

Project Number: 6-CO082.00

Mt Cooee Landfill Development Plan and Resource Recovery Centre Geotechnical Factual Report

5 April 2023





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Approved for Release by:

Chris Fox | Regional Project Director



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Revision Details

Revision	Details
1	Draft – Pending Laboratory Testing Results
2	Final



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Disclaimers and Limitations

This report ('Report') has been prepared by WSP exclusively for the Clutha District Council ('Client') in relation to the Mt Cooee Landfill Development Plan and Resource Recovery Centre project. The scope of this report is to present the findings from geotechnical investigation undertaken as part of the project to inform the Development Plan and Resource Recovery Centre for the landfill ('Purpose') in accordance with the Short Form Agreement dated 11/11/2021. The findings in this Report are based on and subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

In preparing the Report, WSP has relied upon data, surveys, analyses, designs, plans and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable in relation to incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

1 Introduction

WSP have been engaged by the Clutha District Council (CDC) provide engineering services for the renewal and development of the Mt Cooee Landfill ('landfill') in Balclutha. The scope of services was presented in the WSP Offer of Service dated 6 August 2021.

As part of the project, WSP undertook deep ground Investigations in October and November 2022 to inform ground and groundwater variability across the site. This report presents a summary of the factual results from these investigations.

2 Site Description

The Mt Cooee Landfill site (the 'site') is situated on the Kaitangata Highway in the outskirts of Balclutha. The site encompasses Lot 1 (4.3 ha) and Lot 2 (11.4 ha) on the property DP 12203 and has a total area of approximately 12.8 hectares. The approximate location of the site relative to Balclutha is shown on Figure 1 below.



Figure 1: Approximate Location of the Site (Courtesy of the CDC Map Viewer).

The site consists of a gently sloping valley that drops southwest towards the Clutha River. The site is bounded by the Dunedin – Invercargill rail line to the north and the Katitangata Highway to the south. The Highway runs adjacent to the Clutha River. The site adjoins private farmland to the east, from which it is screened by a windbreak of large macrocarpa trees. Access to the site is via a driveway off the Kaitangata Highway.

The area to the east of the site is rural land, with the nearest dwelling roughly 150 m from the site boundary. The Balclutha Golf Course is situated across the rail line to the north of the site.

The landfill has been operating circa 1985 and was originally developed by filling in the shallow valley, commencing from the downstream end and working up the valley. The landfill is currently used for sanitary waste, including municipal waste, contaminants and hazardous waste. The

existing landfill is now nearing closure design level and therefore requires upgrading and reconsenting to continue operation as the main landfill in Balclutha. The proposed expansion area extends to the south and east of the exisitng landfill, to within 15 m of the eastern boundary (refer Appendix A).

3 Geotechnical Investigations

Site-specific ground investigations were undertaken across the site between 11 October and 3 November 2022. The investigation points were spread across the site to assess the nature and variability of the ground conditions and allow groundwater and gas monitoring through installation of piezometers.

The investigations included the following:

- A total of ten machine boreholes (BH1 to BH10) to target depths ranging between 3.0 m and 11.6 m below ground level (bgl) for geotechnical and hydrogeological purposes. Drilling was undertaken using the rotary coring method in both soils and in rock. Boreholes were terminated upon proving a sufficient thickness of bedrock or reaching the target depth.
- Installation of standpipe piezometers in BH1 to BH6 for groundwater monitoring purposes.
- Installation of a standpipe in BH10 for ground gas monitoring.

The approximate locations of the machine boreholes are presented on the Site Plan – Appendix A.

3.1 Machine Borehole

Ten machine boreholes (BH01 to BH10) were drilled by McMillan Drilling between 11 October and 3 November 2022. The purpose of the boreholes to retrieve core for visual logging and samples for laboratory testing.

BHI was drilled near the existing oxidation ponds and is utilised as for both geotechnical and hydrogeological purposes.

BH2 was drilled north of the rail line and serves as a shallow groundwater well.

BH3 to BH5 were drilled to the southeast of the site and serve as shallow groundwater monitoring wells.

BH6 to BH10 were drilled at the location of the proposed landfill development site. BH6 has a shared purpose as a geotechnical investigation borehole and shallow groundwater monitoring well. BH7 to BH10 are primarily for geotechnical purposes.

Details of the machine boreholes are presented in Table 1.

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Table 1: Details of the machine boreholes

BH ID	Approximate Location	Northing ¹ (m)	Easting ¹ (m)	Approximate Borehole Depth (m bgl)
BH1	30m west of Kaitangata Highway, south of oxidation ponds	757426	359516	11.6
BH2	North of site, north side of railway	757579	359724	6.0
BH3	Western area of site, 15m north-east of Kaitangata Highway	757247	359607	4.5
BH4	South-east corner of site	757137	359866	5.5
BH5	Southern area of site, 80m north-east of Kaitangata Highway	757198	359758	3.0
BH6	Middle of site, southwest of proposed landfill expansion	757293	359788	9.45
BH7	Eastern most corner of site, 20m south of railway	757393	359969	6.0
BH8	Eastern area of site, 80m north of BH06	757367	359799	4.3
ВНЭ	Eastern area of site, middle of proposed landfill expansion	757344	359852	6.9
BH10	Eastern edge of site, 20m from boundary	757308	359932	10.0

¹ The co-ordinates are based on the North Taieri Circuit 2000 grid system and estimated using a high accuracy survey and a hand-held GPS system (BH8 and BH9), with estimated accuracy of +/-5m.

Standard Penetration Tests (SPTs) were undertaken at 1.0 m intervals within rock and soils throughout BH1, BH6, BH7, BH9 and BH10 in general accordance with ASTM D1586-11 (2011). The un-corrected SPT N-values are recorded in the borehole logs.

The recovered soils and rock were logged by a WSP Engineering Geologist. Logging was undertaken in accordance with the New Zealand Geotechnical Society Guideline (NZGS, 2005).

Upon completion of drilling, standpipe piezometers were installed within BH1 to BH6 and BH10 to allow ongoing groundwater and ground gas monitoring. The piezometer details are presented in the borehole logs in Appendix B. The remaining boreholes were backfilled with bentonite, gravel and grout.

Bulk and intact soil and rock samples were collected from the machine boreholes for laboratory testing.

The machine borehole logs and photographs are presented in Appendix B.

3.2 Groundwater

Groundwater was observed at depths ranging between approximately 1.23 m and 5.55 m bgl within the machine boreholes during the investigation. These are recorded on the borehole logs in Appendix B.

Before completion of drilling, falling head testing was completed in rock in BH6 (at 7.7 m – 9.0 m bgl) and BH9 (at 4.6 m to 6.9 m bgl) to inform the rock permeability. The testing data is included in Appendix B.

Several rounds of piezometer monitoring have been completed between October and November 2022, with the results recorded in Table 2 below.

Borehole ID	Piezometer Response Zone (m bgl)	Groundwater Level (m bgl)	Measurement Date	Measurement Time		
		2.06	31/10/2022	3:13pm		
	ר בי	2.26	1:58pm			
вні	7.7 - 11.0	2.7	01/02/2023	3:05pm		
		2.61	09/03/2023	11:00am		
		0.73	31/10/2022	3:06pm		
BH2	0.5 – 4.5	2.80	9/11/2022	1:25pm		
		1.03	29/11/2022	3:00pm		
		1.66	31/10/2022	1:30pm		
		1.73	1.73 9/11/2022			
BH3	0.5 – 2.8	1.89	1.89 30/11/2022			
		2.36	01/02/2023	1:56pm		
		Dry	09/03/2023	1:15pm		
		2.48	31/10/2022	1:43pm		
		2.92	9/11/2022	10:10am		
BH4	0.5 – 5.5	3.05	29/11/2022	1:25pm		
		3.91	01/02/2023	2:20pm		
		4.05	09/03/2023	12:54pm		
		0.62	31/10/2022	1:47pm		
	0 / 5 1 0	0.56	9/11/2022	10:15am		
внэ	0.45 - 1.8	0.94	29/11/2022	1:12pm		
		Dry	01/02/2023	2:26pm		
		2.30	31/10/2022	1:38pm		
DUC		Dry	9/11/2022	10:00am		
BH6	0.5 - 3.5	Dry	29/11/2022	1:00pm		
		Dry	01/02/2023	2:13pm		

Table 2: Piezometer details

4 Laboratory Testing

4.1 Soil Samples

Laboratory testing was undertaken by the WSP Laboratory (based in Christchurch) on selected soil samples recovered from BH1, BH8, and BH10. The purpose of the testing was to assess the soil properties, in particular susceptibility to liquefaction. Testing includes the following:

- Atterberg Limits in accordance with NZS 4402: 1986: Test 2.1 Test 2.5.
- Particle Size Distribution (PSD) in accordance with NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)

• Uniaxial Compressive Strength (UCS) testing of intact rock core samples in accordance with ASTM D7012 – Test C (previously ASTM D2938).

Details of the Atterberg Limits and PSD testing samples are presented in Tables 3 and 4 below. The complete lab testing results are available in Appendix C of this report.

Borehole ID	Sample Depth (m BGL)	Sample Description*	Clay %	Silt %	Sand %	Gravel %
BH1	2.0 - 2.45	Sandy SILT with trace clay	5	66	29	0
	5.0 - 5.45	SILT with some clay and minor sand	21	69	10	0

Table 3: Summary of Particle Size Distribution test results

* Sample descriptions are based on visual inspection of materials on site.

Table 4: Summary of Atterberg Limits test results

Borehole ID	Sample Depth (m BGL)	Sample Description*	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Natural Water Content (%)
	2.0 - 2.45	Sandy SILT with trace clay	40	NP**	NP**	29.8
BH1	5.0 - 5.45	SILT with some clay and minor sand	39	25	14	34.2

* Sample descriptions are based on visual inspection of materials on site.

** NP = Non plastic (unable to roll a thread to specified dimensions).

4.2 Rock Samples

Unconfined Compressive Strength (UCS) testing was undertaken by the WSP Laboratory (based in Christchurch) on selected rock samples recovered from BH8 and BH10. The purpose of the testing was to confirm the strength and properties of the bedrock underlying the site. Testing was undertaken in accordance with ASTM D7012 – Test C.

Rock sample details are presented in Table 5 below. The lab testing results are available in Appendix C of this report.

It should be noted that the UCS strength usually refers to the intact strength of a rock, but this is not the case for these test results. During testing the rock samples broke along existing, weathered defects and not through fresh rock, therefore, the test results are assumed to more closely estimate *rock* mass strength, not *intact rock* strength. Project Number: 6-CO082.00 / 02312 Mt Cooee Landfill Development Plan and Resource Recovery Centre Geotechnical Factual Report

Borehole ID	Sample Depth (m bgl)	Rock Description	Unconfined Compressive Strength (MPa) *
	0.6 - 0.8	Moderately weathered, weak SANDSTONE	3.1
BH8	2.1 – 2.4	Slightly weathered, moderately strong SANDSTONE	6.7
вніо	5.6 - 5.9	Slightly weathered, weak to moderately strong SANDSTONE	2.0

* The results are indicative of rock mass strength and not intact rock strength, due to sample failure on existing weathered surfaces

References

ASTM, 2011. ASTM D1586-11, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. ASTM International, West Conshohocken, PA.

ASTM D7012 – Test C. Determination of the Uniaxial Compressive Strength (UCS) of Intact Rock Core Specimens (previously ASTM D2938).

GNS Science, New Zealand Geology Web Map accessed 12 December 2022. <u>http://data.gns.cri.nz/geology/</u>

NZGS, 2005. Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. New Zealand Geotechnical Society.

NZS4402, 1986, Test 2.8.4. Particle Size Distribution (PSD) Washed Grading & Hydrometer Method).

NZS4402, 1986, Test 2.1 - Test 2.5. Determination of Atterberg Limits.

Appendix A Site Plan



CONSU	LTANT		

Appendix B Machine Borehole Logs and Photographs



		Project:	Mt Cooee Landfi	II - C	Developr	nent	Plan				Coor	rdinates: 1350038	E 48	738	17	N			
	Client: Clutha District Council (CDC)										Ref. Grid: NZTM Depth: 11.				1.6 m				
		Project No.:	6-CO082.00								R.L.:	Approx. 9	m			h	nclir	natior	n: Vertical
		Location:	30m west of Kait Mt Cooee Landfi	ang II, B	ata Hwy alclutha	, sout	th of oxida	tion	on ponds Datum: NZ Vertical Datum 2016										
							TESTS	Ξ		U					E	DF	RILLI	NG	z
	GEOLOGY	MAIN DES / DETAIL DE	CRIPTION SCRIPTION	R.L. (m)	DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGT	ROCK WEATHERING	DEFECT SPACIN	DEFEC DIP	T DEFECTS / NOTES s / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEI	INSTALLATIO DETAILS
	TS	TOPSOIL, grass, trace r quartz gravel. 0.40-0.50m - Woody org Silty CLAY with trace gr	ootlets and trace fine anics present. avel and rootlets, dark										RC	80					000000
	-	grey, homogenous. Soft plasticity. Gravel, coarse Core loss. Sandy SILT, light brown Firm, moist to dry, low pl	to firm, moist, high e, subangular. to brown, homogenous. lasticity, micaceous.	. 8			3//						SPT	100					<u>,0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°</u>
	-	Sand; fine. Silty CLAY with trace sa brown with dark grey and homogenous. Firm, mois	nd and gravel, light d brown specks, st, high plasticity.	-	× · × · × · × · × · × · × · ×		1/2/1/2						RC	100					ზიზიზი ბიმიაი 0/2022 ზიმინი ბიმიი
	-	Gravel; fine, subangular 1.50m - Orange mottle. Sandy SILT, brown, hom plasticity. Sand; fine. 1.80m - Becomes light b	rown.	+ :	2 - × · · × - × · · · ×	 5	2// 1/1/1/2					Lab: 1.8 - 3.0m PSD and Atterberg Limits	SPT	100	-				ა°0°0°0°0°0°0° 2°0°0°0°0°0° ∳∰ 31/1 3°0°0°0°0°0°0° 2°0°0°0°0°0°0
		Silty fine to coarse SANI brown, homogenous. Lo Silt; low plasticity. Becomes light grey to gr mottles, homogenous. D	D with trace rootlets, ose, moist, micaceous. ey with trace of orange bry to moist, non-plastic,	-			0.0.02						RC	100					ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°
		micaceous.		_6 ;	3	. 7	2// 1/2/2/2					2.85-3.00m - Broken during removal from core catcher	SPT	100					<u>ი°ი°ი°ი°ი</u> ი°ი°ი°ი°ი° ი°ი°ი°ი°ი° out backfill
	Alluvium	Silty CLAY with trace sal orange mottles througho firm, moist, high plasticit fine to medium. 3.50m - Becomes firm.	nd, light grey with ut, homogenous. Soft to y, micaceous. Sand;										RC	100					<u>ა°°°°°°°°°</u> <u>ა°°°°°°°°°</u> <u>ა°°°°°°°°°</u> n L) with grc
30/3/23	-	3.90m - Becomes light g mottles (less than above Sandy SILT, light browni Soft, non-plastic dry. Sa	irey with trace orange), homogenous. (ish grey, homogenous. nd; fine to medium.	+ '	4 <u>× ×</u>		2// 2/1/2/1				Lab: 4.4 - 6.1m PSD	SPT	100			a. core)		ი°ი°ი°ი° ი° ი°ი°ი°ი°ი° ი°ი°ი°ი°ი ი°ი°ი°ი°	
R11X.GDT		Silty CLAY, light greenis Soft to firm, moist, high	h grey, homogenous. plasticity.	4							and Atterberg Limits		RC	100		cored	mm nom. di		<u>ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი </u>
JS2019_VE						ין דין דין דין דין דין דין דין דין דין ד	0// 0/0/0/1						SPT	100	1	Rotary	ireline (85 I		<u>ოიოი</u> ი იიიიიი ოიიიიიი იიიიიი ი
WSP-OPI		5.65-6.00m - Green sandy lamin 5.65-6.00m - Green sandy greenish grey.	ations. dy lenses. Becomes										RC	100			PQ size v		ე"იე"ი"ი"ი" ე"ი"ი"ი"ი მ/03/2023 ე"ი"ი"ი"ი"ი" ე"ი"ი"ი"ი"ი"ი"
3 - V0.3.GPu	-	Silty CLAY with trace gra	avel and sand, dark grey				13// 9/22/22/7 for 20mm						SPT	100					°0°0°0°0°0° °0°0°0°0°0° ™0°0°0°0°0°0°0°0
IOLE LOGS		moist to wet, high plastic coarse, subangular to ar medium, subangular to s Slightly weathered, high	ity. Gravel; fine to ngular. Sand; fine to subrounded. y fractured, light c SANDSTONE:	2	7-1		12//					6.70-9.35m - Rock broken up by drilling.	RC	100	-				<u>, 70, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0</u>
DEE BOREH		moderately strong; very and white veins. Recovered as: sandy GF light brown. Gravel and s subangular.	Closely spaced joints RAVEL with some silt, sand; fine to coarse,			: 60+	14/46 for 75mm						SPT	100	-				,0,0,0,0,0 0,0,0,0,0 0,0,0,0,0 0,0,0,0,
P MT COC	rane	7.50-8.00m - Gravel bec coarser gravel is angula gravel is rounded to sub	omes; fine to coarse, r to subangular, finer rounded.	- 8	8	: 60+	60 for initial			VC			SPT	100				SWL 2.35m	
JG A4 - WS	aples Teri	Slightly weathered, high grey, fine fabric SANDS	y fractured, light bluish TONE; moderately					MS	sw				RC	100	0				(
L/ROCK LC	U	strong; closely spaced jc Recovered as: Fine to cr minor sand, light greyish well graded, non-plastic. is angular to subangular to subrounded Sand: m	onts and white veins. barse GRAVEL with brown. Very dense, Gravel; coarser gravel , finer gravel is rounded edium to coarse	_• •	9	60+	60 for initial 105mm					Lab: 9.0 - 11.0m UCS	SPT	100	0				ed pipe (3.0
DREHOLE SOI	-	9.17-9.35m - Recovered GRAVEL with minor cob dense, well graded. Gra Greywacke, mm-scale w max 80mm.	as: fine to coarse bles, light grey. Very vel; subangular, rhite veins. Cobbles:							VC C VC		9.17-9.35m - Rock broken up by drilling. Any matrix appears to be lost due to drilling.	RC	100	0				50 mm slott
B	Not	200		<u> </u>	<u>::::</u>	. <u> </u>		S	tarto	d.	10. 10	 /10/2022	Finio	hed		20/	10/3	1 2022	<u>no – sol</u> ,
	SPT	hammer energy ratio	91%					כ ת	rillin	a. a Co	Mo	Millan Drilling	Drilli	na R	ia:	Har	njin	D&F	3-8D - track
	Sha Core	red Hydro / Geotech bo e loss placed at end of mm OD Potory Coring	orenoie run by default					L	ogge	d by:	С.	Hall	Chec	cked	by:	C. I	Park	<es< td=""><td></td></es<>	

