled:	21-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Test Pit / Borehole *	Date Received:	26-Jun-19

	PINHOLE DISPERSION TEST: ASTM D4647-13e1									
Head	Elapsed Time	Flow Rate	Colour of Outflow							
(mm)	(min)	(ml/s)	(Cloudiness)							
50	1	0.25	Barely Visible							
50	5	0.27	Moderately Dark							
50	10	0.49	Very Dark							
Diameter of Hole a	it Start of Test:		1.0mm							
Diameter of Hole a	it End of Test:		≈ 2.0mm							
Water Content Pri	ior to Test:		17.8 %							
Dry Density of Sar	nple Tested:		1.62 t/m ³							

Pinhole Dispersion Classification – Method A:

Dispersive (D)

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ACCREDITED LABORATORY Accreditation No: 434

CR	UMB TEST: ASTM D6572-13e2 ((Method B)	
Elapsed Time	Estimated Slaking	Observations Recorded	0 400 ml
2 min	≈ 20 %	No colloidal cloud	bServ° 300
1 hr	pprox 100%	Dense colloidal cloud over	100-
6 hr	≈ 100 %	Dense colloidal cloud over	2 200 - 200
Crumb Test Classification	n:	Grade 4 (Highly Dispersive)	300 - 100

Note:

Distilled water was used in the pinhole dispersion and crumb test. Both tests were carried out on remoulded samples.

The pinhole dispersion sample was compacted to 95% NZ standard compaction.

Photograph at completion of the crumb test.

The sample tested was the fraction passing the 2.00mm sieve.

Note:

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Tested By:

L.T. Smith

4 to 15-Jul-19 Date:

Checked By:

emplus

Approved Signatory

A.P. Julius Laboratory Manager

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Date: 3 August 2019

TEST REPORT – SMOOTH HILL LANDFILL INVESTIGATIONS

Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – SILT with some sand, minor gravel and minor clay	Client Job No:	12506381
Sample Source:	TP10/01	Sample Depth:	2.2m to 3.6m
Date & Time Sampled:	10-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Test Pit	Date Received:	26-Jun-19

CONSTANT HEAD PERMEABILITY TEST IN A TRIAXIAL CELL – ASTM D5084-16a										
Cell Pressure: (kPa)	610	Compaction:	95% NZ Standard							
Saturation Back Pressure: (kPa)	600	Solid Density: (t/r	ensity: (t/m ³) 2.67							
Effective Confining Pressure: (kPa)	10	Temperature Du	cure During Test: (°C) 20.5							
Saturation by Pore Pressure Response: (B Value)	0.98	Permeant Liquid	Used:	De-aired Tap Water						
Sample Status:	Initial	Final								
Sample Dimensions: (mm)	105.02 ф x 11	5.29	10	06.02 φ x 117.05						
Bulk Density: (t/m ³)	1.92			1.98						
Water Content: (%)	18.0			26.3						
Dry Density: (t/m ³)	1.62			1.57						
Saturation By Calculation: (%)	75			100						
Void Ratio: (e)	0.65		0.70							
Constant Head: (kPa)	3.0			5.0						
Hydraulic Conductivity: (k ₂₀)	2.9 x 10 ⁻⁸ n	n/s		3.2 x 10 ⁻⁸ m/s						

Note:

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Tested By: N.P. Danischewski

Checked By:

emplus

Date: 11-Jul-19 to 3-Aug-19







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Date: 3 August 2019

TEST REPORT – SMOOTH HILL LANDFILL INVESTIGATIONS

Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – SILT with some sand, minor gravel and minor clay	Client Job No:	12506381
Sample Source:	TP10/01	Sample Depth:	2.2m to 3.6m
Date & Time Sampled:	10-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Test Pit	Date Received:	26-Jun-19

CONSTANT HEAD PERMEABILITY TEST IN A TRIAXIAL CELL – ASTM D5084-16a						
Cell Pressure: (kPa)	727	Compaction:		95% NZ Standard		
Saturation Back Pressure: (kPa)	650	Solid Density: (t/r	m ³)	2.67		
Effective Confining Pressure: (kPa)	77	Temperature Du	ring Test: (°C)	18.0		
Saturation by Pore Pressure Response: (B Value)	0.99	Permeant Liquid Used:		De-aired Tap Water		
Sample Status:	ample Status: Initial		Final			
Sample Dimensions: (mm)	105.04 φ x 11	5.72	105.27 ф x 116.26			
Bulk Density: (t/m ³)	1.89		1.99			
Water Content: (%)	17.8			24.0		
Dry Density: (t/m ³)	1.60			1.61		
Saturation By Calculation: (%)	71			97		
Void Ratio: (e)	0.67			0.66		
Constant Head: (kPa)	Constant Head: (kPa) 3.0			10.0		
Hydraulic Conductivity: (k ₂₀)	2.7 x 10 ⁻⁸ n	n/s	2	2.8 x 10 ⁻⁸ m/s		