Core loss placed at end of run by default 123mm OD Rotary Coring



	Project: Mt Cooee Landfill - Development Plan Client: Client: Clutha District Council (CDC) R Project No.: 6-CO082.00 R Location: 30m west of Kaitangata Hwy, south of oxidation ponds D Mt Cooee Landfill, Balclutha Mt Cooee Landfill, Balclutha D						Coordinates:1350038 E4873817 NRef. Grid:NZTMDepth:11.6 mR.L.:Approx. 9 mInclination:VerticalDatum:NZ Vertical Datum 201610.00000000000000000000000000000000000					1.6 m : Vertical								
	GEOLOGY	MAIN DESCRI / DETAIL DESCF	PTION RIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFE DIF degre	CT DEFI ees / OT	ECTS / NOTES THER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)		CASING	BASE OF HOLE & WATER LEVEL	INSTALLATION DETAILS
	Caples Terrane	Slightly weathered, fractured, fabric SANDSTONE; strong; n and tight aperture. Recovered as: COBBLES, wi sand. Well graded. Cobbles a to subangular. Sand; fine to n 10.11-11.00m - Thinly laminal throughout. Veins are mostly greenish white. Apertures ext spaced, very narrow. 10.40-10.60m - Heavily veine 10.80-11.00m - Angular GRA COBBLES.	light grey, fine white veins smooth th some gravel and ind gravel; angular nedium.(continued) ted veins white, some are remely closely d. Minor sand. VEL and	211		60+ 	60 for initial 105mm 60 for initial 95mm	s	sw	vc c vc c vc				RC SPT RC	100 100 100	0 0 0 0	Rotary cored			
BOREHOLE SOIL/ROCK LOG A4 - WSP_MT_CODEE BOREHOLE LOGS - V0.3.GPJ_WSP-OPUS2019_VER11X.GDT_30/3/23		END OF DUREHOLE AT THE Reached	, in - Target Deput	- 12 12 																
	Not SPT	es: hammer energy ratio 91%						St	arte rilling	d: a Co	1 · N	9/10/202 1cMillan	22 Drilling	Finis Drillin	hed:	ia:	20/ Har	10/2 hiin	2022 D&B	-8D - track

Logged by: C. Hall

SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring

Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350
Client:	Clutha District Council (CDC)	Ref. Grid:	NZTI
Project No.:	6-CO082.00	R.L.:	Appr
Location:	30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, Balclutha	Datum:	NZ V

dinates:	1350038 E 4873817 N	
Grid:	NZTM	Depth: 11.6 m
	Approx. 9 m	Inclination: Vertical
m:	NZ Vertical Datum 2016	



Photo BH1.1 BH1 Box 1: 0.0m - 2.4m



Photo BH1.2 BH1 Box 2: 2.4m - 4.45m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring Started:19/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:20/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Draiaati	Mt Cooco Londfill Dovolonment Dian	Coordinatoo	
Projeci.	Mit Coolee Lanumi - Development Plan	Coordinates.	
Client:	Clutha District Council (CDC)	Ref. Grid:	I
Project No.:	6-CO082.00	R.L.:	/
Location:	30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, Balclutha	Datum:	I

rdinates:	1350038 E 4873817 N	
Grid:	NZTM	Depth: 11.6 m
	Approx. 9 m	Inclination: Vertical
ım:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH1.3 BH1 Box 3: 4.45m - 7.0m



Photo BH1.4 BH1 Box 4: 7.0m - 9.35m

Started:

19/10/2022

Drilling Co.: McMillan Drilling

Logged by: C. Hall

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

20/10/2022 Finished: Drilling Rig: Hanjin D&B-8D - track Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350
Client:	Clutha District Council (CDC)	Ref. Grid:	NZT
Project No.:	6-CO082.00	R.L.:	Арр
Location:	30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, Balclutha	Datum:	NZ۱



PHOTOGRAPHS



Photo BH1.5 BH1 Box 5: 9.35m - 11.0m



Photo BH1.6 BH1 Box 6: 11.0m - 11.6m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

Started:19/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:20/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:

Borehole No. BH1 (ROYDS)

Coordinates: Not established

	Client: Clutha District Project No.: 6-CO082.00	Council (CD	C)		Ref. Grid: N R.L.: A Datum:	ZTM pprox. 116.39 r	n	Dep Incli	th: 15 m nation: Vertical
	Mt Cooee Lan	dfill, Balcluth							
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT IN' VALUE	ROCK STRENGTH ROCK WEATHERING ROCK DEFECT SPACING	EFECT DIP DEFECT legrees / OTHEI	S/NOTES TESTS	RQD (%)		BASE OF HOLE & WATER LEVEL & NOTALLATION DETAILS
DREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23 Tuapeka Group Greywacke Tuapeka Group Greywacke TS	TOPSOIL with some fine gravel.							Rotary open hole	
m No Air Tal	L ofes: Rotary drilling method. 150mm diameter. ken from Royds Garden I td borehole record	<u> ····</u>	···	Started: Drilling Co.:	28/01/1994	Finishe Drilling	d: 2 Rig:	28/01/	1994

Logged by:

Checked by:



BOREHOLE SOILROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

Mt Cooee Landfill - Development Plan Project:

Clutha District Council (CDC) Client:

Project No.: 6-CO082.00

Near Clutha River Bridge Mt Cooee Landfill, Balclutha Location:

Borehole No. BH1 (ROYDS)

Coordinates: Not established

NZTM Ref. Grid:

Approx. 116.39 m

Depth: 15 m

R.L.: Datum:

Inclination: Vertical

					TESTS	-		0				(CORE	-	DF	RILLI	NG	-	
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACINO	DEF D deç	FECT DIP grees 90	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL		
Tuapeka Group Greywacke	Light grey moderate to widely jointed GREYWACKE] - weathered, fractured zone at top of layer - very hard - some quartz filled joints(continued)										~				Rotary open hole				status en en entre en en en en
	END OF BOREHOLE AT 15m																		
<i>Not</i> Air F Take	es: Rotary drilling method. 150mm diameter. en from Royds Garden Ltd borehole records.					St Di Lo	tarte rillin page	ed: g Co ed by).: /:	28/0	01/1994	Finis Drillii Chec	hed: ng R :ked	ig: bv:	28/	01/1	1994		

Logged by:



	Project:Mt Cooee LandfClient:Clutha District CProject No.:6-CO082.00Location:North of site, no Mt Cooee Landf	ill - Development Plan council (CDC) rth side of railway ill, Balclutha	Coo Ref R.L Dat	ardinates: 1350241 E Grid: NZTM Approx. 16 MZ Vertical	4873 m Datur	978 n 20	N / 16	Dept Inclir	h: 6 m nation: Vertical
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) DEPTH (m) SPT IN' VALUE SPT BLOW SHE BLOW SHE BLOW SHE REAR VALUE	ROCK STRENGTH ROCK WEATHERING DEFECT SPACING DEFECT SPACING	DEFECTS / NOTES	SAMPLE TYPE				BASE OF HOLE S & WATER LEVEL S INSTALLATION DETAILS
TS	TOPSOIL. GRAVEL with minor sand, brownish grey. Loose. Gravel; fine to coarse, subrounded, sandstone. Clay/silt/sand matrix inferred washed away. 0.70m - Some matrix present at 0.7m Core loss.	$ \begin{array}{c} $			RC 5	5 0	-		Cement sea
Alluvium	Gravelly CLAY with some silt and minor sand, brown. Homogenous, soft, moist, high plasticity. Gravel; fine to coarse, angular, well graded. Core loss.				RC 4	5 0	pe	om. dia. core)	Image: 1 Image: 1
)/3/23 ane	Completely weathered grey and orange/brown, fine fabric SANDSTONE. Extremely weak. Recovered as: SILT with minor gravel and some sand and clay. Homogenous, stiff to very stiff, moist, low plasticity. Gravel; fine to medium, subangular. Sand; fine.	3 -124 	EW CW EC W SW VC EW CW EC		RC 8) 0	Rotary core	PQ size wireline (85 mm n	
SP-OPUS2019_VER11X.GDT_30 Caples Terr	Moderately weathered greenish grey, fine fabric SANDSTONE. Very weak to weak. Completely weathered grey and orangeish brown, indistinctly bedded SANDSTONE. Extremely weak. Residual soil recovered as: SILT with some clay. Homogenous, stiff to very stiff, moist, and low plasticity. Moderately weathered greenish grey, indistinctly bedded SANDSTONE. Very weak to weak.		EW CW EC W HW C VW HW VC		RC 10	0 30			SWL 1.00m
BOREHOLE SOILROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ W	END OF BOREHOLE AT 6m - Target Depth Reached								
No Sha Coi 123	tes: allow groundwater well re loss placed at end of run by default 8mm OD Rotary Coring		Started: 18 Drilling Co.: M	B/10/2022 F cMillan Drilling C	inishe Drilling Checke	d: Rig: d bv [:]	19/ Ha C.	/10/2 njin Parl	2022 D&B-8D - track kes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	North of site, north side of railway Mt Cooee Landfill, Balclutha

Coordinates:	1350241 E 4873978 N	
Ref. Grid:	NZTM	Depth: 6 m
R.L.:	Approx. 16 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH2.1 BH2 Box 1: 0.0m - 4.2m



Photo BH2.2 BH2 Box 2: 4.2m - 6.0m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started:18/10/2022Drilling Co.:McMillan DrillingLogged by:N. Ahern

Finished:19/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:

Mt Cooee Landfill - Development Plan

Borehole No. BH2 (ROYDS)

Coordinates: Not established

	Client: Clutha District C	ouncil	(CDC)						Ref. G	irid: NZTM				Ľ	Dept	h: 9	.5 m
	Project No.: 6-CO082.00	dfill							R.L.:	Approx. 10	9.29) m		L	nclir	nation	: Vertical
	Mt Cooee Landf	ill, Balo	clutha						Daturi	Ι.							
					TESTS	ЭТН		DNG					E	DF	RILLI	NG ⊒⊒	NO
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENC	ROCK WEATHERING	ROCK DEFECT SPAC	DEFECT DIP degrees	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLI & WATER LEV	INSTALLATI DETAILS
TS	TOPSOIL with some line gravel.		<u>1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1</u>														
Pleistocene Glacial Deposits	Grey brown mottle yellow brown sandy silty fine GRAVEL.																
	Light grey moderate to widely jointed GREYWACKE. - Weathered, fractured zone at top of layer - Very hard - Some quartz filled joints		<u>~~~~</u>											Rotary open hole			
	END OF BOREHOLE AT 9.5m	9															
No	ites:	·				Si	tarte	d:	30/0	1/1994	- Finis	hed:		30/	01/	1994	

Taken from Royds Garden Ltd borehole records.

Drilling Co.: Logged by:



Project:

Mt Cooee Landfill - Development Plan

Borehole No. BH3

Coordinates: 1350135 E 4873642 N

	Client: Clutha District C	ouncil	(CDC)						F	Ref.	Grid: NZTM				L	Dept	th: 4	.5 m
	Project No.: 6-CO082.00		_						F	R.L.:	Approx. 1	l m			1	nclii	natioi	<i>:</i> Vertical
	Location: Western area of Mt Cooee Landf	site, 1 ill. Balo	5m nor clutha	th-e	ast of Kait	ang	ata	Hwy	I D	Datu	<i>im:</i> NZ Vertica	l Da	tum	20'	16			
		1			TESTS								CORI	E	D	RILL	ING	
S GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DE [de	FEC DIP gree:	T DEFECTS / NOTES s / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL	DETAILS
Ĕ	SILT with some clay and minor sand, grey/dark	=	××															
uvium	brown, homogenous. Soft, moist, low plasticity. Sand; fine to medium.		×															
Allt	Clayey SILT with minor sand, light brownish orange. Homogenous, soft, moist, with low to medium plasticity. Sand; fine. 0.90-0.92m - Cobble of moderately weathered, light brown massive SANDSTONE. Weak. Completely weathered, brownish orange, fine fabric SANDSTONE. Extremely weak. Recovered as: sandy SILT with minor clay, brownish orange, homogenous. Stiff, dry to moist, low plasticity. Sand: fine to medium.		× — × - × _ 			EW	cw	EC C				RC	100			core)		31/10/2022
rane	Highly weathered orange/brown, fine fabric SANDSTONE. Very weak. Recovered as: sandy GRAVEL with some cobbles and minor silt and clay, homogenous. Gravel; fine to coarse, subrounded. Cobbles; max 100mm, subrounded. Sand; fine to coarse.	2				vw	нw	EC C			2.40-2.50m - Core	RC	65	0	Rotary cored	ie (85 mm nom. dia.		
caples Ter	Core loss.										broken during removal from catcher. 3.00-4.30m - Possible					size wirelin		
0	fabric SAMDSTONE. Weak. Orange staining on all joint faces. Recovered as: COBBLES with minor gravel. Cobbles; max 100mm, mostly subangular with some subrounded (due to driling). Gravel; medium to coarse, subangular.					w	MW	vc c vc			weaker material washed out by drilling.	RC	80	0		Q		
	Core loss	. =															SWL 1.60m	
	END OF BOREHOLE AT 4.5m - Target Depth		\succ									-						
	Keached																	
N/		-					orte	<i>d</i> .		11	(10/2022	-	bad		10	10"	2022	

Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started: 11/10/2022 Drilling Co.: McMillan Drilling

Logged by: N. Ahern

Finished: 12/10/2022 Drilling Rig: Hanjin D&B-8D - track Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350135 E
Client:	Clutha District Council (CDC)	Ref. Grid:	NZTM
Project No.:	6-CO082.00	R.L.:	Approx. 11 r
Location:	Western area of site, 15m north-east of Kaitangata Hwy Mt Cooee Landfill, Balclutha	Datum:	NZ Vertical I

4873642 N m

Depth: 4.5 m Inclination: Vertical

Datum 2016

PHOTOGRAPHS

Photo BH3.1 BH3 Box 1: 0.0m - 3.0m



Photo BH3.2 BH3 Box 2: 3.0m - 4.5m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring

11/10/2022 Started: Drilling Co.: McMillan Drilling Logged by: N. Ahern

12/10/2022 Finished: Drilling Rig: Hanjin D&B-8D - track Checked by: C. Parkes



Project: Mt Cooee Landfill - Development Plan Ca Client: Clutha District Council (CDC) Ra Project No.: 6-CO082.00 R. Location: South-east corner of site Mt Cooee Landfill, Balclutha Date						Coordinates:1350398 E 4873540 NRef. Grid:NZTMDepth:5.5 mR.L.:Approx. 9 mInclination:VerticalDatum:NZ Vertical Datum 2016								
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE SPT BLOW SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP degrees	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)			BASE OF HOLE S & WATER LEVEL	INSTALLATION DETAILS
TS	TOPSOIL with roots and grass. Sandy GRAVEL with trace rootlets, light brown to grey. Loosely packed, well graded, non-plastic. Gravel; angular to subangular, greywacke. Sand; fine to coarse, subrounded. 0.50-0.80m - Gravel; subangular to subrounded. Coarse sand; subangular to angular. Core loss.	-8 1 -8 1					0.15-3.70m - Assumed some fines or weaker seams were present but these have been washed away by drilling.	RC	53	0				Blank 1m Cmt seal
s Terrane	Slightly weathered to moderately weathered, highly fractured, orangish brown, fine fabric SANDSTONE; extremely weak; extremely closely spaced tight white veins; extremely weathered defects. Recovered as: COBBLES with some gravel and trace silt and rootlets, orangey brown to grey. Cobbles and gravel; fine to coarse. Cobbles; max 100mm, subangular. Sand; fine to coarse, subangular to subrounded. Silt, dark grey, !ensoidal. 2.20-2.40m - Trace pockets of dark grey silt. Core loss.			ew Mw	EC		1.50-5.50m - Fracturing due to drilling	RC	40	0	tary cored	85 mm nom. dia. core)		5 m L)
Caples	Slightly weathered to moderately weathered, highly fractured, dark grey SILTSTONE. Very weak, bedding is thinly laminated. Recovered as: Sandy GRAVEL with some cobbles and silt, dark grey with some orange and white veins. Sand; fine to coarse, angular to subangular. Gravel and cobbles; fine to coarse, subangular. Cobbles; max 60mm. Fines; non-plastic. Core loss.			vw Mw	EC			RC	80	0	Rot	PQ size wireline (● 9/03/2023
119_VER11X.GDT 30/3/23	Slightly weathered, highly fractured, dark bluish grey, fine fabric SILTSTONE. Weak. Mm scale mostly closed and oxidised defects. Recovered as: COBBLES with some gravel and trace silt, dark bluish grey with orange staining. Cobbles and gravel; fine to coarse, subangular. Cobbles; max 150mm. Sand; fine to coarse, subangular to subrounded. 5.00m - Slickenslides on one piece of gravel.	-4 5		w sw	vc	.150 .145	4.10m - J, 50° 4.20m - J, 45°	RC	100	0			SWL	
BOREHOLE SOILROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS20	END OF BOREHOLE AT 5.5m - Target Depth Reached			Starte	d	27/1	0/2022		hed		27/	10/2	2.30m	

Logged by: C. Hall

Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	South-east corner of site Mt Cooee Landfill, Balclutha

Coordinates:	1350398 E 4873540 N	
Ref. Grid:	NZTM	Depth: 5.5 m
R.L.:	Approx. 9 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH4.1 BH4 Box 1: 0.0m to 3.8m



Photo BH4.2 BH4 Box 2: 3.8m - 5.5m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started: 27/10/2022 Drilling Co.: McMillan Drilling Logged by: C. Hall Finished:27/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



	Project: Mt Cooee Landfill - Development Plan							Сс	oro	dinates:	1350288 E	48	3735	98	N					
	Client:	Clutha District C	ouncil	(CDC)				Ref. Grid: NZTM Depth: 3 m						m						
	Project No.:	6-CO082.00								R.	L.:		Approx. 7 r	n			I	nclii	natioi	: Vertical
	Location:	Southern area of Mt Cooee Landf	f site, 8 ill, Balo	30m no clutha	orth-	east of Kai	tang	jata	Hw	y Da	atur	n:	NZ Vertica	l Da	tum	20 ⁻	16			
						TESTS	-		5						COR	E	D	RILL	NG	-
GEOLOGY	MAIN DES / DETAIL DE	CRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFE DI degr	ECT P rees	DEFEC	CTS / NOTES HER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL	INSTALLATION DETAILS
TS	TOPSOIL with some gra minor quartz sand.	iss and rootlets and	=	<u> 11/</u> <u>11/</u>	j															
Alluvium	Silty CLAY with trace sa homogenous. Firm to sti Sand, medium. Silty CLAY with minor sa with minor white specks homogenous. Stiff, mois 0.90m - Becomes orang	nd, orangish brown, ff, moist, high plasticity. ind, light greyish orange and orange mottle, t, high plasticity. e. Soft to firm.										Lab: 0.4 and per testing. Lab: 1.7	4 - 1.1m PSD meability 1 - 2.6m UCS	RC	100	0		n. dia. core)		Blank biee 0.9 m
errane	indistination of the second se	nan orange, me rabic DSTONE. Weak to very rately weathered to o slightly weathered.					vw	HW	VC			testing.					Rotary cored	ine (85 mm nor		tted pipe 0.6 m
aples To	Moderately weathered, o indistinctly bedded SAN weak; orange staining al	greenish grey, fine fabric DSTONE. Weak to very ong open defects.	2-			 		мw	С	J10		2.15m -	- J, 10°	RC	100	17		size wirel		e e e e e e e e e e e e e e e e e e e
U				1		 	w	sw	vc	J10		2.50m -	- J, 10°					PQ	SWL 2.30m	
	END OF BOREHOLE A	T 3m - Target Depth	4 3						С			2.90-3.0 broken	00m - Core during removal	\vdash						
<i>Not</i> Sha	tes: Illow groundwater well						St	arte	d:	- 1	7/ //	- 10/2022 Millan Г	2 Drilling	Finis	hed:	ia:	18/ H2	10/2 niin	- 2022 אח	3-8D - trac
Jore	e ioss placed at end of mm OD Rotary Coring	run by default							,			B	3	<u></u>			0	 اعت		

Logged by: C. Hall

Checked by: C. Parkes



Depth: 3 m Inclination: Vertical

Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350288 E 4873598 N
Client:	Clutha District Council (CDC)	Ref. Grid:	NZTM
Project No.:	6-CO082.00	R.L.:	Approx. 7 m
Location:	Southern area of site, 80m north-east of Kaitangata Hwy Mt Cooee Landfill, Balclutha	Datum:	NZ Vertical Datum 2016

PHOTOGRAPHS



Photo BH5.1 BH5 Box 1: 0.0m to 2.2m



Photo BH5.2 BH5 Box 2: 2.2m to 3.0m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started: 17/10/2022 Drilling Co.: McMillan Drilling Logged by: C. Hall Finished:18/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project No.: 6-CO082.00 Location: Middle of site, southwest of excavation Mt Cooee Landfill, Balclutha					NGTH	R.L.: Approx. 21 m Inclinat Datum: NZ Vertical Datum 2016						NG	n: Vertical					
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LO	SPT 'N' VALL	SPT BLOW COUNTS OR SHEAR VALL	ROCK STRE	ROCK WEATHERIN	ROCK DEFECT SPA	DEFE DIF degre	CT	DEFECTS / NOTES	SAMPLE TYF	TCR (%)	RQD (%)	DRILLING Method	CASING	BASE OF HO & WATER LE	INSTALLA DETAILS
IS	TOPSOIL with some grass and rootlets, dark brown. 0.20m - Becomes orangish brown.		$\frac{1}{2} \underbrace{\langle \Lambda I_{\ell} \rangle}{\underline{\langle \Lambda I_{\ell} \rangle} \underbrace{\langle \Lambda I_{\ell} \rangle} \underbrace{\langle \Lambda I_{\ell} \rangle}{\underline{\langle \Lambda I_{\ell} \rangle} \underbrace{\langle \Lambda I_{\ell} \rangle}{\underline{\langle \Lambda I_{\ell} \rangle} \underbrace{\langle \Lambda I_{\ell} \rangle} \langle \Lambda I_$															(1.0 m L)
	Moderately weathered, light brownish orange, highly fractured, SANDSTONE. Moderately strong. Recovered as: gravelly COBBLES with some sand. Cobbles; angular, max 100mm. Gravel; medium to coarse, angular. Core loss.	_ ²⁰ 1				MS	MW	VC				RC	73					50 mm blank pipe
	Highly weathered, light brownish orange, highly fractured SANDSTONE. Weak. Recovered as: Sandy GRAVEL with some clay, orangish brown. Gravel; fine to coarse, subangular. Fines; high plasticity.			56 	15// 10/13/15/18	w	HW	EC				SPT	100	-				31/10/2022
	2.30m - Re-drilled cobble.											RC	38					e (1.5 m L)
	Moderately weathered, light grey to dark grey, highly fractured SANDSTONE. Moderately strong. Recovered as: GRAVEL with some sand, light grey to dark grey. Gravel; fine to coarse,	183		 60+ 	17// 14/16/21/9 for 25mm	MS	MW	VC				SPT	100	-				mm slotted pip
	Subangular.											RC	38			dia. core)		501
s Terrane	Completely weathered, greenish grey, fine fabric SILTSTONE. Extremely weak. Recovered as: clayey SAND with trace silt. Sand; fine to medium. Fines; high plasticity. 4.95-5.25m - Lenses of silty CLAY, greenish			 60+ 	15// 13/26/21 for 45mm	EW	CW	EC				SPT	100	-	Rotary cored	ne (85 mm nom.	SWL	
Caples	grey, homogenous. Soft, moist, high plasticity. Moderately weathered, greenish grey, highly fractured fine fabric, indistinctly bedded SANDSTONE. Weak. Recovered as: sandy GRAVEL with some clay, bluish green. Gravel; medium to coarse. Fines; high plasticity.			 		W	MW SW	С			Lab: 5.3 - 9.45m UCS testing.	RC	100			PQ size wirelir	2.20m	
	Slightly weathered greenish blue, massive SILTSTONE. Weak to moderately strong. 5.70-5.90m - Moderately weathered, highly fractured along defects. Defects; open or extremely closed spaced and closed. 6.45.6.55m . Pockets of silty SNID with pockets.			 60+ 	15// 20/24/16 for 50mm	MS	sw	EC				SPT	100	0				out
	or Joy Julish green, homogenous Loose, non-plastic. 6.55-7.20m - Black stained defects throughout. Moderately weathered greenish blue, fine fabric SILTSTONE. Weak; black stained defects. BLOWNER Weak; black stained defects.						CW	С				RC	100	0				Ő
	sitt. Cobbles and gravel; angular. Gravel; medium to coarse. 7.00-7.20m - Grades into completely weathered rock. 7.20-7.50m - Recovered as: sandy GRAVEL with some silt, dark greenish grey to black.			60+ 	36// 48/12 for 35mm			EC				SPT	- 90	0				
	Subsey, non-piasuc. Gravel; tine to coarse, subrounded Siltstone. Subset of the subset of t					w	MW SW	С				RC	100	0			SWI	
	8.75-9.00m - Recovered as: sandy GRAVEL with some silt, dark greenish blue, homogenous. Loose. Gravel; highly weathered. 9.00-9.45m - Recovered as: silty SAND, greenish yellow, homogenous. Soft to firm, low plasticity. Sand; fine to medium.	129		60+ 	19// 22/38 for 75mm		HW	EC				SPT	93	0			4.96m	
	END OF BOREHOLE AT 9.45m - Target Depth Reached																	
Voi	tes: Γ hammer energy ratio 91%	. .	L	1		Sta	arteo	d:	1	2/1	10/2022	Finis	shed.	ler	18/	10/2	2022	
Sha Nai	rred Hydro / Geotech borehole iting on core box photos to calcuate RQD					Lo	gge	d by	IV 7: C). F	hall	Che	rig R cked	by:	C.	Parl	kes	

Waiting on core box photos to calcuate RQD Core loss placed at end of run by default 123mm OD Rotary Coring Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

BOREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

Scale 1:50 @ A4



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Middle of site, southwest of excavation Mt Cooee Landfill, Balclutha

Coordinates:	1350315 E 4873694 N	
Ref. Grid:	NZTM	Depth: 9.45 m
R.L.:	Approx. 21 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH6.1 BH6 Box 1: 0.0m to 4.5m



Photo BH6.2 BH6 Box 2: 4.5m to 6.8m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Waiting on core box photos to calcuate RQD Core loss placed at end of run by default 123mm OD Rotary Coring Started: 12/10/2022 Drilling Co.: McMillan Drilling Logged by: C. Hall Finished:18/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Middle of site, southwest of excavation Mt Cooee Landfill, Balclutha

Coordinates:	1350315 E 4873694 N	
Ref. Grid:	NZTM	Depth: 9.45 m
R.L.:	Approx. 21 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH6.3 BH6 Box 3: 6.8m to 9.45m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Waiting on core box photos to calcuate RQD Core loss placed at end of run by default 123mm OD Rotary Coring Started:12/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:18/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



	Project: Mt Cooee Landfill - Development Plan					ordinates: 1350492 E	48	7380	0 N			
	Client: Clutha District C	ouncil (CDC)			Ref	Grid: NZTM				Dep	oth: 6	6 m
	Project No.: 6-CO082.00				R.L.	.: Approx. 25	i m			Incl	inatio	n: Vertical
	Location: Eastern most co Mt Cooee Landf	rner of site, 2 ill, Balclutha	0m south c	of railway	Dat	um: NZ Vertica	l Da	tum 2	2016			
			TESTS		97		- (_	DRILL		z
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE	SHEAR VALUE ROCK STRENGT ROCK		DEFECTS / NOTES es / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%) DRILLING	METHOD CASING	BASE OF HOLE & WATER LEVEI	INSTALLATIO DETAILS
TS	TOPSOIL.					0.20-6.00m -						
	with orange mottle, fine fabric SANDSTONE. Weak to moderately strong. Recovered as: gravely COBBLES with some sand. Cobbles and gravel; angular. Gravel; medium, subrounded. 0.20-0.70m - Coarse to fine gravel, sandy silty matrix inferred fines washed away.	2 ⁴ 1		w MV	VC	Fractures opened by drilling.	RC	75	0			
	Highly weathered, light brown with orange mottle, highly fractured, fine fabric SANDSTONE. Strong. Recovered as: Gravelly COBBLES. Gravel and cobbles; angular. 1.00-2.00m - Sand/silt matrix inferred washed away. 1.55m - Becomes completely weathered.		60 31// 	6 SHV	v vc		RC	85	0			
ane	Slightly weathered light grey with some orange mottle, fractured, fine fabric SANDSTONE. Moderately strong. 2.70-2.90m - Moderately fractured same			MS SW	v VC	2.40m - J, 40°	RC	100	30	rea nom. dia. core)		
Terra	materials as above, rootlets present. 2.90-3.20m - Recovered as: silty SAND, brownish orange. Loosely packed, dry to moist,					2.90-3.00m - Core broken during removal			_	ary cor 35 mm		
Caples	low plasticity. Moderately weathered dark grey with light brown and orange mottle, fractured, interbedded SANDSTONE and SILTSTONE. Sst = strong, siltst = weak. 3.60-4.05m - Becomes moderately thickly bedded and more mudstone dominant.			w	v vc	from catcher. Core inferred to be baked during drilling.	RC	100	10	2 size wireline (8		
	4.05-4.20m - Recovered as: medium to fine gravel with some silt and sand, greenish grey. Loosely packed, moist. Silt, low plasticity.// Slightly weathered dark grey with orange mottle, fractured, indistinctly bedded SILTSTONE. Moderately strong. 4.30-4.70m - Discontinuities: extremely closely			MS SM	v vc	4.00-4.20m - Core broken during removal from catcher.				Ĩ		
	4.90-5.20m - Discontinuities: becomes thinly bedded, thinly laminated, sub-horiztonal planar bedding. 5.20-5.40m - Orange staining increasing. 5.40-5.55m - Minor orange mottle. Core loss.			w MV	V Jade	50 5.30m - J, 60° 5.31m - J, 40°	RC	80	0		SWL	
										_	5.05m	$\circ \bigcirc \bigcirc \circ$
	END OF BORCHOLE AT om - rarger Depth Reached	187 										
Not	es:			Starte	ed: 1/	11/2022	Finis	hed:	1	/11/2	2022	_
SP1 Geo	hammer energy ratio 91% technical borehole			Drillin	ng Co.: M	cMillan Drilling	Drilliı	ng Rig	<i>y:</i> ⊢	lanjir	n D&E	8-8D - track
Cor	e loss placed at end of run by default			Logg	ed by: N	. Ahern	Chec	ked k	y: C). Pa	rkes	

Core loss placed at end of run by default 123mm OD Rotary Coring



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern most corner of site, 20m south of railway Mt Cooee Landfill, Balclutha

Coordinates:	1350492 E 4873800 N							
Ref. Grid:	NZTM	Depth: 6 m						
R.L.:	Approx. 25 m	Inclination: Vertica						
Datum:	NZ Vertical Datum 2016							