Note:

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Date: 11-Jul-19 to 3-Aug-19

Checked By:

emplus





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Date: 3 August 2019

TEST REPORT – SMOOTH HILL LANDFILL INVESTIGATIONS

Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – Silty CLAY with minor sand and trace of gravel	Client Job No:	12506381
Sample Source:	BH5 @ 0.0m to 1.2m & BH7 @ 0.0m to 1.4m	Sample Depth:	Combined (0.0m to 1.4m)
Date & Time Sampled:	21-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Borehole	Date Received:	26-Jun-19

CONSTANT HEAD PERMEABILITY TEST IN A TRIAXIAL CELL – ASTM D5084-16a						
Cell Pressure: (kPa)	460	Compaction:		95% NZ Standard		
Saturation Back Pressure: (kPa)	450	Solid Density: (t/m ³)		2.71		
Effective Confining Pressure: (kPa)	10	Temperature Du	ring Test: (°C)	20.0		
Saturation by Pore Pressure Response: (B Value)	0.97	Permeant Liquid Used:		De-aired Tap Water		
Sample Status:	Initial		Final			
Sample Dimensions: (mm)	105.01 ¢ x 115.08		106.2 ¢ x 117.40			
Bulk Density: (t/m ³)	1.94		1.96			
Water Content: (%)	18.7			25.9		
Dry Density: (t/m ³)	1.63			1.56		
Saturation By Calculation: (%) 77		95		95		
Void Ratio: (e)	0.66			0.74		
Constant Head: (kPa) 3.0				5.0		
Hydraulic Conductivity: (k ₂₀)	1.7 x 10 ⁻⁹ n	n/s	2	2.1 x 10 ⁻⁹ m/s		

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11-Jul-19 to 3-Aug-19

Date:

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Tested By: N.P. Danischewski

Checked By:

emplus

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Specialist Quality Assurance Service in Aggregate, Concrete and Soils Testing



18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: <u>www.centraltesting.co.nz</u>, E: info@centraltesting.co.nz Page 4 of 4 Pages

Reference No: 19/1963-1

Date: 3 August 2019

TEST REPORT – SMOOTH HILL LANDFILL INVESTIGATIONS

Client Details:	GHD, Level 3, 138 Victoria Street, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess – Silty CLAY with minor sand and trace of gravel	Client Job No:	12506381
Sample Source:	BH5 @ 0.0m to 1.2m & BH7 @ 0.0m to 1.4m	Sample Depth:	Combined (0.0m to 1.4m)
Date & Time Sampled:	21-Jun-19	Sampled By:	M. Fitzmaurice
Sample Method:	Borehole	Date Received:	26-Jun-19

CONSTANT HEAD PERMEABILITY TEST IN A TRIAXIAL CELL – ASTM D5084-16a						
Cell Pressure: (kPa)	527	Compaction:		95% NZ Standard		
Saturation Back Pressure: (kPa)	450	Solid Density: (t/m ³)		2.71		
Effective Confining Pressure: (kPa)	77	Temperature Du	ring Test: (°C)	19.5		
Saturation by Pore Pressure Response: (B Value)	0.97	Permeant Liquid Used:		De-aired Tap Water		
Sample Status: Initial		Final		Final		
Sample Dimensions: (mm)	104.96 φ x 11	4.97	10)4.52 φ x 115.45		
Bulk Density: (t/m ³)	1.94			2.03		
Water Content: (%)	18.7			24.3		
Dry Density: (t/m ³)	1.63			1.64		
Saturation By Calculation: (%) 77		1		100		
Void Ratio: (e)	0.66			0.66		
Constant Head: (kPa) 3.0				5.0		
Hydraulic Conductivity: (k ₂₀)	5.6 x 10 ⁻¹⁰ r	m/s	5	5.3 x 10 ⁻¹⁰ m/s		

Note:

• Information contained in this report which is Not IANZ Accredited relates to the sample description based on NZ Geotechnical Society Guidelines 2005 and sampling.

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Tested By: N.P. Danischewski

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Checked By:

emplus

Date: 11

e: 11-Jul-19 to 3-Aug-19

Approved Signatory

A.P. Julius Laboratory Manager

Tests indicated as Not Accredited are outside the scope of the laboratory's accreditation



Specialist Quality Assurance Service in Aggregate, Concrete and Soils Testing



18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz Page 1 of 2 Pages Reference No: 19/3782-1