PHOTOGRAPHS



Photo BH7.1 BH7 Box 1: 0.0m to 3.0m



Photo BH7.2 BH7 Box 2: 3.0m to 6.0m

Notes: SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring Started: 1/11/2022 Drilling Co.: McMillan Drilling Logged by: N. Ahern Finished:1/11/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:Mt Cooee Landfill - Development PlanClient:Clutha District Council (CDC)Project No.:6-CO082.00Location:Eastern area of site, 80m north of BH06 Mt Cooee Landfill, Balclutha						Coordinates:1350323 E4873768 NRef. Grid:NZTMDepth:4.3 mR.L.:Approx.16 mInclination:VerticalDatum:NZ Vertical Datum 2016VerticalVertical							.3 m ∵ Vertical					
GEOLOGY	CLCLCC I	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP degrees	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)			BASE OF HOLE D & WATER LEVEL	INSTALLATION DETAILS
Caples Terrane	_	Moderately weathered dark grey to greenish grey with white specks, highly fractured SANDSTONE. Weak. Recovered as: coarse to fine gravel, with some sand. Gravel; subangular. Sand; coarse. 0.20-0.40m - Becomes completely weathered. Slightly weathered greenish grey with white specks, coarse grained, veined, indistinctly bedded SANDSTONE. Weak to moderately strong.					w	м₩	EC		Lab: 0.0 - 2.8m UCS testing. 0.40m - Vein, N	RC	100	0				
		 1.25-1.50m - Crushed zone. Recovered as: coarse to fine GRAVEL with minor sand. Gravel; angular. Sand; coarse. 1.50m - Becomes light greenish grey and coarse-grained. 2.50-4.30m - Crushed zone. Recovered as: COBBLES with some gravel and minor silt and 				VW MS	sw	W EC C	Vein ⁸ Vein75	1.25m - CZ 1.50m - Vein, 80°, MW 2.00m - Vein, 75°, N 2.50m - CZ	, 80°, , 75°, N	95	60	C I Rotary cored	reline (85 mm nom. dia. core)		Grout	
0		sand. Cobbles and gravel; subangular, strong. Sand; fine to medium. 2.70-2.85m - Becomes moderately weathered. Very weak. Recovered as: COBBLES with some gravel and sand. Cobbles and gravel; subangular. Core loss. Moderately weathered greenish grey with minor white specks, coarse grained highly fractured, indistinctly bedded SAINDSTONE. Very weak. Recovered as: COBBLES with some gravel and sand. Cobbles and gravel; subangular.					vw	HW	vc		3.05m - Vein, VN 3.10-4.10m - Highly factured insitu rock. Disturbed on removal from core catcher.	RC	90	53		PQ size wir		
OREHOLE SOIL/ROCK LOG A4 - WSP_MT COOEE BOREHOLE LOGS - V0.3.GPJ_WSP-OPUS2019_VER11X.GDT_30/		END OF BOREHOLE AT 4.3m - Target Depth Reached																
M G El C 12	Image:				St Di Lo	tarte rilling ogge	d: g Co d by	3/1 ⁻ .: McI :: N. /	1/2022 Millan Drilling Ahern	Finis Drillii Cheo	hed: ng R :ked	ig: by:	3/1 Hai C. I	1/20 njin Parl	D22 D&B	-8D - tracł		


Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern area of site, 80m north of BH06 Mt Cooee Landfill, Balclutha

Coordinates:	1350323 E 4873768 N	
Ref. Grid:	NZTM	Depth: 4.3 m
R.L.:	Approx. 16 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH8.1 BH8 Box 1: 0.0m to 2.1m



Photo BH8.2 BH8 Box 2: 2.1m to 4.3m

Notes: Geotechnical borehole Elevation is estimated from Google Earth Core loss placed at end of run by default 123mm OD Rotary Coring Started: 3/11/2022 Drilling Co.: McMillan Drilling Logged by: N. Ahern Finished:3/11/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Yogou Main DESCRIPTION (DETAIL DESCRIPTION (DETAIL DESCRIPTION) Imply black Impl	0 RQD (%)	METHON CASING CASING BASE OF HOLE & WATER LEVEI INSTALLATIO DETAILS	
egg Sightly weathered, dark grey with vellowy while weathered, dark grey with vellowy while sightly weathered, dark grey with vellowy while sign and a sit. Core loss. Sightly weathered, dark grey with vellowy while end sign of the si	0		
egged Silghtly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and Sil TSTONE. As above. Core loss.	0		ÿ
HW to CW interbedded SANDSTONE and SILTSTONE As above. Image: Core loss. Image: Core loss. <t< td=""><td>0</td><td></td><td>$\langle \Delta \rangle$</td></t<>	0		$\langle \Delta \rangle$
But TSTONE. As above. Core loss. Slightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and Silt TSTONE. As above. Core loss. Slightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and Silt TSTONE. As above.			
Bightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and SILTSTONE. Moderately strong to strong. Bedding is thinky laminated, undulating smooth, very narrow to closed, fine grained. Veining is stepped. 4 500 00 5.10-5.25m - Broken RC 100 50 5.10-5.25m - Broken RC 100 50 5.10-5.25m - Broken RC 100 50	0	(au)	
Slightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and SILTSTONE. Moderately strong to strong. Bedding is thinly laminated, undulating smooth, very narrow to closed, fine grained. Veining is stepped. 4 604 70m Completely weathered Becovered	0 Rotary corred	Rotary corred 2 size wireline (85 mm nom. da.	Grout
SILTSTONE. Moderately strong to strong. Bedding is thinly laminated, undulating smooth, very narrow to closed, fine grained. Veining is stepped. 4 50 4 70m Completely weathered. Recovered			X
as: sity SAND with minor gravel and cobbles, dark grey. Moist. Sand; coarse to medium. Gravel; fine to coarse, subangular. Sit;	50	SWL 1.70m	
Single Sector Se	0	SWI	
Core loss.		0.00m	
Notes: Started: 2/11/2022 Finished:	3/	3/11/2022	
SPT hammer energy ratio 91% Drilling Co.: McMillan Drilling Drilling Rig: Geotechnical borehole Logged by: N Abern Checked by:	g: H	Hanjin D&B-8D - ti C. Parkes	rack

Elevation is estimated from Google Earth Core loss placed at end of run by default 123mm OD Rotary Coring

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern area of site, middle of excavation Mt Cooee Landfill, Balclutha

Coordinates:	1350377 E 4873747 N	
Ref. Grid:	NZTM	Depth: 6.9 m
R.L.:	Approx. 20 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH9.1 BH9 Box 1: 0.0m to 5.5m



Photo BH9.2 BH9 Box 2: 5.5m to 6.9m

Notes: SPT hammer energy ratio 91% Geotechnical borehole Elevation is estimated from Google Earth Core loss placed at end of run by default 123mm OD Rotary Coring Started:2/11/2022Drilling Co.:McMillan DrillingLogged by:N. Ahern

Finished:3/11/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Borehole No. BH10

	Project: Mt Cooee Landfi Client: Clutha District Co	ll - Dev ouncil (/elopm (CDC)	ent	Plan				Coord Ref. (dinates: 1350458 E Grid: NZTM	48	737	14	N L	Dept	h: 1	0 m
	Project No.: 6-CO082.00	·	()						R.L.:	Approx. 26	m			I	nclir	nation	: Vertical
	Location: Eastern edge of	site, 20)m fron	n bo	oundary				Datur	n: NZ Vertica	l Da	tum	201	16			
		II, Baic	lutha		TESTS	1							-		211 1 1	NG	
				ш I	ш	GTH					<u> </u>					ᆈᆐ	NO
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOO	SPT 'N' VALUI	SPT BLOW COUNTS OR SHEAR VALU	ROCK STREN	ROCK WEATHERING	ROCK DEFECT SPA(DEFECT DIP degrees 9	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPI	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOI & WATER LEV	DETALLAT
TS	TOPSOIL with grass and rootlets.			i													mL)
Ē	Clayey SILT with trace gravel, light brown with black specks, homogenous. Firm to stiff, moist, low plasticity. 0.65m - Becomes brownish orange and firm. Completely weathered brownish orange highly		× × - × ×								RC	100	0				nk pipe (1.0
	Fractured, fine fabric SANDSTONE. Extremely weak. Recovered as: SILT with some clay and trace gravel, homogenous. Firm, moist, low plasticity. Minor rootlets present. Gravel corestones are	- 1-		 22	6// 5/5/6/6						SPT	100	0				50 mm bla
	very weak. 1.42-2.75m - Remoulds to: clayey SAND with minor silt and gravel, orangish brown, homogenous. Moist, low plasticity. Gravel; fine to coarse, HW - CW Sandstone, very weak.	240					cw				RC	100	0				
	Sand; medium to coarse, angular to subangular. Fines; Soft.	2		57 	13// 10/15/14/18	EW		EC			SPT	100	0				
	2.45-2.75m - Trace rootlets. Grading to highly weathered, dark brown with orange weathering and white specks, fractured, the Geoder Science Tobus Fectore										RC	100	0				
	International and the second s			60+ 	21// 17/20/23 for 70mm						SPT	100	0				
	Recover as: Sandy GRAVEL with some cobbles and minor silt. Low plasticity. Gravel; fine to medium, angular to subangular. Sand; fine to coarse, angular to subangular.	224				vw	HW				RC	100	0			SWL nilm	
	Moderately weathered, orangish brown fractured		· · · · · · · · · · · · · · · · · · ·	 57 	18// 12/12/16/17						SPT	100	0		a. core)		
0	SANDSTONE: Weak. Recovered as: gravelly COBBLES with some sand. Cobbles and gravel; fine to coarse, cobbles max 100mm, subangular. Sand; medium to coarse, rounded.				27//	w	MW	VC			RC	100	0	/ cored	mm nom. d		m L)
s Terrane	Slightly weathered, orangish brown with oxidised defects, fractured SANDSTONE. Moderately strong. Discontinuities; very closely spaced closed joints, cross-cutting and sub-vertical, rouch be smach placed.		.	60+ 	51/9 for 5mm	MS	sw			5.30m - J, 70° 5.40m - L 60°	SPT	100	0	Rotary	reline (85		0.0 r
Caples	5.60-5.70m - Highly fractured zone. Weak.	20.				W MS	HW SW	EC VC	.160	0.4011 - 0, 00	RC	100	0		⊃Q size wi		9/03/2023
	6.10-6.15m - Crushed zone. Recovered as: sandy medium GRAVEL with minor silt. Subrounded.					VW	HW	EC VC	JZ8	6.00m - J, 60° 6.10m - CZ 6.11m - J, 70° 6.15m - J, 70°	RC	100	0		-		20 u
	7.20-7.90m - Highly fractured zone.	- 7- - 7- 				MS	SW	С	J5070 J50 J40 J30 J30	6.60-6.70m - Core broken during removal from catcher. 6.85m - J, 50° 6.85m - J, 70° 6.95m - J, 50° 7.20m - J, MN, silica coated 7.30m - J, 40°	RC	100	8				
	7.90-8.50m - Recovered as: COBBLES with some gravel and sand. Cobbles and gravel; angular to subangular, weak to very weak. 8.20-8.30m - Well-rounded coarse sized gravel.	¹⁸ 8 	, , ,			w	MW	VC		7.50m - 3, 30 7.75m - 3, 30° 7.90-8.80m - Disturbed on removal from core catcher.	RC	75	0				
	8.60-8.80m - Crushed zone, Recovered as: GRAVEL with some sand and minor silt. Gravel; fine to medium, subangular. Core loss.					EW	CW	EC		8.60m - CZ							
	Slightly weathered, light and dark grey fractured and indistinctly bedded SILTSTONE. Moderately strong.					MS	мw	VC	J45	9.00m - B, PL, silica coated	RC	95	0				
	9:50-9:60m - Crushed zone. Recovered as: GRAVEL with some sand. Gravel and sand; fine to coarse, subangular. 9:60-9.85m - Dark grey. Green and white vein					S	SW	С		9.50m - 62 9.51m - J, 45° 9.70m - B, ST, limonite stained			v				
No	tes:					St	arteo	d:	28/	10/2022	Finis	hed:		31/	10/2	2022	

Drilling Co.: McMillan Drilling

Logged by: C. Hall

Notes:

BOREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

Drilling Rig: Hanjin D&B-8D - track

Checked by: C. Parkes



	Project: Mt Cooee Landfill - Development Plan								С	oordinates:	1350458 E	48	737	14 I	N			
	Client: Clutha District Council (CDC)							Re	ef. Grid:	NZTM				Ľ	Dept	h: 1	0 m	
	Project No.: 6-CO082.00								R.	L.:	Approx. 26	m			lı	nclin	ation	: Vertical
	Location: Eastern edge of	site, 2	0m fror	n bo	oundary				Da	atum:	NZ Vertica	Dat	tum	201	6			
	Mt Cooee Landf	ill, Balo	clutha											_				
					TESTS	E		DNG					CORI	E	DR		NG	z
۲			LOG	LUE		RENG	SING	PACI	DEF	ЕСТ		ΥPE					HOLE	ATIC
POG		E H	비	N. <₽		K STF	L HE	K CT S	D			PLE 1	(%)	(%)	Q C R	g	TER	AILS
GEO	/ DETAIL DESCRIPTION	R.L. (DEP1	GRAI	SPT -	SPTI	ROCI	WEA	DEFE	deg	rees / OT	HER TESTS	SAMI	TCR	Rap	DRIL	CASI	BASE & W∕	DET
	Core loss	_																
	END OF BOREHOLE AT 10m - Target Depth Reached	=																
		=																
		_																
		=																
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Not	tes:		-			Si	tarte	d:		28/10/202	2	- inis	hed:		31/	10/2	2022	
SPT	「hammer energy ratio 91% technical borebole					D	rilling	g Co	.: I	McMillan I	Drilling I	Drillir	ng R	ig:	Har	njin	D&B	-8D - track

Logged by: C. Hall

SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement

BOREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4 Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern edge of site, 20m from boundary Mt Cooee Landfill, Balclutha

Coordinates:	1350458 E 4873714 N	
Ref. Grid:	NZTM	Depth: 10 m
R.L.:	Approx. 26 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH10.1 BH10 Box 1: 0.0m to 2.5m



Photo BH10.2 BH10 Box 2: 2.5m to 5.0m

Started:

28/10/2022

Drilling Co.: McMillan Drilling

Logged by: C. Hall

Notes: SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

BOREHOLE SOIL/ROCK LOG A4 - WSP_MT COOEE BOREHOLE LOGS - V0.3.GPJ_WSP-OPUS2019_VER11X.GDT_30/3/23

Finished:31/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern edge of site, 20m from boundary Mt Cooee Landfill, Balclutha

Coordinates:	1350458 E 4873714 N	
Ref. Grid:	NZTM	Depth: 10 m
R.L.:	Approx. 26 m	Inclination: Vertica
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH10.3 BH10 Box 3: 5.0m to 7.2m



Photo BH10.4 BH10 Box 4: 7.2m to 10.0m

Notes: SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement Started:28/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:31/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes





Appendix C Laboratory Testing Results

UNCONFINED COMPRESSIVE STRESS ON ROCK

Material Investigation
Mt Cooee Landfill
Clutha District Council
Scott Kvick
Scott Kvick
13 December 2022
Rotary Core Drill
Damp as received
Sandstone
BH08 0.6-0.8m

Project No:	6-CO082.00/231A
Lab ref No:	CH9589/3
Client Ref:	Scott Kvick

Sample ID	CH9589/3	1	
Bulk Density t/m ³	2.39		
Water Content %	8.3		
Dry Density t/m ³	2.20		
Max Stress kPa	3115.01		
Strain at Failure %	0.44		
3500	L/C	D CORR STRESS (kPa)	
3000			
2500			
2000			
± 1500			
1000			
500 -			
0			
0.00 0.	.05 0.10 0.15	0.20 0.25 0.30 0.35 0.40 0.45	0.50
		Strain (%)	

Test Methods

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Uniaxial Compression Test : International Society for Rock Mechanics, Part 1 Suggested Method for Determination of the Uniaxial Compres Strength of Rock Materials. (Not IANZ Accredited)

Water Content : NZS 44

IANZ Approved Signatory :

NZS 4402:1986 Test 2.1

Str

Designation : Date : *Laboratory Manager* 11 January 2023



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

CLF 044 (1/9/22)

WSP New Zealand Limited Christchurch Laboratory Quality Management Systems Certified to ISO 9001 52C Hayton Rd, Wigram PO Box 1482, Christchurch Mail Centre, Christchurch 8140, New Zealand Page 1 of 1

Telephone +64 3 343 0739 Facsimile Website www.wsp.com/nz

UNCONFINED COMPRESSIVE STRESS

	ON ROCK
Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Client ref :	Scott Kvick
Sampled by :	Scott Kvick
Date Sampled:	13 December 2022
Sampling method :	Rotary Core Drill
Sample condition :	Damp as received
Sample description :	Sandstone
Source:	BH08 2.1-2.4m

Project No:	6-CO082.00/231A
Lab ref No:	CH9589/4
Client Ref:	Scott Kvick

Sampl	le ID	CH9589	/4				
Bulk I	Density t/m ³	2.42					
Water	Content %	6.6					
Dry D	ensity t/m ³	2.27					
Max S	stress kPa	6659.64	1				
Strain	at Failure %	0.47					
	8000		L/D COF	R STRESS (kPa	a)		
	7000						
	6000						
	5000						
	4000						
кРа	4000						
	3000						+ + -
	2000						
	1000						
	0	0.10			0.40		
	0.00	0.10	0.20	0.30	0.40	0.50	0.60
				Strain (%)			

Test Methods

This report may only be reproduced in full

Uniaxial Compression Test : International Society for Rock Mechanics, Part 1 Suggested Method for Determination of the Uniaxial Compres Strength of Rock Materials. (Not IANZ Accredited)

Water Content : NZS 4402:1986 Test 2.1

IANZ Approved Signatory : Sin

Laboratory Manager 11 January 2023



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

CLF 044 (1/9/22)

Designation :

Date :

WSP New Zealand Limited Christchurch Laboratory Quality Management Systems Certified to ISO 9001

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Page 1 of 1

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UNCONFINED COMPRESSIVE STRESS ON ROCK

- Windowski Andrea Statistica (Statistica)	OIT ALO OAL
Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Client ref :	Scott Kvick
Sampled by :	Scott Kvick
Date Sampled:	13 December 2022
Sampling method :	Rotary Core Drill
Sample condition :	Damp as received
Sample description :	Sandstone
Source:	BH10 5.6-5.9m

Project No:	6-CO082.00/231A
Lab ref No:	CH9589/5
Client Ref:	Scott Kvick

Sample ID	CH9589/5						
Bulk Density t/m ³	2.39						
Water Content %	7.8						
Dry Density t/m³	2.22						
Max Stress kPa	1994.6	0					
Strain at Failure %	0.82						
2500		L/D	CORR STF	RESS (kPa)	 	
2000							
2000							
1500							
1000							
0							
0.00	0.20	0.40		0.60	0.80	1.00	1.20
			Stra	ain (%)			

Test Methods

Uniaxial Compression Test : International Society for Rock Mechanics, Part 1 Suggested Method for Determination of the Uniaxial Compres Strength of Rock Materials. (Not IANZ Accredited)

Water Content : NZS 4402:1986 Test 2.1

IANZ Approved Signatory :Designation :LabDate :11 J

y: Sta Laboratory Manager 11 January 2023



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CLF 044 (1/9/22)

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PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) **TEST REPORT**

Project :		Material Investigation							
Location :		Mt Cooee L	andfill						
Client :	Clutha District Council								
Client/Samp	le Ref:	Scott Kvick							
Contractor :		WSP Dune	din						
Borehole No	BH01 Depth: 2.0-2.45m metres								
Sampled by : Scott Kvick									
Date receive	ed :	15 Decembe	er 2022						
Sampling m	ethod :	NZS 4402: 1	986 (Fine)						
Sample cond	dition :	Damp as re	ceived				Project No:	6-CO082.00/2	31A
Sample desc	cription :	Sandy SILT	with trace c	lav			Lab Ref No:	CH9589/1	
Solid Particle	e Density (t/r	m ³).	2.68	Assumed			Client Ref:	Scott Kvick	
Water Conte	ent (as receiv	ved):	29.8	%					
		Sieve Ar	alvsis		10000		Hvdromet	er Analysis	
Sieve Size	Passing	Sieve Size	Passing	Sieve Size	Passing	Particle Size	Passing	Particle Size	
(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	
63.0		4.75		0.300	100	0.0351	55	0.0073	
37.5		2.36	100	0.212	100	0.0277	48	0.0052	
19.0		1.18	100	0.150	99	0.0219	39	0.0038	
13.2		0.600	100	0.075	83	0.0168	32	0.0029	
9.5		0.425	100	0.063	71	0.0132	23	0.0016	
Note:	"" denotes sie	eve not used and	d/or hydromet	er analysis not	tested	0.0099	16		
				Sieve Aperl	ure Size (m	m)			
			.063	150 212 300	425	36	.5	9.0	3.0
100							4 0 7		
90				\times					
80									
8 70									
u eo									
A G									
50									
ຍ 40									
B 30									
å 20									

Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)

0.010

medium

SILT

fine

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

1 000

coarse

Notes

Particle Size (mm)

medium

SAND

0.100

fine

coarse

Date Tested:

Test Methods

10 0

0.001

CLAY

19 December 2022

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Date Reported:

10 January 2023

IANZ Approved Signatory Designation :

Date :

10 January 2023

de Laboratory Manager



fine

All information supplied by Client

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

coarse

100.000 very coarse

Pagel of 2

PF-LAB-100 (11/07/2020)

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10 000

medium

GRAVEL

PLASTICITY INDEX FOR AGGREGATES TEST REPORT

Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Contractor :	WSP Dunedin
Sampled by :	Scott Kvick
Date sampled :	13 December 2022
Sampling method :	NZS 4402: 1986 (Fine)
Sample description :	Sandy SILT with trace clay
Sample condition :	As Received
Source :	BH01 2.0-2.45m

Project No :	6-CO082.00/231A
Lab Ref No :	CH9589/1
Client Ref No :	Scott Kvick

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	Test Results				
Client Ref No :	Scott Kvick				
Cone penetration limit :	40				
Plastic limit :	Unable to Roll Threads				
Plasticity index :	NP				
Sample fraction :	Fraction passing 425µm test sieve				
As received water content :	29.8				
Test Methods					
Water Content	NZS 4407 : 2015 Test 3.1				
Cone Penetration	NZS 4407 : 2015 : Test 3.2				
Plastic Limit	NZS 4407 : 2015 : Test 3.3				

Date tested : 21 December 2022 Date reported : 10 January 2023



Date :

Plasticity Index

81A

Designation : Laboratory Manager 10 January 2023

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested. This report may only be reproduced in full All information supplied by Client

NZS 4407 : 2015 : Test 3.4



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PF-LAB-053 (09/06/2021)

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PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :		Material In	vestigation								
Location :		Mt Cooee	Mt Cooee Landfill								
Client :		Clutha District Council									
Client/Samp	ole Ref:	Scott Kvick									
Contractor :		WSP Dune	edin								
Borehole No):	BH01	Depth	: 5.0-5.45 r	netres						
Sampled by	:	Scott Kvick	< compared by the second s								
Date receive	ed :	15 Decemb	er 2022								
Sampling m	ethod :	NZS 4402:	1986 (Fine)								
Sample cond	dition :	Damp as re	eceived				Project No:	6-CO082.00/2	31A		
Sample desc	cription :	SILT with s	ome clay ar	nd minor sa	nd		Lab Ref No:	CH9589/2			
Solid Particle	e Density (t/r	m^{3}):	2.68	Assumed			Client Ref:	Scott Kvick			
Water Conte	ent (as receiv	ved):	34.2	%							
		Sieve A	nalvsis				Hydromete	er Analysis			
Sieve Size	Passing	Sieve Size	Passing	Sieve Size	Passing	Particle Size	Passing	Particle Size	Passing		
(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)		
63.0		4.75		0.300	99	0.0387	81	0.0066	38		
37.5		2.36	100	0.212	98	0.0284	77	0.0049	31		
19.0		1.18	100	0.150	97	0.0207	73	0.0035	26		
13.2		0.600	99	0.075	92	0.0153	67	0.0027	23		
9.5 Note:	"" denotes sie	ve not used an	d/or hydrome	ter analysis no	90 ot tested	0.0089	48	0.0015	19		
				0: 1		\ \		1			
			(C) (C)	Sieve Ape	ture Size (m	nm)					
100			0.06:	0.150	0.42	1.18	4.75 9.5 13.2	37.5	63.U		
90											
80											
) 70 sse											
Ë 60 											
50 L											
e 40		AII									
30 E											
d 20											
10											
0				Destial							
0.001		0.010	(0.100 Partici	e Size (mm) 1.0	000	10.000		100.000		
CLAY	fine	medium	coarse	fine n	nedium co	barse fir	ne mediur	m coarse	coarse		
		SILT		5	SAND		GRAVE	EL			
						Ter .					
Particle Size Apply	sis: N75 4402-100	6: Test 2.9 / JMA	hed Grading 8	-wdromotor Ma	thad)	Notes					
Farticle Size Analy	515. INZ 3 44UZ.198	00. TESL 2.0.4 (VVB	sileo orading & l	nyorometer Me	(100)	All information	supplied by Clien	t			
				Sampling is i	not covered by	/ IANZ Accredita	tion. Results ar	poly only to sam	nple tested		
Date Tested		19 Decemb	≥r 2022	This report m	av only be rer	produced in full			1.12 1001001		

Designation :

Date :

an

10 January 2023

Laboratory Manager

Date Reported:

IANZ Approved Signatory

10 January 2023



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PF-LAB-100 (11/07/2020)

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PLASTICITY INDEX FOR SOILS TEST REPORT

Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Contractor :	WSP Dunedin
Sampled by :	Scott Kvick
Date sampled :	13 December 2022
Sampling method :	NZS 4402: 1986 (Fine)
Sample description :	SILT with some clay and minor sand
Sample condition :	As Received
Sample reference:	BH01 5.0-5.45m
Sample depth:	5.0-5.45m

Project No :	6-CO082.00/231A
Lab Ref No :	CH9589/2
Client Ref No :	Scott Kvick

	Test Results	
Liquid Limit :	39	
Plastic Limit :	25	
Plasticity Index :	14	
Natural Water Content :	34.2	

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Fraction passing 425µm test sieve
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	,
Water Content	NZS 4402 : 1986, Test 2.1	All information supplied by Client

Date tested : 21 December 2022 Date reported : 10 January 2023

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested. This report may only be reproduced in full

IANZ Approved Signatory

Designation : Laboratory Manager Date :

PF-LAB-101 (14/10/2022)

815



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10 January 2023

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CONSU	LTANT		



		Project:	Mt Cooee Landfi	II - C	Developr	nent	Plan				Coor	rdinates: 1350038	E 48	738	17	N			
		Client:	Clutha District C	ound	cil (CDC)					Ref.	Grid: NZTM				Ľ	Dept	h: 1	1.6 m
		Project No.:	6-CO082.00								R.L.:	Approx. 9	m			h	nclir	natior	n: Vertical
		Location:	30m west of Kait Mt Cooee Landfi	ang II, B	ata Hwy alclutha	, sout	th of oxida	tion	por	lds	Datu	m: NZ Vertic	al Da	tum	201	16			
							TESTS	Ξ		U					E	DF	RILLI	NG	z
	GEOLOGY	MAIN DES / DETAIL DE	CRIPTION SCRIPTION	R.L. (m)	DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGT	ROCK WEATHERING	DEFECT SPACIN	DEFEC DIP	T DEFECTS / NOTES s / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEI	INSTALLATIO DETAILS
	TS	TOPSOIL, grass, trace r quartz gravel. 0.40-0.50m - Woody org Silty CLAY with trace gr	ootlets and trace fine anics present. avel and rootlets, dark										RC	80					000000
	-	grey, homogenous. Soft plasticity. Gravel, coarse Core loss. Sandy SILT, light brown Firm, moist to dry, low pl	to firm, moist, high e, subangular. to brown, homogenous. lasticity, micaceous.	. 8			3//						SPT	100					<u>,0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°0°</u>
	-	Sand; fine. Silty CLAY with trace sa brown with dark grey and homogenous. Firm, mois	nd and gravel, light d brown specks, st, high plasticity.	-	× · × · × · × · × · × · × · ×		1/2/1/2						RC	100					ზიზიზი ბიმიაი 0/2022 ზიმინი ბიმიი
	-	Gravel; fine, subangular 1.50m - Orange mottle. Sandy SILT, brown, hom plasticity. Sand; fine. 1.80m - Becomes light b	rown.	+ :	2 - × · · × - × · · · ×	 5	2// 1/1/1/2					Lab: 1.8 - 3.0m PSD and Atterberg Limits	SPT	100	-				ა°0°0°0°0°0°0° 2°0°0°0°0°0° ∳∰ 31/1 3°0°0°0°0°0°0° 2°0°0°0°0°0°0
		Silty fine to coarse SANI brown, homogenous. Lo Silt; low plasticity. Becomes light grey to gr mottles, homogenous. D	D with trace rootlets, ose, moist, micaceous. ey with trace of orange bry to moist, non-plastic,	-			0.0.02						RC	100					ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°ი°
		micaceous.		_6 ;	3	. 7	2// 1/2/2/2					2.85-3.00m - Broken during removal from core catcher	SPT	100					<u>ი°ი°ი°ი°ი</u> ი°ი°ი°ი°ი° ი°ი°ი°ი°ი° out backfill
	Alluvium	Silty CLAY with trace sal orange mottles througho firm, moist, high plasticit fine to medium. 3.50m - Becomes firm.	nd, light grey with ut, homogenous. Soft to y, micaceous. Sand;										RC	100					<u>ა°°°°°°°°°</u> <u>ა°°°°°°°°°</u> <u>ა°°°°°°°°°</u> n L) with grc
30/3/23	-	3.90m - Becomes light g <u>mottles (less than above</u> Sandy SILT, light browni Soft, non-plastic dry. Sa	irey with trace orange), homogenous. (ish grey, homogenous. nd; fine to medium.	+ '	4 <u>× ×</u>		2// 2/1/2/1					Lab: 4.4 - 6.1m PSD	SPT	100			a. core)		ი°ი°ი°ი° ი° ი°ი°ი°ი°ი° ი°ი°ი°ი°ი ი°ი°ი°ი°
R11X.GDT		Silty CLAY, light greenis Soft to firm, moist, high	h grey, homogenous. plasticity.	4								and Atterberg Limits	RC	100		cored	nm nom. di		<u>ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი ი </u>
JS2019_VE						ין דין דין דין דין דין דין דין דין דין ד	0// 0/0/0/1						SPT	100		Rotary	ireline (85 I		<u>ოიოი</u> ი იიიიიი ოიიიიიი იიიიიი ი
WSP-OPI		5.65-6.00m - Green sandy lamin 5.65-6.00m - Green sandy greenish grey.	ations. dy lenses. Becomes										RC	100			PQ size v		ე"იე"ი"ი"ი" ე"ი"ი"ი"ი მ/03/2023 ე"ი"ი"ი"ი"ი" ე"ი"ი"ი"ი"ი"ი"
3 - V0.3.GPu	-	Silty CLAY with trace gra	avel and sand, dark grey				13// 9/22/22/7 for 20mm						SPT	100					°0°0°0°0°0° °0°0°0°0°0° ™0°0°0°0°0°0°0°0
IOLE LOGS		moist to wet, high plastic coarse, subangular to ar medium, subangular to s Slightly weathered, high	ity. Gravel; fine to ngular. Sand; fine to subrounded. y fractured, light c SANDSTONE:	2	7-1		12//					6.70-9.35m - Rock broken up by drilling.	RC	100	-				<u>, 70, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0</u>
DEE BOREH		moderately strong; very and white veins. Recovered as: sandy GF light brown. Gravel and s subangular.	Closely spaced joints RAVEL with some silt, sand; fine to coarse,			: 60+	14/46 for 75mm						SPT	100	-				,0,0,0,0,0 0,0,0,0,0 0,0,0,0,0 0,0,0,0,
P MT COC	rane	7.50-8.00m - Gravel bec coarser gravel is angula gravel is rounded to sub	omes; fine to coarse, r to subangular, finer rounded.	- 8	8	: 60+	60 for initial			VC			SPT	100				SWL 2.35m	
JG A4 - WS	aples Teri	Slightly weathered, high grey, fine fabric SANDS	y fractured, light bluish TONE; moderately					MS	sw				RC	100	0				(
L/ROCK LC	U	strong; closely spaced jc Recovered as: Fine to cr minor sand, light greyish well graded, non-plastic. is angular to subangular to subrounded Sand: m	onts and white veins. barse GRAVEL with brown. Very dense, Gravel; coarser gravel , finer gravel is rounded edium to coarse	_• •	9	60+	60 for initial 105mm					Lab: 9.0 - 11.0m UCS	SPT	100	0				ed pipe (3.0
DREHOLE SOI	-	9.17-9.35m - Recovered GRAVEL with minor cob dense, well graded. Gra Greywacke, mm-scale w max 80mm.	as: fine to coarse bles, light grey. Very vel; subangular, rhite veins. Cobbles:							VC C VC		9.17-9.35m - Rock broken up by drilling. Any matrix appears to be lost due to drilling.	RC	100	0				50 mm slott
B	Not	200		<u> </u>	<u>::::</u>	. <u> </u>		S	tarto	d.	10. 10	 /10/2022	Finio	hed		20/	10/3	1 2022	<u>no – sol</u> ,
	SPT	hammer energy ratio	91%					כ ת	rillin	a. a Co	Mo	Millan Drilling	Drilli	na R	ia:	Har	njin	D&F	3-8D - track
	Sha Core	red Hydro / Geotech bo e loss placed at end of mm OD Potory Coring	orenoie run by default					L	ogge	d by:	С.	Hall	Cheo	cked	by:	C. I	Park	<es< td=""><td></td></es<>	

Core loss placed at end of run by default 123mm OD Rotary Coring



	Project:Mt Cooee Landfill - Development PlanCClient:Clutha District Council (CDC)RProject No.:6-CO082.00RLocation:30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, BalcluthaD					Coordinates:1350038 E 4873817 NRef. Grid:NZTMR.L.:Approx. 9 mDatum:NZ Vertical Datum 2016														
	GEOLOGY	MAIN DESCRI / DETAIL DESCF	PTION RIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFE DIF degre	CT DEFI ees / OT	ECTS / NOTES THER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)		CASING	BASE OF HOLE	INSTALLATION DETAILS
	Caples Terrane	Slightly weathered, fractured, fabric SANDSTONE; strong; n and tight aperture. Recovered as: COBBLES, wi sand. Well graded. Cobbles a to subangular. Sand; fine to n 10.11-11.00m - Thinly laminal throughout. Veins are mostly greenish white. Apertures ext spaced, very narrow. 10.40-10.60m - Heavily veine 10.80-11.00m - Angular GRA COBBLES.	light grey, fine white veins smooth th some gravel and ind gravel; angular nedium.(continued) ted veins white, some are remely closely d. Minor sand. VEL and	211		60+ 	60 for initial 105mm 60 for initial 95mm	s	sw	vc c vc c vc				RC SPT RC	100 100 100	0 0 0 0	Rotary cored			
BOREHOLE SOIL/ROCK LOG A4 - WSP_MT_CODEE BOREHOLE LOGS - V0.3.GPJ_WSP-OPUS2019_VER11X.GDT_30/3/23		END OF DUREHOLE AT THE Reached	, in - Target Deput	- 12 12 																
	Not SPT	es: hammer energy ratio 91%						St	arte rilling	d: a Co	1 · N	9/10/202 1cMillan	22 Drilling	Finis Drillin	hed:	ia:	20/ Har	10/2 hiin	2022 D&B	-8D - track