Date: 7 January 2020

TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD L	GHD Ltd, P.O. Box 13468, Christchurch Attention: J. Southworth							
Job Description:	DCC S	mooth Hill L	andfill Invest	igations					
Sample Description:	Loess					Client Order No: N/A			
Sample Source:	BS01 @ and BS	0.5m, BS03 013 @ 1.2m	@ 0.7m, BS(combined	07 @ 0.5m, B	S08 @ 0.6m,	, BS010 @ 0.7	7m, BS011 (a) 1.3m, BS012	@ 0.4m
Date & Time Sampled:	Unkno	wn				Sampled B	y:	GHD Ltd Stat	ff
Sample Method:	Unkno	wn				Date Receiv	ved:	6-Dec-19	
LIME DEMAN	D TEST	Γ– NSW Tra	nsport; Road	ls & Maritim	e Services T	est Method T		NZ Accredited)
Sample Description:	Loess - Natural Soil Sub-sample #1Loess - Natural Soil Sub-sample #2				le #2				
% Passing 2.36mm Test Si	ieve:	ve: 99.5%				9	9.5%		
Lime Type:			Taylors Hyd	Irated Lime			Taylors H	Iydrated Lime	
pH of Lime Solution			12.	60				12.63	
% Added Lime: (by dry m	ass)	0%	1%	2%	3%	4%	5%	6%	7%
pH Sub-sample #1:		5.12	10.15	12.12	12.42	12.46	12.49	12.48	12.42
pH Sub-sample #2:		5.16	10.31	12.08	12.50	12.55	12.56	12.55	12.55
	1					Sub-sample #1			8
-		_	_	% Li	me				
Note: • IANZ endorsement	nt of this	report applies	to the samples of	is received.					

L.T. Smith **Tested By:** 9 to 17-Dec-19 Date: emplus Checked By:



accreditation

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Reference No: 19/3782-1

Date: 7 January 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch A			J. Southworth		
Job Description:	DCC Smooth Hill Landfill Investigations					
Sample Description:	Loess	N/A				
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 @ 0.7m, BS011 @ 1.3m, BS012 @ 0.4m and BS013 @ 1.2m combined					
Date & Time Sampled:	Unknown	Sampleo	l By:	GHD Ltd Staff		
Sample Method:	Unknown	Date Re	ceived:	6-Dec-19		

WATER CONTENT & PLASTICITY INDEX RESULTS - NZS 4402:1986, Test 2.1, 2.2, 2.3 & 2.4						
Sample Description:		Loess - I	Natural Soil			
Water Content: (As Received)	25.0 %					
Sub-sample ID	#1	#2	#3	#4		
Liquid Limit: (LL)	41	41	41	41		
Plastic Limit: (PL)	25	25	25	25		
Plasticity Index: (PI) 16 16 16 16						
Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.						

Note:

• IANZ endorsement of this report applies to the samples as received.

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Tested By:

L.T. Smith

Date: 9 to 17-Dec-19

Checked By:

emplus

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Approved Signatory

A.P. Julius Laboratory Manager





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Date: 17 January 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch Atte			J. Southworth		
Job Description:	DCC Smooth Hill Landfill Investigations					
Sample Description:	Loess	N/A				
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 @ 0.7m, BS011 @ 1.3m, BS012 @ 0.4m and BS013 @ 1.2m combined					
Date & Time Sampled:	Unknown	Sampleo	l By:	GHD Ltd Staff		
Sample Method:	Unknown	Date Re	ceived:	6-Dec-19		

PLASTICITY INDEX RESULTS - NZS 4402:1986, Tests 2.2, 2.3 & 2.4							
Sample Description:	Loess - Natural Soil						
Sub-sample ID:	#1 #2 #3 #4						
Sample Additive (By Dry Mass)	2.5% Lime	2.5% Lime	3.0% Bentonite	3.0% Bentonite			
Time Cured For:	1 day	7 days	1 day	7 days			
Liquid Limit: (LL)	54	55	42	40			
Plastic Limit: (PL)	30	32	23	23			
Plasticity Index: (PI)	24	23	19	17			

Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.

Note:

• IANZ endorsement of this report applies to the samples as received.

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Tested By:

L.T. Smith

Date: 9 to 17-Jan-20

emplus **Checked By:**

Approved Signatory

A.P. Julius Laboratory Manager

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TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	1	Attention:	J. Southworth		
Job Description:	DCC Smooth Hill Landfill Investigations					
Sample Description:	Loess	N/A				
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 @ 0.7m, BS011 @ 1.3m, BS012 @ 0.4m and BS013 @ 1.2m combined – 2.5% Added Hydrated Lime (by dry mass)					
Date & Time Sampled:	Unknown	Samp	led By:	GHD Ltd Staff		
Sample Method:	Unknown	Date I	Received:	6-Dec-19		



General Notes:

IANZ endorsement of this report applies to the samples as received.