Logged by: C. Hall

SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring

Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350
Client:	Clutha District Council (CDC)	Ref. Grid:	NZTI
Project No.:	6-CO082.00	R.L.:	Appr
Location:	30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, Balclutha	Datum:	NZ V

dinates:	1350038 E 4873817 N	
Grid:	NZTM	Depth: 11.6 m
	Approx. 9 m	Inclination: Vertical
m:	NZ Vertical Datum 2016	



Photo BH1.1 BH1 Box 1: 0.0m - 2.4m



Photo BH1.2 BH1 Box 2: 2.4m - 4.45m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring Started:19/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:20/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Draiaati	Mt Cooco Londfill Dovolonment Dian	Coordinatoo	
Projeci.	Mit Coolee Lanumi - Development Plan	Coordinates.	
Client:	Clutha District Council (CDC)	Ref. Grid:	I
Project No.:	6-CO082.00	R.L.:	/
Location:	30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, Balclutha	Datum:	I

rdinates:	1350038 E 4873817 N	
Grid:	NZTM	Depth: 11.6 m
	Approx. 9 m	Inclination: Vertical
ım:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH1.3 BH1 Box 3: 4.45m - 7.0m



Photo BH1.4 BH1 Box 4: 7.0m - 9.35m

Started:

19/10/2022

Drilling Co.: McMillan Drilling

Logged by: C. Hall

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

20/10/2022 Finished: Drilling Rig: Hanjin D&B-8D - track Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350
Client:	Clutha District Council (CDC)	Ref. Grid:	NZT
Project No.:	6-CO082.00	R.L.:	Арр
Location:	30m west of Kaitangata Hwy, south of oxidation ponds Mt Cooee Landfill, Balclutha	Datum:	NZ۱



PHOTOGRAPHS



Photo BH1.5 BH1 Box 5: 9.35m - 11.0m



Photo BH1.6 BH1 Box 6: 11.0m - 11.6m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Core loss placed at end of run by default 123mm OD Rotary Coring

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

Started:19/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:20/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:

Borehole No. BH1 (ROYDS)

Coordinates: Not established

	Client: Clutha District Project No.: 6-CO082.00		Ref. Grid: NZTM Depth: 15 m R.L.: Approx. 116.39 m Inclination: Ve Datum: Depth: 15 m						
	Mt Cooee Lan	dfill, Balcluth							
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT IN' VALUE	ROCK STRENGTH ROCK WEATHERING ROCK DEFECT SPACING	EFECT DIP DEFECT legrees / OTHEI	S/NOTES TESTS	RQD (%)		BASE OF HOLE & WATER LEVEL & NOTALLATION DETAILS
DREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23 Tuapeka Group Greywacke Tuapeka Group Greywacke TS	TOPSOIL with some fine gravel.							Rotary open hole	
m No Air Tal	L ofes: Rotary drilling method. 150mm diameter. ken from Royds Garden I td borehole record	<u> ····</u>	···	Started: Drilling Co.:	28/01/1994	Finishe Drilling	d: 2 Rig:	28/01/	1994

Logged by:

Checked by:



BOREHOLE SOILROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

Mt Cooee Landfill - Development Plan Project:

Clutha District Council (CDC) Client:

Project No.: 6-CO082.00

Near Clutha River Bridge Mt Cooee Landfill, Balclutha Location:

Borehole No. BH1 (ROYDS)

Coordinates: Not established

NZTM Ref. Grid:

Approx. 116.39 m

Depth: 15 m

R.L.: Datum:

Inclination: Vertical

					TESTS	-		0				(CORE	-	DF	RILLI	NG	-	
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACINO	DEF D deç	FECT DIP grees 90	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL		
Tuapeka Group Greywacke	Light grey moderate to widely jointed GREYWACKE] - weathered, fractured zone at top of layer - very hard - some quartz filled joints(continued)										~				Rotary open hole				status en en entre en en en en
	END OF BOREHOLE AT 15m																		
<i>Not</i> Air F Take	es: Rotary drilling method. 150mm diameter. en from Royds Garden Ltd borehole records.					St Di Lo	tarte rillin page	ed: g Co ed by).: /:	28/0	01/1994	Finis Drillii Chec	hed: ng R :ked	ig: bv:	28/	01/1	1994		

Logged by:



	Project:Mt Cooee LandfClient:Clutha District CProject No.:6-CO082.00Location:North of site, no Mt Cooee Landf	Coo Ref R.L Dat	Coordinates:1350241 E4873978 NRef. Grid:NZTMDepth:6 mR.L.:Approx.16 mInclination:Datum:NZ Vertical Datum 2016						
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) DEPTH (m) SPT IN' VALUE SPT BLOW SHT BLOW SHEAR VALUE	ROCK STRENGTH ROCK WEATHERING DEFECT SPACING DEFECT SPACING	DEFECTS / NOTES	SAMPLE TYPE				BASE OF HOLE S & WATER LEVEL S INSTALLATION DETAILS
TS	TOPSOIL. GRAVEL with minor sand, brownish grey. Loose. Gravel; fine to coarse, subrounded, sandstone. Clay/silt/sand matrix inferred washed away. 0.70m - Some matrix present at 0.7m Core loss.	$ \begin{array}{c} $			RC 5	5 0	-		Cement sea
Alluvium	Gravelly CLAY with some silt and minor sand, brown. Homogenous, soft, moist, high plasticity. Gravel; fine to coarse, angular, well graded. Core loss.				RC 4	5 0	pe	om. dia. core)	Image: 1 Image: 1
)/3/23 ane	Completely weathered grey and orange/brown, fine fabric SANDSTONE. Extremely weak. Recovered as: SILT with minor gravel and some sand and clay. Homogenous, stiff to very stiff, moist, low plasticity. Gravel; fine to medium, subangular. Sand; fine.	3 -124 	EW CW EC W SW VC EW CW EC		RC 8) 0	Rotary core	PQ size wireline (85 mm n	
SP-OPUS2019_VER11X.GDT_30 Caples Terr	Moderately weathered greenish grey, fine fabric SANDSTONE. Very weak to weak. Completely weathered grey and orangeish brown, indistinctly bedded SANDSTONE. Extremely weak. Residual soil recovered as: SILT with some clay. Homogenous, stiff to very stiff, moist, and low plasticity. Moderately weathered greenish grey, indistinctly bedded SANDSTONE. Very weak to weak.		EW CW EC W HW C VW HW VC		RC 10	0 30			SWL 1.00m
BOREHOLE SOILROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ W	END OF BOREHOLE AT 6m - Target Depth Reached								
No Sha Coi 123	tes: allow groundwater well re loss placed at end of run by default 8mm OD Rotary Coring		Started: 18 Drilling Co.: M	B/10/2022 F cMillan Drilling C	inishe Drilling Checke	d: Rig: d bv [:]	19/ Ha C.	/10/2 njin Parl	2022 D&B-8D - track kes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	North of site, north side of railway Mt Cooee Landfill, Balclutha

Coordinates:	1350241 E 4873978 N	
Ref. Grid:	NZTM	Depth: 6 m
R.L.:	Approx. 16 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH2.1 BH2 Box 1: 0.0m - 4.2m



Photo BH2.2 BH2 Box 2: 4.2m - 6.0m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started:18/10/2022Drilling Co.:McMillan DrillingLogged by:N. Ahern

Finished:19/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:

Mt Cooee Landfill - Development Plan

Borehole No. BH2 (ROYDS)

Coordinates: Not established

	Client: Clutha District Council (CDC)							Ref. Grid: NZTM Depth: 9.5 m						.5 m			
	Project No.: 6-CO082.00	dfill				R.L.: Approx. 109.29 m Inclination: Vertu							: Vertical				
	Mt Cooee Landfill, Balclutha								Daturi	Ι.							
					TESTS	ЭТН		DNG					E	DF	RILLI	NG ⊒⊒	NO
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENC	ROCK WEATHERING	ROCK DEFECT SPAC	DEFECT DIP degrees	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLI & WATER LEV	INSTALLATI DETAILS
TS	TOPSOIL with some line gravel.		<u>1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1</u>														
Pleistocene Glacial Deposits	Grey brown mottle yellow brown sandy silty fine GRAVEL.																
	Light grey moderate to widely jointed GREYWACKE. - Weathered, fractured zone at top of layer - Very hard - Some quartz filled joints		<u>~~~~</u>											Rotary open hole			
	END OF BOREHOLE AT 9.5m	9															
No	ites:	·				Si	tarte	d:	30/0	1/1994	- Finis	hed:		30/	01/	1994	

Taken from Royds Garden Ltd borehole records.

Drilling Co.: Logged by:



Project:

Mt Cooee Landfill - Development Plan

Borehole No. BH3

Coordinates: 1350135 E 4873642 N

	Client: Clutha District C	ouncil	(CDC)						F	Ref.	Grid: NZTM				L	Dept	th: 4	.5 m
	Project No.: 6-CO082.00				R.L.: Approx. 11 m Inclination: Vertical													
	Location: Western area of Mt Cooee Landf	site, 1 ill. Balo	5m nor clutha	th-e	ast of Kait	ang	ata	Hwy	I D	Datu	<i>im:</i> NZ Vertica	l Da	tum	20'	16			
		1			TESTS								CORI	E	D	RILL	ING	
S GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DE [de	FEC DIP gree:	T DEFECTS / NOTES s / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL	DETAILS
Ĕ	SILT with some clay and minor sand, grey/dark	=	××															
uvium	brown, homogenous. Soft, moist, low plasticity. Sand; fine to medium.		×															
Allt	Clayey SILT with minor sand, light brownish orange. Homogenous, soft, moist, with low to medium plasticity. Sand; fine. 0.90-0.92m - Cobble of moderately weathered, light brown massive SANDSTONE. Weak. Completely weathered, brownish orange, fine fabric SANDSTONE. Extremely weak. Recovered as: sandy SILT with minor clay, brownish orange, homogenous. Stiff, dry to moist, low plasticity. Sand: fine to medium.		× — × - × _ 			EW	cw	EC C				RC	100			core)		31/10/2022
rane	Highly weathered orange/brown, fine fabric SANDSTONE. Very weak. Recovered as: sandy GRAVEL with some cobbles and minor silt and clay, homogenous. Gravel; fine to coarse, subrounded. Cobbles; max 100mm, subrounded. Sand; fine to coarse.	2				vw	нw	EC C			2.40-2.50m - Core	RC	65	0	Rotary cored	ie (85 mm nom. dia.		
caples Ter	Core loss.										broken during removal from catcher. 3.00-4.30m - Possible					size wirelin		
0	fabric SAMDSTONE. Weak. Orange staining on all joint faces. Recovered as: COBBLES with minor gravel. Cobbles; max 100mm, mostly subangular with some subrounded (due to driling). Gravel; medium to coarse, subangular.					w	MW	vc c vc			weaker material washed out by drilling.	RC	80	0		Q		
	Core loss	. =															SWL 1.60m	
	END OF BOREHOLE AT 4.5m - Target Depth		\succ									-						
	Keached																	
N/		-					orte	<i>d</i> .		11	(10/2022	-	bad		10	10"	2022	

Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started: 11/10/2022 Drilling Co.: McMillan Drilling

Logged by: N. Ahern

Finished: 12/10/2022 Drilling Rig: Hanjin D&B-8D - track Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350135 E
Client:	Clutha District Council (CDC)	Ref. Grid:	NZTM
Project No.:	6-CO082.00	R.L.:	Approx. 11 r
Location:	Western area of site, 15m north-east of Kaitangata Hwy Mt Cooee Landfill, Balclutha	Datum:	NZ Vertical I

4873642 N m

Depth: 4.5 m Inclination: Vertical

Datum 2016

PHOTOGRAPHS

Photo BH3.1 BH3 Box 1: 0.0m - 3.0m



Photo BH3.2 BH3 Box 2: 3.0m - 4.5m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring

11/10/2022 Started: Drilling Co.: McMillan Drilling Logged by: N. Ahern

12/10/2022 Finished: Drilling Rig: Hanjin D&B-8D - track Checked by: C. Parkes



	Project:Mt Cooee LandfClient:Clutha District CProject No.:6-CO082.00Location:South-east corn Mt Cooee Landf	Coordinates:1350398 E 4873540 NRef. Grid:NZTMDepth:5.5 mR.L.:Approx. 9 mInclination:VerticalDatum:NZ Vertical Datum 2016												
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE SPT BLOW SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP degrees	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)			BASE OF HOLE S & WATER LEVEL	INSTALLATION DETAILS
TS	TOPSOIL with roots and grass. Sandy GRAVEL with trace rootlets, light brown to grey. Loosely packed, well graded, non-plastic. Gravel; angular to subangular, greywacke. Sand; fine to coarse, subrounded. 0.50-0.80m - Gravel; subangular to subrounded. Coarse sand; subangular to angular. Core loss.	-8 1 -8 1					0.15-3.70m - Assumed some fines or weaker seams were present but these have been washed away by drilling.	RC	53	0				Blank 1m Cmt seal
s Terrane	Slightly weathered to moderately weathered, highly fractured, orangish brown, fine fabric SANDSTONE; extremely weak; extremely closely spaced tight white veins; extremely weathered defects. Recovered as: COBBLES with some gravel and trace silt and rootlets, orangey brown to grey. Cobbles and gravel; fine to coarse. Cobbles; max 100mm, subangular. Sand; fine to coarse, subangular to subrounded. Silt, dark grey, !ensoidal. 2.20-2.40m - Trace pockets of dark grey silt. Core loss.			ew Mw	EC		1.50-5.50m - Fracturing due to drilling	RC	40	0	tary cored	85 mm nom. dia. core)		5 m L)
Caples	Slightly weathered to moderately weathered, highly fractured, dark grey SILTSTONE. Very weak, bedding is thinly laminated. Recovered as: Sandy GRAVEL with some cobbles and silt, dark grey with some orange and white veins. Sand; fine to coarse, angular to subangular. Gravel and cobbles; fine to coarse, subangular. Cobbles; max 60mm. Fines; non-plastic. Core loss			vw Mw	EC			RC	80	0	Rot	PQ size wireline (● 9/03/2023
119_VER11X.GDT 30/3/23	Slightly weathered, highly fractured, dark bluish grey, fine fabric SILTSTONE. Weak. Mm scale mostly closed and oxidised defects. Recovered as: COBBLES with some gravel and trace silt, dark bluish grey with orange staining. Cobbles and gravel; fine to coarse, subangular. Cobbles; max 150mm. Sand; fine to coarse, subangular to subrounded. 5.00m - Slickenslides on one piece of gravel.	-4 5		w sw	vc	.150 .145	4.10m - J, 50° 4.20m - J, 45°	RC	100	0			SWL	
BOREHOLE SOILROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS20	END OF BOREHOLE AT 5.5m - Target Depth Reached			Starte	d	27/1	0/2022		hed		27/	10/2	2.30m	

Logged by: C. Hall

Checked by: C. Parkes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	South-east corner of site Mt Cooee Landfill, Balclutha

Coordinates:	1350398 E 4873540 N	
Ref. Grid:	NZTM	Depth: 5.5 m
R.L.:	Approx. 9 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH4.1 BH4 Box 1: 0.0m to 3.8m