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Tested By:

C. Fisher

Date:

24 to 29-Jan-20

Checked By:

emplus





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TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch Attention: J. Southwe			
Job Description:	DCC Smooth Hill Landfill Investigations			
Sample Description:	Loess	Order No	D:	N/A
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 @ 0.7m, BS011 @ 1.3m, BS012 @ 0.4m and BS013 @ 1.2m combined – 2.5% Added Hydrated Lime (by dry mass)			
Date & Time Sampled:	Unknown	Sampled	By:	GHD Ltd Staff
Sample Method:	Unknown	Date Rec	eived:	6-Dec-19



General Notes:

IANZ endorsement of this report applies to the samples as received.

This report may not be reproduced except in full.

Tested By:

C. Fisher

Date:

24 to 29-Jan-20

Checked By:

emplus

All tests reported herein have been performed in accordance with the scope of the laboratory's accreditation





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TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	J. Southworth			
Job Description:	DCC Smooth Hill Landfill Investigations				
Sample Description:	Loess	Orde	er No:	N/A	
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 @ 0.7m, BS011 @ 1.3m, BS012 @ 0.4m and BS013 @ 1.2m combined – 3.0% Added Bentonite (by dry mass)				
Date & Time Sampled:	Unknown	Samp	oled By:	GHD Ltd Staff	
Sample Method:	Unknown	Date	Received:	6-Dec-19	



General Notes:

IANZ endorsement of this report applies to the samples as received.

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Tested By:

C. Fisher

Date:

24 to 29-Jan-20

Checked By:

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<u>TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	ntion:	J. Southworth		
Job Description:	DCC Smooth Hill Landfill Investigations				
Sample Description:	Loess	Order No:		N/A	
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 @ 0.7m, BS011 @ 1.3m, BS012 @ 0.4m and BS013 @ 1.2m combined – 3.0% Added Bentonite (by dry mass)				
Date & Time Sampled:	Unknown	Sampled B	sy:	GHD Ltd Staff	
Sample Method:	Unknown	Date Recei	ived:	6-Dec-19	



General Notes:

IANZ endorsement of this report applies to the samples as received.

This report may not be reproduced except in full.

Tested By:

C. Fisher

Date:

24 to 29-Jan-20

Checked By:

emplus **Approved Signatory**

A.P. Julius Laboratory Manager

All tests reported herein have been performed in accordance with the scope of the laboratory's accreditation





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P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Page 1 of 5 Pages Reference No: 19/3782-4 Date: 10 February 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess	Order No:	N/A
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 and BS013 @ 1.2m combined – 2.5% Added Hydrated Lime (by o	@ 0.7m, BS011 @ 1.3 Iry mass) – 1 day curi	m, BS012 @ 0.4m ng
Date & Time Sampled:	Unknown	Sampled By:	GHD Ltd Staff
Sample Method:	Unknown	Date Requested:	20-Jan-20

PINHOLE DISPERSION TEST: ASTM D4647-13e1						
Head	Elapsed Time	Flow Rate	Colour of Outflow			
(mm)	(min)	(ml/s)	(Cloudiness)			
50	5	0.43	Completely Clear			
50	10	0.44	Completely Clear			
180	15	0.67	Completely Clear			
380	20	0.95	Completely Clear			
1020	25	1.82	Completely Clear			
Diameter of Hole at Start of Test:			1.0 mm			
Diameter of Hole at End of Test:			1.0 mm			
Water Content Prior to Test:			20.0 %			
Dry Density of Sample Tested:			1.56 t/m ³			
	· · · · · · · · · · · · · · · · · · ·					

Pinhole Dispersion Classification - Method A: (1 Day Curing)

ND1 (Non-Dispersive)

CRU	JMB TEST: ASTM D6572-13e2 (N	A RECEIPTION OF	
Elapsed Time	Estimated Slaking	Observations Recorded	
2 min	< 2%	Clear – no colloidal cloud evident	Server 100 miles
1 hr	≈ 5%	Clear – no colloidal cloud evident	Julmi ma sua
6 hr	≈ 5% - 10%	Clear – no colloidal cloud evident	200 200
Crumb Test Classification: (1 Day Curing)		Grade 1 (Non-Dispersive)	300 - 100

Note:

• Distilled water was used in the pinhole dispersion and crumb test. Both tests were carried out on remoulded samples.

- The pinhole dispersion sample was compacted to 95% NZ standard compaction.
- Photograph at completion of the crumb test.
- The sample tested was the fraction passing the 2.00mm sieve.

General Notes:

IANZ endorsement of this report applies to the samples as received.
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This r	report	may	not be	e reprod	luced e.	xcept i	n full.	

Tested By:	L.T. Smith	Date:	25-Jan-20 to 7-Feb-20	
Checked By:	emplus		All tests reported herein have been performed in accordance with the scope of the laboratory's accreditation	ACCREDITED LABORATORY Accreditation No: 434



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P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Page 2 of 5 Pages Reference No: 19/3782-4 Date: 10 February 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	Attention:	J. Southworth	
Job Description:	DCC Smooth Hill Landfill Investigations			
Sample Description:	Loess	Ord	er No:	N/A
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 and BS013 @ 1.2m combined – 2.5% Added Hydrated Lime (by o	@ 0.7 lry m	/m, BS011 @ 1.3 ass) – 7 days curi	m, BS012 @ 0.4m ing
Date & Time Sampled:	Unknown	Sam	pled By:	GHD Ltd Staff
Sample Method:	Unknown	Date	e Requested:	20-Jan-20

	PINHOLE DISPERSION TEST: ASTM D4647-13e1				
Head (mm)	Elapsed Time (min)	Flow Rate (ml/s)	Colour of Outflow (Cloudiness)		
50	5	0.30	Completely Clear		
50	10	0.30	Completely Clear		
180	15	0.60	Completely Clear		
380	20	0.94	Completely Clear		
1020	25	1.73	Completely Clear		
Diameter of Hole at Start of Test:			1.0 mm		
Diameter of Hole at End of Test:			1.0 mm		
Water Content Prior to Test:			19.7 %		
Dry Density of Sample Tested:			1.56 t/m ³		

Pinhole Dispersion Classification – Method A: (7 Day Curing)

ND1 (Non-Dispersive)

accreditation

CRU	JMB TEST: ASTM D6572-13e2 (N		
Elapsed Time	Estimated Slaking	Observations Recorded	0 400 m
2 min	< 1%	Clear – no colloidal cloud evident	
1 hr	≈ 30%	Clear – no colloidal cloud evident	
6 hr	≈ 60%	Clear – no colloidal cloud evident	200 - 200
Crumb Test Classification: (7 Day Curing)		Grade 1 (Non-Dispersive)	300

Note:

• Distilled water was used in the pinhole dispersion and crumb test. Both tests were carried out on remoulded samples.

- The pinhole dispersion sample was compacted to 95% NZ standard compaction.
- Photograph at completion of the crumb test.
- The sample tested was the fraction passing the 2.00mm sieve.

General Notes:

• IANZ endorsement of this report applies to the samples as received.

This report may not be reproduced except in full.

Tested By:	L.T. Smith	Date:	25-Jan-20 to 7-Feb-20
Checked By:	emplus		All tests reported herein have been performed in accordance with the scope of the laboratory's





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P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Page 3 of 5 Pages Reference No: 19/3782-4 Date: 10 February 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

		A 44 4 *	
Client Details:	GHD Ltd, P.O. Box 13468, Christenurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description: Loess Order No: N		N/A	
Samula Sauraa	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010	@ 0.7m, BS011 @ 1.3	m, BS012 @ 0.4m
Sample Source:	and BS013 @ 1.2m combined - 3.0% Added Bentonite (by dry ma	ass) – 1 day curing	_
Date & Time Sampled:	Unknown	Sampled By:	GHD Ltd Staff
Sample Method:	Unknown	Date Requested:	20-Jan-20

	PI	NHOLE DISPERSIO	DN TEST: ASTM D4647-13e1
Head (mm)	Elapsed Time (min)	Flow Rate (ml/s)	Colour of Outflow (Cloudiness)
50	1	0.50	Dark
50	3	1.23	Very Dark
50	5	2.23	Very Dark
Diameter of Hole at S	tart of Test:		1.0 mm
Diameter of Hole at E	Ind of Test:		3.0 mm
Water Content Prior	to Test:		17.6 %
Dry Density of Sampl	e Tested:		1.60 t/m ³

Pinhole Dispersion Classification – Method B: (1 Day Curing)

D (Dispersive)

CR	UMB TEST: ASTM D65	72-13e2 (Method B)	
Elapsed Time	Estimated Slaking	Observations Recorded	1 August
2 min	< 2%	Colloidal cloud evident around cube	LabServ
1 hr	≈ 55%	Heavy colloidal cloud ≈ 20mm deep covering entire bottom	500 mL 100 - 300
6 hr	≈ 80%	Heavy colloidal cloud ≈ 20mm deep covering entire bottom	L 200 - 200
Crumb Test Classification	n: (1 Day Curing)	Grade 4 (Dispersive)	300 - 100

Note:

• Distilled water was used in the pinhole dispersion and crumb test. Both tests were carried out on remoulded samples.

• The pinhole dispersion sample was compacted to 95% NZ standard compaction.

• Photograph at completion of the crumb test.

• The sample tested was the fraction passing the 2.00mm sieve.

General Notes:

IANZ endorsement of this report applies to the samples as received.

This report may not be reproduced except in full.