Photo BH4.2 BH4 Box 2: 3.8m - 5.5m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started: 27/10/2022 Drilling Co.: McMillan Drilling Logged by: C. Hall Finished:27/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project: Mt Cooee Landfill - Development Plan								Coordinates: 1350288 E 4873598 N												
Client: Clutha District Council (CDC)							Ref. Grid: NZTM Depth: 3							m						
Project No.: 6-CO082.00							R.L.: Approx. 7 m Inclination:						n: Vertical							
	Location:	Southern area of Mt Cooee Landf	f site, 8 ill, Balo	30m no clutha	orth-	east of Kai	tang	jata	Hw	y Da	atur	n:	NZ Vertica	i Da	itum	20	16			
						TESTS	.		J						COR	E	D	RILL	ING	7
GEOLOGY	MAIN DES / DETAIL DE	CRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACINO	DEF DI deg	ECT P rees	DEFEO / OTI	CTS / NOTES HER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL	INSTALLATION DETAILS
TS	TOPSOIL with some gra minor quartz sand.	iss and rootlets and	=																	
Alluvium	Silty CLAY with trace sai homogenous. Firm to sti Sand; medium. Silty CLAY with minor sa with minor white specks homogenous. Stiff, mois 0.90m - Becomes orang	nd, orangish brown, ff, moist, high plasticity. Ind, light greyish orange and orange mottle, t, high plasticity. e. Soft to firm.		× × · · · · · · · · · · · · · · · · · ·								Lab: 0.4 and per testing. Lab: 1.1	4 - 1.1m PSD meability 1 - 2.6m UCS	RC	100	0		n. dia. core)		Blank biee 0.9 m
errane	nighti weathered, John indistinctly bedded SANI weak; orange defects. 1.20m - Becomes model slightly weathered. 1.80-2.00m - Grades into	nan orange, me rabic DSTONE. Weak to very rately weathered to o slightly weathered.				 	vw	HW SW	VC			testing.					Rotary cored	line (85 mm nor		
Caples T	Moderately weathered, g indistinctly bedded SAN weak; orange staining al	preenish grey, fine fabric OSTONE. Weak to very ong open defects.	- 2-			 		MW	с	J10		2.15m ·	- J, 10°	RC	100	17		Q size wire		
						, 	W	sw	VC C	J10		2.50m	- J, 10°					P	SWL 2.30m	
	END OF BOREHOLE A	T 3m - Target Depth	+ <u>+</u> 3- - -			1						broken from ca	during removal ttcher.	\square						<u> </u>
			- 4-			 														
			- 5-			 														
			- 6-			 														
						, 														
			_0 7			 														
						, 														
			- 8-			, 														
			² 9			 														
Not	tes:		1	1	1	1	St	arte	d:	<u></u> ,	17/	10/2022	2	Finis	shed.		18/	/10/:	2022	
Core loss placed at end of run by default D 123mm OD Rotary Coring									Drilling Co.: McMillan Drilling Drilling Rig: Hanjin D&E						8-8D - trac					

Logged by: C. Hall

Checked by: C. Parkes



Depth: 3 m Inclination: Vertical

Project:	Mt Cooee Landfill - Development Plan	Coordinates:	1350288 E 4873598 N
Client:	Clutha District Council (CDC)	Ref. Grid:	NZTM
Project No.:	6-CO082.00	R.L.:	Approx. 7 m
Location:	Southern area of site, 80m north-east of Kaitangata Hwy Mt Cooee Landfill, Balclutha	Datum:	NZ Vertical Datum 2016

PHOTOGRAPHS



Photo BH5.1 BH5 Box 1: 0.0m to 2.2m



Photo BH5.2 BH5 Box 2: 2.2m to 3.0m

Notes: Shallow groundwater well Core loss placed at end of run by default 123mm OD Rotary Coring Started: 17/10/2022 Drilling Co.: McMillan Drilling Logged by: C. Hall Finished:18/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project: Mt Cooee Landfill - Development Plan Client: Clutha District Council (CDC) Project No.: 6-CO082.00 Location: Middle of site, southwest of excavation Mt Cooee Landfill, Balclutha							Coordinates: 1350315 E 4873694 N Ref. Grid: NZTM Depth: 9.45 m R.L.: Approx. 21 m Inclination: Vertical Datum: NZ Vertical Datum 2016										9.45 m n: Vertical
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT DIP DIP DIP DEFECT DIP DEFECT DIP DEFECT OFHI odegrees PD OTHI		DEFECTS / NOT / OTHER TEST	0 G SAMPLE TYPE	TCR (%)	RQD (%)			BASE OF HOLE	INSTALLATION DETAILS	
TS	TOPSOIL with some grass and rootlets, dark brown. 0.20m - Becomes orangish brown. Moderately weathered, light brownish orange, highly fractured, SANDSTONE. Moderately strong. Recovered as: gravelly COBBLES with some sand. Cobbles; angular, max 100mm. Gravel; 				MS	MW	vc				R	73					0 mm blank pipe (1.0 m.L)
Caples Terrane	Highly weathered, light brownish orange, highly fractured SANDSTONE. Weak. Recovered as: Sandy GRAVEL with some clay, orangish brown. Gravel, fine to coarse, subangular. Fines; high plasticity.	- 2	56	 15// 10/13/15/18 	w	нw	EC				SP	T 100	-				5
	2.30m - Re-drilled cobble.	183									R	38					1 bibe (1.5 m L)
	Moderately weathered, light grey to dark grey, highly fractured SANDSTONE. Moderately strong. Recovered as: GRAVEL with some sand, light grey to dark grey. Gravel; fine to coarse, subangular.		60+ 14 fo 	17// 14/16/21/9 for 25mm	21/9 MS 21 mm EW W 16 MS	MW	v vc				SP	T 100	_	y cored	nm nom. dia. core)		50 mm slotter
	Core loss. Completely weathered, greenish grey, fine fabric SILTSTONE. Extremely weak.			60+ 15// 15// 60+ 13/26/21 for 45mm 1 1 60+ 20/24/16 for 50mm 1 1 60+ 36// 60+ 48/12 for 35mm							R	C 38	_				
	Recovered as: clayey SAND with trace silt. Sand; fine to medium. Fines; high plasticity. 4.95-5.25m - Lenses of silty CLAY, greenish grey, homogenous. Soft, moist, high plasticity. Moderately weathered, greenish grey, highly fractured fine fabric, indistinctly bedded SANDSTONE. Weak.					EW W	CW E	EC C			Lab: 5.3 - 9.45m U0 testing.	S R	c 100	_	Rotary	size wireline (85 m	SWL 2.20m
	Recovered as: sandy GRAVEL with some clay, bluish green. Gravel; medium to coarse. Fines; high plasticity. Slightly weathered greenish blue, massive SILTSTONE. Weatk to moderately strong. 5.70-5.90m - Moderately weathered, highly fractured along defects. Defects; open or extremely closed spaced and closed.	- 6 - · · · · · · · · · · · · · · · · ·	60+			ww sw cw	VVC EC C EC				SP	T 100	0		РО		5
	6.45-6.55m - Pockets of silty SAND with pockets of clay, bluish green, homogenous. Loose, non-plastic. 6.55-7.20m - Black stained defects throughout. Moderately weathered greenish blue, fine fabric SILTSTONE. Weak; black stained defects. Recovered as: COBBLES with some gravel and										R	C 100	0				Glo
	silt. Cobbles and gravel; angular. Gravel; medium to coarse. 7.00-7.20m - Grades into completely weathered rock. 7.20-7.50m - Recovered as: sandy GRAVEL with some silt, dark greenish grey to black. Loose, non-plastic. Gravel; fine to coarse, subrounded Siltstone.		60+								SP	т 90	0	-			
	8.25m - Becomes slightly weathered, minor fractures, weak to moderately strong. Defects; closed aperture. Grainsize grading larger from Siltstone to Sandstone. 8.75-9.00m - Recovered as: sandy GRAVEL with some silt, dark greenish blue, homogenous.					MW SW HW	С				R	100	0			SWL 4.96m	
	Loose. Gravel; highly weathered. 9.00-9.45m - Recovered as: silty SAND, greenish yellow, homogenous. Soft to firm, low plasticity. Sand; fine to medium. END OF BOREHOLE AT 9.45m - Target Depth Reached	- ''29	60+	19// 22/38 for 75mm			EC				SP	т 93	0				
Voi								1	2/1	0/2022	Fini	Finished: 18/10/2022					
Sha Na	hared Hydro / Geotech borehole Vaiting on core box photos to calcuate RQD Jore loss placed at end of run by default						Logged by: C. Hall					Checked by: C. Parkes				- נומכא - נומכא	

BOREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

Waiting on core box photos to calcuate RQD Core loss placed at end of run by default 123mm OD Rotary Coring Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4


Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Middle of site, southwest of excavation Mt Cooee Landfill, Balclutha

Coordinates:	1350315 E 4873694 N	
Ref. Grid:	NZTM	Depth: 9.45 m
R.L.:	Approx. 21 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH6.1 BH6 Box 1: 0.0m to 4.5m



Photo BH6.2 BH6 Box 2: 4.5m to 6.8m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Waiting on core box photos to calcuate RQD Core loss placed at end of run by default 123mm OD Rotary Coring Started: 12/10/2022 Drilling Co.: McMillan Drilling Logged by: C. Hall Finished:18/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Middle of site, southwest of excavation Mt Cooee Landfill, Balclutha

Coordinates:	1350315 E 4873694 N	
Ref. Grid:	NZTM	Depth: 9.45 m
R.L.:	Approx. 21 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH6.3 BH6 Box 3: 6.8m to 9.45m

Notes: SPT hammer energy ratio 91% Shared Hydro / Geotech borehole Waiting on core box photos to calcuate RQD Core loss placed at end of run by default 123mm OD Rotary Coring Started:12/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:18/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



	Project: Mt Cooee Landf	ill - Developm	ent Plan		Coc	ordinates: 1350492 E	48	7380	0 N			
	Client: Clutha District C	ouncil (CDC)			Ref	Grid: NZTM				Dep	oth: 6	6 m
	Project No.: 6-CO082.00				R.L.	.: Approx. 25	i m			Incl	inatio	n: Vertical
	Location: Eastern most co Mt Cooee Landf	rner of site, 2 ill, Balclutha	0m south c	of railway	Dat	um: NZ Vertica	l Da	tum 2	2016			
			TESTS		97		- (_	DRILL		z
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m) GRAPHIC LOG	SPT 'N' VALUE	SHEAR VALUE ROCK STRENGT ROCK		DEFECTS / NOTES es / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%) DRILLING	METHOD CASING	BASE OF HOLE & WATER LEVEI	INSTALLATIO DETAILS
TS	TOPSOIL.					0.20-6.00m -						
	with orange mottle, fine fabric SANDSTONE. Weak to moderately strong. Recovered as: gravely COBBLES with some sand. Cobbles and gravel; angular. Gravel; medium, subrounded. 0.20-0.70m - Coarse to fine gravel, sandy silty matrix inferred fines washed away.	2 ⁴ 1		w MV	VC	Fractures opened by drilling.	RC	75	0			
	Highly weathered, light brown with orange mottle, highly fractured, fine fabric SANDSTONE. Strong. Recovered as: Gravelly COBBLES. Gravel and cobbles; angular. 1.00-2.00m - Sand/silt matrix inferred washed away. 1.55m - Becomes completely weathered.		60 31// 	6 SHV	v vc		RC	85	0			
ane	Slightly weathered light grey with some orange mottle, fractured, fine fabric SANDSTONE. Moderately strong. 2.70-2.90m - Moderately fractured same			MS SW	v VC	2.40m - J, 40°	RC	100	30	rea nom. dia. core)		
Terra	materials as above, rootlets present. 2.90-3.20m - Recovered as: silty SAND, brownish orange. Loosely packed, dry to moist,					2.90-3.00m - Core broken during removal			_	ary cor 35 mm		
Caples	low plasticity. Moderately weathered dark grey with light brown and orange mottle, fractured, interbedded SANDSTONE and SILTSTONE. Sst = strong, siltst = weak. 3.60-4.05m - Becomes moderately thickly bedded and more mudstone dominant.			w	v vc	from catcher. Core inferred to be baked during drilling.	RC	100	10	2 size wireline (8		
	4.05-4.20m - Recovered as: medium to fine gravel with some silt and sand, greenish grey. Loosely packed, moist. Silt, low plasticity.// Slightly weathered dark grey with orange mottle, fractured, indistinctly bedded SILTSTONE. Moderately strong. 4.30-4.70m - Discontinuities: extremely closely			MS SM	v vc	4.00-4.20m - Core broken during removal from catcher.				Ĩ		
	4.90-5.20m - Discontinuities: becomes thinly bedded, thinly laminated, sub-horiztonal planar bedding. 5.20-5.40m - Orange staining increasing. 5.40-5.55m - Minor orange mottle. Core loss.			w MV	V Jade	50 5.30m - J, 60° 5.31m - J, 40°	RC	80	0		SWL	
										_	5.05m	$\circ \bigcirc \bigcirc \circ$
	END OF BORCHOLE AT om - rarger Depth Reached	187 										
Not	es:			Starte	ed: 1/	11/2022	Finis	hed:	1	/11/2	2022	_
SP1 Geo	hammer energy ratio 91% technical borehole			Drillin	ng Co.: M	cMillan Drilling	Drilliı	ng Rig	<i>y:</i> ⊢	lanjir	n D&E	8-8D - track
Cor	e loss placed at end of run by default			Logg	ed by: N	. Ahern	Chec	ked k	y: C). Pa	rkes	

Core loss placed at end of run by default 123mm OD Rotary Coring



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern most corner of site, 20m south of railway Mt Cooee Landfill, Balclutha

Coordinates:	1350492 E 4873800 N	
Ref. Grid:	NZTM	Depth: 6 m
R.L.:	Approx. 25 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH7.1 BH7 Box 1: 0.0m to 3.0m



Photo BH7.2 BH7 Box 2: 3.0m to 6.0m

Notes: SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring Started: 1/11/2022 Drilling Co.: McMillan Drilling Logged by: N. Ahern Finished:1/11/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



		Project:Mt Cooee LandfClient:Clutha District CProject No.:6-CO082.00Location:Eastern area of Mt Cooee Landf	ill - De ouncil site, 80	velopm (CDC) Om nort	ent l	Plan BH06				Coord Ref. (R.L.: Datur	dinates: 1350323 E Grid: NZTM Approx. 16 m: NZ Vertica	48 m I Da	737 tum	68 20	N / 16	Dept nclir	h: 4 nation	.3 m c Vertical
GEOLOGY	CLCLCC I	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP degrees	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD		BASE OF HOLE D & WATER LEVEL	INSTALLATION DETAILS
	_	Moderately weathered dark grey to greenish grey with white specks, highly fractured SANDSTONE. Weak. Recovered as: coarse to fine gravel, with some sand. Gravel; subangular. Sand; coarse. 0.20-0.40m - Becomes completely weathered. Slightly weathered greenish grey with white specks, coarse grained, veined, indistinctly bedded SANDSTONE. Weak to moderately strong.					w	м₩	EC		Lab: 0.0 - 2.8m UCS testing. 0.40m - Vein, N	RC	100	0				
Canles Terrane		 1.25-1.50m - Crushed zone. Recovered as: coarse to fine GRAVEL with minor sand. Gravel; angular. Sand; coarse. 1.50m - Becomes light greenish grey and coarse-grained. 2.50-4.30m - Crushed zone. Recovered as: COBBLES with some gravel and minor silt and 					VW MS	sw	C W	Vein ⁸ Vein75	1.25m - CZ 1.50m - Vein, 80°, MW 2.00m - Vein, 75°, N 2.50m - CZ	RC	95	60	Rotary cored	reline (85 mm nom. dia. core)		Grout
co.		Sand. Cobbles and gravel; subangular, strong. Sand, Cobbles and gravel; subangular, strong. 2,70-2.85m - Becomes moderately weathered. Very weak. Recovered as: COBBLES with some gravel and sand. Cobbles and gravel; subangular. Core loss. Moderately weathered greenish grey with minor white specks, coarse grained highly fractured, indistinctly bedded SAINDSTONE. Very weak. Recovered as: COBBLES with some gravel and sand. Cobbles and gravel; subangular.					vw	нw	vc		3.05m - Vein, VN 3.10-4.10m - Highly factured insitu rock. Disturbed on removal from core catcher.	RC	90	53		PQ size wi	SWL	
OREHOLE SOIL/ROCK LOG A4 - WSP_MT COOEE BOREHOLE LOGS - V0.3.GPJ_WSP-OPUS2019_VER11X.GDT_30/		END OF BOREHOLE AT 4.3m - Target Depth Reached																
M G El C 12	lote eoi lev ore 23r	es: technical borehole ation is estimated from Google Earth e loss placed at end of run by default nm OD Rotary Coring	16	1	· I		St Di Lo	tarte rilling ogge	d: g Co d by	3/1 ⁻ .: McI :: N. /	1/2022 Millan Drilling Ahern	Finis Drillii Cheo	hed: ng R :ked	ig: by:	3/1 Ha C.	1/20 njin Parl	D22 D&B kes	-8D - tracł



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern area of site, 80m north of BH06 Mt Cooee Landfill, Balclutha

Coordinates:	1350323 E 4873768 N	
Ref. Grid:	NZTM	Depth: 4.3 m
R.L.:	Approx. 16 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH8.1 BH8 Box 1: 0.0m to 2.1m