Tested By:

L.T. Smith

Date:

25-Jan-20 to 7-Feb-20

Checked By:

emplus

All tests reported herein have been performed in accordance with the scope of the laboratory's accreditation





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P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Page 4 of 5 Pages

Reference No: 19/3782-4

Date: 10 February 2020

TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess	Order No:	N/A
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 and BS013 @ 1.2m combined – 3.0% Added Bentonite (by dry ma	@ 0.7m, BS011 @ 1.3 ass) – 7 days curing	m, BS012 @ 0.4m
Date & Time Sampled:	Unknown	Sampled By:	GHD Ltd Staff
Sample Method:	Unknown	Date Requested:	20-Jan-20

	Р	INHOLE DISPERSIO	N TEST: ASTM D4647-13e1					
Head	Elapsed Time	Flow Rate	Colour of Outflow					
PINHOLE DISPERSION TEST: ASTM D4647-13c Head Elapsed Time (min) Flow Rate (ml/s) O 50 1 1.43 1.43 50 3 2.33 1.43 50 5 2.58 1.43 Diameter of Hole at Start of Test: Diameter of Hole at End of Test: 1.43 Water Content Prior to Test: 1.43 Dry Density of Sample Tested: 1.43	(Cloudiness)							
50	1	1.43	Very Dark					
50	50 3 2.33 Very Dark							
PINHOLE DISPERSION TEST: ASTM D4647-13e1Head (mm)Elapsed Time (min)Flow Rate (ml/s)Colour of Outflow (Cloudiness)5011.43Very Dark5032.33Very Dark5052.58Very DarkDiameter of Hole at Start of Test:1.0 mmDiameter of Hole at End of Test:4.0 mmWater Content Prior to Test:17.9 %Dry Density of Sample Tested:1.60 t/m³	Very Dark							
		_						
Diameter of Hole at S	Start of Test:		1.0 mm					
Diameter of Hole at H	End of Test:		4.0 mm					
Water Content Prior	to Test:		17.9 %					
Diameter of Hole at Start of Test:1.0 mmDiameter of Hole at End of Test:4.0 mmWater Content Prior to Test:17.9 %Dry Density of Sample Tested:1.60 t/m³		1.60 t/m ³						

Pinhole Dispersion Classification – Method B: (7 Day Curing)

D (Dispersive)

CR	UMB TEST: ASTM D65	72-13e2 (Method B)	
Elapsed Time	Estimated Slaking	Observations Recorded	0 400 mL
2 min	< 1%	Colloidal cloud evident around cube	±5%
1 hr	≈ 40%	Heavy colloidal cloud ≈ 20mm deep covering entire bottom	500 mL 100 - 300
6 hr	≈ 95% - 100%	Heavy colloidal cloud ≈ 20mm deep covering entire bottom	4 200 — 200
Crumb Test Classificatio	n: (7 Day Curing)	Grade 4 (Dispersive)	300 — 100

Note:

Distilled water was used in the pinhole dispersion and crumb test. Both tests were carried out on remoulded samples.

- The pinhole dispersion sample was compacted to 95% NZ standard compaction.
- Photograph at completion of the crumb test.
- The sample tested was the fraction passing the 2.00mm sieve.

General Notes:

IANZ endorsement of this report applies to the samples as received.

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Tested By: Checked By:

emplus

Date:

25-Jan-20 to 7-Feb-20

L.T. Smith

•



All tests reported herein have been performed in accordance with the scope of the laboratory's accreditation





18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz Page 5 of 5 Pages Reference No: 19/3782-4 Date: 10 February 2020

TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Loess	Order No:	N/A
Sample Source:	BS01 @ 0.5m, BS03 @ 0.7m, BS07 @ 0.5m, BS08 @ 0.6m, BS010 and BS013 @ 1.2m combined – 2.5% Added Hydrated Lime (by 0	@ 0.7m, BS011 @ 1.3 dry mass)	m, BS012 @ 0.4m
Date & Time Sampled:	Unknown	Sampled By:	GHD Ltd Staff
Sample Method:	Unknown	Date Requested:	20-Jan-20

PLASTICITY	INDEX RESULTS - NZS 4402:1986, Test 2.2, 2.3 & 2.4
Sample Description:	Loess - 2.5% Added Hydrated Lime (by dry mass)
Time Cured For:	28 days
Liquid Limit: (LL)	53
Plastic Limit: (PL)	30
Plasticity Index: (PI)	23

Note: The sample was received in a natural state. The plasticity index material tested was the fraction passing the 425 µm test sieve.

General Notes:

IANZ endorsement of this report applies to the samples as received.

This report may not be reproduced except in full. .

Tested By:

L.T. Smith

Checked By:

emplus

Approved Signatory

A.P. Julius Laboratory Manager

Date:

25-Jan-20 to 7-Feb-20

All tests reported herein have been performed in accordance with the scope of the laboratory's accreditation





18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: <u>www.centraltesting.co.nz</u>, E: info@centraltesting.co.nz Page 1 of 4 Pages Reference No: 20/228 Date: 4 March 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	Attention:	J. Southworth
Job Description:	DCC Smooth Hill Landfill Investigations		
Sample Description:	Siltstone – Sandy SILT with minor clay	Client Order No:	Not Stated
Sample Source:	BH05 @ 2.7m - 7.2m	Sample Label No:	N/A
Date & Time Sampled:	Unknown	Sampled By:	GHD Ltd Staff
Sample Method:	Borehole *	Date Received:	December 2019

									Wat	er Cor	itent (%)						
		1.69	8	9	10	11	12	13 1	14 :	15 1	6	17 1	8 1	9 2	20 21	1 22	2	3
													j	-		ý		
an assumed solid densi	ty of 2.70 t/m^3 .	1.71												6				
 The material tested in t Compaction test was w The air voids lines wer 	he NZ Standard hole soil. e calculated from	1.72																
• The sample was receive state.	ed in a natural	172																
Notes:		y Densi																
Optimum Water Content:	16.0 %	(_E m/1) ft 1.74																
Maximum Dry Density:	1.76 t/m ³	1.70						0			``	a a a						
Water Content: ("All In" As Received)	13.7 %	1.77									i							
% Retained (+19.0mm Fraction)	0.0 %	1.78									5%			<u>8% Ai</u>	r Voids	Line		
WATE	<u>R CONTENT &</u>	NZ STA	NDA	ARD	CON	IPA	CTI	<u>ON - N2</u>	<u>ZS 44</u>	02:19	986, '	Fest 2	2.1 &	4.1.1				
WATE:	D CONTENT &	NZ STA	ND/		CON	TD A	CTI	ON N'	78 14	102.10	196 7	Tost 1	1 8-	111				

PLASTICITY INDEX RE	SULTS - NZS 4402:1986, Test 2.2, 2.3 & 2.4
Liquid Limit: (LL)	41
Plastic Limit: (PL)	25
Plasticity Index: (PI)	16
Note: The sample was received in a natural state. The pla	isticity index material tested was the fraction passing the 425 μ m test sieve.

Note:

Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005, the sample method * and sampling.

This report may not be reproduced except in full.

Tested By: L.T. Smith, N.P. Danischewski, C. Fisher & C. Pearson

arson Date:

10-Jan-20 to 4-Mar-20

Checked By:

•

emplus





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18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: <u>www.centraltesting.co.nz</u>, E: info@centraltesting.co.nz Page 2 of 4 Pages Reference No: 20/228 Date: 4 March 2020

TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468	, Christchur	ch						Α	tten	tion	:	J.	Sou	thw	orth	l			
Job Description:	DCC Smooth Hill Landfill	Investigatio	ns																	
Sample Description:	Siltstone – Sandy SILT wi	th minor cla	y				Cli	ient	Ord	er N	0:		No	ot St	ated	l				
Sample Source:	BH05 @ 2.7m - 7.2m						Sa	mpl	e Lal	bel N	No:		N/A							
Date & Time Sampled:	Unknown						Sa	mpl	ed B	y:			G	HD	Ltd	Staf	ſſ			
Sample Method:	Borehole * Date F				te R	leceiv	ved:			De	ecen	ıber	201	9						
	UNCONFINED COM	PRESSIVE S	STRE	NGT	H - I	NZS -	4402	2:19	86, T	'est (5.3.1	l								
Sample Diameter: (mm)	101.50	120																		
Sample Length: (mm)	202.68	120										BI	105	@ 2	.7m	to 7	.2m			
Length / Diameter Ratio:	2.00	110												T	Т					
Bulk Density: (t/m ³)	1.94	100					$\left \right $		and a sec	×~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	.		+	_	+			-		
Water Content: (%)	15.9	90						1			Ň	•		_	+			-		
Dry Density (t/m ³)	1.67	80					Į	-							_					
Mode of Failure:	Plastic / Plastic Brittle	(Pa)					Ĭ													
Strain @ Failure:	2.0 %	ress (h				1														
Load @ Failure:	0.840 kN	al Str 00				1									+			\neg		
Unconfined Compressive Strength:	100 kPa	XV 50				4			_						_			_		
Notes: 1. Dry density rounded to 2. The rate of axial compr	the nearest 0.01 t/m³. ression was 0.40 mm/min.	40 30 20 10 0	.00			0.01		A	(()	0.02	'n			0.03				0.0)4	

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Tested By:L.T. Smith, N.P. Danischewski, C. Fisher & C. PearsonDate:10-Jan-20 to 4-Mar-20Checked By:emplies

Tests indicated as Not Accredited are outside the scope of the laboratory's accreditation





18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand P: 03 4487644, W: <u>www.centraltesting.co.nz</u>, E: info@centraltesting.co.nz Page 3 of 4 Pages Reference No: 20/228 Date: 4 March 2020

<u> TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS</u>

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch	Attention:	J. Southworth					
Job Description:	DCC Smooth Hill Landfill Investigations							
Sample Description:	Sands & Sandstone; SILT & SAND with minor clay	Client C	Order No:	Not Stated				
Sample Source:	BH10 @ 2.4m - 7.0m	Sample	Label No:	N/A				
Date & Time Sampled:	Unknown	Sampleo	d By:	GHD Ltd Staff				
Sample Method:	Borehole *	Date Re	ceived:	December 2019				



Liquid Limit: (LL)	37
Plastic Limit: (PL)	23
Plasticity Index: (PI)	14
Note: The sample was received in a natural state. Th	he plasticity index material tested was the fraction passing the 425 μ m test sieve

Note:

Tested By: L.T. Smith, N.P. Danischewski, C. Fisher & C. Pearson

Checked By:

emplus

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10-Jan-20 to 4-Mar-20

Date:



Specialist Quality Assurance Service in Aggregate, Concrete and Soils Testing



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TEST REPORT – DCC SMOOTH HILL INVESTIGATIONS

Client Details:	GHD Ltd, P.O. Box 13468, Christchurch							Attention:			J. Southworth							
Job Description:	DCC Smooth Hill Landfill Investigations																	
Sample Description:	Sands & Sandstone; SILT & SAND with minor clay Client O						t Or	Order No:			Not Stated							
Sample Source:	BH10 @ 2.4m - 7.0m Sample I						le L	Label No:			N/	N/A						
Date & Time Sampled:	Unknown Sampled							led	d By: GHD) Ltd Staff					
Sample Method:	Borehole * Date Rec						Rece	eceived: December 2				2019						
	PRESSIV	E STRF	ENGT	ГН -	NZS	5 440	02:19	986,	Test	t 6.3.	.1							
Sample Diameter: (mm)	101.49																	
Sample Length: (mm)	202.66		120									вн	10 @	D 2.4	4m to	7.01	n	
Length / Diameter Ratio:	2.00		110								╞─└							
Bulk Density: (t/m ³)	2.00	:	100														_	
Water Content: (%)	13.9		90						م م	0°°°	~ ~~	aas a					_	
Dry Density (t/m ³)	1.76		80					P	° -									
Mode of Failure:	Plastic / Plastic Brittle	kPa)	70				2											
Strain @ Failure:	1.7 %	ress (<i>•</i>											
Load @ Failure:	0.767 kN	ial St	60			ĵ												
Unconfined Compressive Strength:	93 kPa	AX	50			-											-	
Notes:			40		i													
1. Dry density rounded	to the nearest $0.01 t/m^3$.																	
2. The rate of axial con	pression was 0.40 mm/min.		30	'														
			20	1														
				/														
			10	•													_	
			ľ															
			0 🕊 0.00	-			0.0	01				0.	02				0.0	3
				Axial Strain														
Sample Length: (mm) Length / Diameter Ratio: Bulk Density: (t/m ³) Water Content: (%) Dry Density (t/m ³) Mode of Failure: Strain @ Failure: Load @ Failure: Unconfined Compressive Strength: Notes: 1. Dry density rounded 2. The rate of axial con	202.66 2.00 2.00 13.9 1.76 Plastic / Plastic Brittle 1.7 % 0.767 kN 93 kPa to the nearest 0.01 t/m³. pression was 0.40 mm/min.	Axial Stress (kPa)	110 100 90 90 80 70 60 50 40 30 20 10 0 0.00				0.0		Axia			BH	02			7.01	m	•

Note:

Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society

• T/	uidelines 2005, the sample method * and sampling. his report may not be reproduced except in full.			
Tested By:	L.T. Smith, N.P. Danischewski, C. Fisher & C. Pearson	Date:	10-Jan-20 to 4	1-Mar-20
Checked By:	emplus			
Approved Signa	itory			
at			Tests indicated as Not Accredited are outside the scope of the laboratory's	
A.P. Julius Laboratory Mai	nager	_	accreditation	ACCREDITED LABORATORY Accreditation No: 434
2	Specialist Quality Assurance Service in Aggre	gate, Conci	rete and Soils Tes	ting

This report has been prepared by Matt Fitzmaurice, John Southworth and Dhugal McQuistan under the direction of Samantha Webb, a Technical Director and Engineering Geologist with GHD Ltd. Matt has 9 years as an engineering geologist, John has 23 years experience as an engineering geologist and Dhugal has 4 years experience as a geotechnical engineer. Samantha has 30 years in all aspects of engineering geology including a number of landfill projects and has the following qualifications BSc (Hons) Earth Sciences and MSc Engineering Geology.

GHD

Level 4 Security Building 115 Stuart Street T: 64 3 378 0991 F: E:

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Document Status

Revision	Author	Reviewer		Approved for Issue							
		Name	Signature	Name	Signature	Date					
Rev01	M. Fitzmaurice/ J. Southworth	S.Webb	Sladb	S.Douglass	flored .	17-8- 20					
<u>Rev02</u>	J.Southworth	S.Webb	Sladb	S.Douglass	Jour .)	24-05- 21					

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