Photo BH8.2 BH8 Box 2: 2.1m to 4.3m

Notes: Geotechnical borehole Elevation is estimated from Google Earth Core loss placed at end of run by default 123mm OD Rotary Coring Started: 3/11/2022 Drilling Co.: McMillan Drilling Logged by: N. Ahern Finished:3/11/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Yogou Main DESCRIPTION (DETAIL DESCRIPTION (DETAIL DESCRIPTION) Imply black Impl	0 RQD (%)	METHON CASING CASING BASE OF HOLE & WATER LEVEI INSTALLATIO DETAILS	
egg Sightly weathered, dark grey with vellowy while weathered, dark grey with vellowy while sightly weathered, dark grey with vellowy while sign and a sit. Core loss. Sightly weathered, dark grey with vellowy while end sign of the si	0		
egged Silghtly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and Sil TSTONE. As above. Core loss.	0		ÿ
HW to CW interbedded SANDSTONE and SILTSTONE As above. Image: Core loss. Image: Core loss. <t< td=""><td>0</td><td></td><td>$\langle \Delta \rangle$</td></t<>	0		$\langle \Delta \rangle$
But TSTONE. As above. Core loss. Slightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and Silt TSTONE. As above. Core loss. Slightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and Silt TSTONE. As above.			
Bightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and SILTSTONE. Moderately strong to strong. Bedding is thinky laminated, undulating smooth, very narrow to closed, fine grained. Veining is stepped. 4 500 00 5.10-5.25m - Broken RC 100 50 5.10-5.25m - Broken RC 100 50 5.10-5.25m - Broken RC 100 50	0	(au)	
Slightly weathered, dark grey with yellowy white veins, interbedded SANDSTONE and SILTSTONE. Moderately strong to strong. Bedding is thinly laminated, undulating smooth, very narrow to closed, fine grained. Veining is stepped. 4 604 70m Completely weathered Becovered	0 Rotary corred	Rotary corred 2 size wireline (85 mm nom. da.	Grout
SILTSTONE. Moderately strong to strong. Bedding is thinly laminated, undulating smooth, very narrow to closed, fine grained. Veining is stepped. 4 50 4 70m Completely weathered. Recovered			X
as: sity SAND with minor gravel and cobbles, dark grey. Moist. Sand; coarse to medium. Gravel; fine to coarse, subangular. Sit;	50	SWL 1.70m	
Single Sector Se	0	SWI	
Core loss.		0.00m	
Notes: Started: 2/11/2022 Finished:	3/	3/11/2022	
SPT hammer energy ratio 91% Drilling Co.: McMillan Drilling Drilling Rig: Geotechnical borehole Logged by: N Abern Checked by:	g: H	Hanjin D&B-8D - ti C. Parkes	rack

Elevation is estimated from Google Earth Core loss placed at end of run by default 123mm OD Rotary Coring

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern area of site, middle of excavation Mt Cooee Landfill, Balclutha

Coordinates:	1350377 E 4873747 N	
Ref. Grid:	NZTM	Depth: 6.9 m
R.L.:	Approx. 20 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH9.1 BH9 Box 1: 0.0m to 5.5m



Photo BH9.2 BH9 Box 2: 5.5m to 6.9m

Notes: SPT hammer energy ratio 91% Geotechnical borehole Elevation is estimated from Google Earth Core loss placed at end of run by default 123mm OD Rotary Coring Started:2/11/2022Drilling Co.:McMillan DrillingLogged by:N. Ahern

Finished:3/11/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Borehole No. BH10

	Project: Mt Cooee Landfi Client: Clutha District Co	ll - Dev ouncil (/elopm (CDC)	ent	Plan				Coord Ref. (dinates: 1350458 E Grid: NZTM	48	737	14	N L	Dept	h: 1	0 m
	Project No.: 6-CO082.00	·	()						R.L.:	Approx. 26	m			I	nclir	nation	: Vertical
	Location: Eastern edge of	site, 20)m fron	n bo	oundary				Datur	n: NZ Vertica	l Da	tum	201	16			
		II, Baic	lutha		TESTS	1							-		211 1 1	NG	
				ш I	ш	GTH					<u> </u>					ᆈᆐ	NO
GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m) DEPTH (m)	GRAPHIC LOO	SPT 'N' VALUI	SPT BLOW COUNTS OR SHEAR VALU	ROCK STREN	ROCK WEATHERING	ROCK DEFECT SPA(DEFECT DIP degrees 9	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPI	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOI & WATER LEV	DETALLAT
TS	TOPSOIL with grass and rootlets.			i													mL)
Ē	Clayey SILT with trace gravel, light brown with black specks, homogenous. Firm to stiff, moist, low plasticity. 0.65m - Becomes brownish orange and firm. Completely weathered brownish orange highly		× × - × ×								RC	100	0				nk pipe (1.0
	Fractured, fine fabric SANDSTONE. Extremely weak. Recovered as: SILT with some clay and trace gravel, homogenous. Firm, moist, low plasticity. Minor rootlets present. Gravel corestones are	- 1-		 22	6// 5/5/6/6						SPT	100	0				50 mm bla
	very weak. 1.42-2.75m - Remoulds to: clayey SAND with minor silt and gravel, orangish brown, homogenous. Moist, low plasticity. Gravel; fine to coarse, HW - CW Sandstone, very weak.	240					cw				RC	100	0				
	Sand; medium to coarse, angular to subangular. Fines; Soft.	2		57 	13// 10/15/14/18	EW		EC			SPT	100	0				
	2.45-2.75m - Trace rootlets. Grading to highly weathered, dark brown with orange weathering and white specks, fractured, the Geoder Science Tobus Fectore										RC	100	0				
	International and the second s			60+ 	21// 17/20/23 for 70mm						SPT	100	0				
	Recover as: Sandy GRAVEL with some cobbles and minor silt. Low plasticity. Gravel; fine to medium, angular to subangular. Sand; fine to coarse, angular to subangular.	224				vw	HW				RC	100	0			SWL nilm	
	Moderately weathered, orangish brown fractured		· · · · · · · · · · · · · · · · · · ·	 57 	18// 12/12/16/17						SPT	100	0		a. core)		
0	SANDSTONE: Weak. Recovered as: gravelly COBBLES with some sand. Cobbles and gravel; fine to coarse, cobbles max 100mm, subangular. Sand; medium to coarse, rounded.				27//	w	MW	VC			RC	100	0	/ cored	mm nom. d		m L)
s Terrane	Slightly weathered, orangish brown with oxidised defects, fractured SANDSTONE. Moderately strong. Discontinuities; very closely spaced closed joints, cross-cutting and sub-vertical, rouch be smach placed.		.	60+ 	51/9 for 5mm	MS	sw			5.30m - J, 70° 5.40m - L 60°	SPT	100	0	Rotary	reline (85		0.0 r
Caples	5.60-5.70m - Highly fractured zone. Weak.	20.				W MS	HW SW	EC VC	.160	0.4011 - 0, 00	RC	100	0		⊃Q size wi		9/03/2023
	6.10-6.15m - Crushed zone. Recovered as: sandy medium GRAVEL with minor silt. Subrounded.					VW	HW	EC VC	JZ8	6.00m - J, 60° 6.10m - CZ 6.11m - J, 70° 6.15m - J, 70°	RC	100	0		-		20 u
	7.20-7.90m - Highly fractured zone.	- 7- - 7- 				MS	SW	С	J5070 J50 J40 J30 J30	6.60-6.70m - Core broken during removal from catcher. 6.85m - J, 50° 6.85m - J, 70° 6.95m - J, 50° 7.20m - J, MN, silica coated 7.30m - J, 40°	RC	100	8				
	7.90-8.50m - Recovered as: COBBLES with some gravel and sand. Cobbles and gravel; angular to subangular, weak to very weak. 8.20-8.30m - Well-rounded coarse sized gravel.	¹⁸ 8 	, , ,			w	MW	VC		7.50m - 3, 30 7.75m - 3, 30° 7.90-8.80m - Disturbed on removal from core catcher.	RC	75	0				
	8.60-8.80m - Crushed zone, Recovered as: GRAVEL with some sand and minor silt. Gravel; fine to medium, subangular. Core loss.					EW	CW	EC		8.60m - CZ							
	Slightly weathered, light and dark grey fractured and indistinctly bedded SILTSTONE. Moderately strong.					MS	мw	VC	J45	9.00m - B, PL, silica coated	RC	95	0				
	9:50-9:60m - Crushed zone. Recovered as: GRAVEL with some sand. Gravel and sand; fine to coarse, subangular. 9:60-9.85m - Dark grey. Green and white vein					S	SW	С		9.50m - 62 9.51m - J, 45° 9.70m - B, ST, limonite stained			v				
No	tes:					St	arteo	d:	28/	10/2022	Finis	hed:		31/	10/2	2022	

Drilling Co.: McMillan Drilling

Logged by: C. Hall

Notes:

BOREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

Drilling Rig: Hanjin D&B-8D - track



	Project: Mt Cooee Landf	ill - De	velopm	ent	Plan				С	oordinates:	1350458 E	48	737	14 I	N			
	Client: Clutha District C	ouncil	(CDC)						Re	ef. Grid:	NZTM				Ľ	Dept	h: 1	0 m
	Project No.: 6-CO082.00								R.	L.:	Approx. 26	m			lı	nclin	ation	: Vertical
	Location: Eastern edge of	site, 2	0m fror	n bo	oundary				Da	atum:	NZ Vertica	Dat	tum	201	6			
	Mt Cooee Landf	ill, Balo	clutha											_				
					TESTS	E		DNG					CORI	E	DR		NG	z
۲			LOG	LUE		RENG	NG N	PACI	DEF	ЕСТ		ΥPE					HOLE	ATIC
POG		E H	비	N. <₽		K STF	L HE	K CT S	D			PLE 1	(%)	(%)	Q C R	g	TER	AILS
GEO	/ DETAIL DESCRIPTION	R.L. (DEP1	GRAI	SPT -	SPTI	ROCI	WEA	DEFE	deg	rees / OT	HER TESTS	SAMI	TCR	Rap	DRIL	CASI	BASE & W∕	DET
	Core loss	_																
	END OF BOREHOLE AT 10m - Target Depth Reached	=																
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Not	tes:		-			Si	tarte	d:		28/10/202	2	- inis	hed:		31/	10/2	2022	
SPT	「hammer energy ratio 91% technical borebole					D	rilling	g Co	.: I	McMillan I	Drilling I	Drillir	ng R	ig:	Har	njin	D&B	-8D - track

Logged by: C. Hall

SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement

BOREHOLE SOIL/ROCK LOG A4 - WSP MT COOEE BOREHOLE LOGS - V0.3.GPJ WSP-OPUS2019_VER11X.GDT 30/3/23

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern edge of site, 20m from boundary Mt Cooee Landfill, Balclutha

Coordinates:	1350458 E 4873714 N	
Ref. Grid:	NZTM	Depth: 10 m
R.L.:	Approx. 26 m	Inclination: Vertical
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH10.1 BH10 Box 1: 0.0m to 2.5m



Photo BH10.2 BH10 Box 2: 2.5m to 5.0m

Started:

28/10/2022

Drilling Co.: McMillan Drilling

Logged by: C. Hall

Notes: SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols. Scale 1:50 @ A4

BOREHOLE SOIL/ROCK LOG A4 - WSP_MT COOEE BOREHOLE LOGS - V0.3.GPJ_WSP-OPUS2019_VER11X.GDT_30/3/23

Finished:31/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes



Project:	Mt Cooee Landfill - Development Plan
Client:	Clutha District Council (CDC)
Project No.:	6-CO082.00
Location:	Eastern edge of site, 20m from boundary Mt Cooee Landfill, Balclutha

Coordinates:	1350458 E 4873714 N	
Ref. Grid:	NZTM	Depth: 10 m
R.L.:	Approx. 26 m	Inclination: Vertica
Datum:	NZ Vertical Datum 2016	

PHOTOGRAPHS



Photo BH10.3 BH10 Box 3: 5.0m to 7.2m



Photo BH10.4 BH10 Box 4: 7.2m to 10.0m

Notes: SPT hammer energy ratio 91% Geotechnical borehole Core loss placed at end of run by default 123mm OD Rotary Coring SWL 'nilm' indicates dry well measurement Started:28/10/2022Drilling Co.:McMillan DrillingLogged by:C. Hall

Finished:31/10/2022Drilling Rig:Hanjin D&B-8D - trackChecked by:C. Parkes





UNCONFINED COMPRESSIVE STRESS ON ROCK

Material Investigation
Mt Cooee Landfill
Clutha District Council
Scott Kvick
Scott Kvick
13 December 2022
Rotary Core Drill
Damp as received
Sandstone
BH08 0.6-0.8m

Project No:	6-CO082.00/231A
Lab ref No:	CH9589/3
Client Ref:	Scott Kvick

Sample ID	CH9589/3	1	
Bulk Density t/m ³	2.39		
Water Content %	8.3		
Dry Density t/m ³	2.20		
Max Stress kPa	3115.01		
Strain at Failure %	0.44		
3500	L/C	D CORR STRESS (kPa)	
3000			
2500			
2000			
± 1500			
1000			
500 -			
0			
0.00 0.	.05 0.10 0.15	0.20 0.25 0.30 0.35 0.40 0.45	0.50
		Strain (%)	

Test Methods

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Uniaxial Compression Test : International Society for Rock Mechanics, Part 1 Suggested Method for Determination of the Uniaxial Compres Strength of Rock Materials. (Not IANZ Accredited)

Water Content : NZS 44

IANZ Approved Signatory :

NZS 4402:1986 Test 2.1

Str

Designation : Date : *Laboratory Manager* 11 January 2023



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

CLF 044 (1/9/22)

WSP New Zealand Limited Christchurch Laboratory Quality Management Systems Certified to ISO 9001 52C Hayton Rd, Wigram PO Box 1482, Christchurch Mail Centre, Christchurch 8140, New Zealand Page 1 of 1

UNCONFINED COMPRESSIVE STRESS

	ON ROCK
Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Client ref :	Scott Kvick
Sampled by :	Scott Kvick
Date Sampled:	13 December 2022
Sampling method :	Rotary Core Drill
Sample condition :	Damp as received
Sample description :	Sandstone
Source:	BH08 2.1-2.4m

Project No:	6-CO082.00/231A
Lab ref No:	СН9589/4
Client Ref:	Scott Kvick

Sampl	le ID	CH9589	/4				
Bulk I	Density t/m ³	2.42					
Water Content %		6.6					
Dry D	ensity t/m ³	2.27					
Max S	stress kPa	6659.64	1				
Strain	at Failure %	0.47					
	8000		L/D COF	R STRESS (kPa	a)		
	7000						
	6000						
	5000						
	4000						
кРа	4000						
	3000						+ + -
	2000						
	1000						
	0	0.10			0.40		
	0.00	0.10	0.20	0.30	0.40	0.50	0.60
				Strain (%)			

Test Methods

This report may only be reproduced in full

Uniaxial Compression Test : International Society for Rock Mechanics, Part 1 Suggested Method for Determination of the Uniaxial Compres Strength of Rock Materials. (Not IANZ Accredited)

Water Content : NZS 4402:1986 Test 2.1

IANZ Approved Signatory : Sin Laboratory Manager

11 January 2023



Test results indicated as not accredited are outside the scope of the laboratory's accreditation

CLF 044 (1/9/22)

Designation :

Date :

WSP New Zealand Limited Christchurch Laboratory Quality Management Systems Certified to ISO 9001

52C Hayton Rd, Wigram PO Box 1482, Christchurch Mail Centre, Christchurch 8140, New Zealand

Page 1 of 1

UNCONFINED COMPRESSIVE STRESS ON ROCK

- Windowski Andrewski w statistick i statistick	OIT ALO OAL
Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Client ref :	Scott Kvick
Sampled by :	Scott Kvick
Date Sampled:	13 December 2022
Sampling method :	Rotary Core Drill
Sample condition :	Damp as received
Sample description :	Sandstone
Source:	BH10 5.6-5.9m

Project No:	6-CO082.00/231A
Lab ref No:	CH9589/5
Client Ref:	Scott Kvick

Sample ID	CH9589)/5					
Bulk Density t/m ³	2.39						
Water Content %	7.8						
Dry Density t/m³	2.22						
Max Stress kPa	1994.6	0					
Strain at Failure %	0.82						
2500		L/D	CORR STF	RESS (kPa)	 	
2000							
2000							
1500 -							
1000							
0							
0.00	0.20	0.40		0.60	0.80	1.00	1.20
			Stra	ain (%)			

Test Methods

Uniaxial Compression Test : International Society for Rock Mechanics, Part 1 Suggested Method for Determination of the Uniaxial Compres Strength of Rock Materials. (Not IANZ Accredited)

Water Content : NZS 4402:1986 Test 2.1

IANZ Approved Signatory :Designation :Lab.Date :11 J

y: Sta Laboratory Manager 11 January 2023



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CLF 044 (1/9/22)

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PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) **TEST REPORT**

Project :		Material Inv	estigation/						
Location :		Mt Cooee L	andfill						
Client :		Clutha Dist	rict Council						
Client/Samp	le Ref:	Scott Kvick							
Contractor :		WSP Dune	din						
Borehole No):	BH01	Depth:	2.0-2.45m	metres				
Sampled by	:	Scott Kvick							
Date receive	ed :	15 Decembe	er 2022						
Sampling m	ethod :	NZS 4402: 1	986 (Fine)						
Sample cond	dition :	Damp as re	ceived				Project No:	6-CO082.00/2	31A
Sample desc	cription :	Sandy SILT	with trace c	lav			Lab Ref No:	CH9589/1	
Solid Particle	e Density (t/r	m ³).	2.68	Assumed			Client Ref:	Scott Kvick	
Water Conte	ent (as receiv	ved):	29.8	%					
		Sieve Ar	alvsis		10000		Hvdromet	er Analysis	
Sieve Size	Passing	Sieve Size	Passing	Sieve Size	Passing	Particle Size	Passing	Particle Size	
(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	
63.0		4.75		0.300	100	0.0351	55	0.0073	
37.5		2.36	100	0.212	100	0.0277	48	0.0052	
19.0		1.18	100	0.150	99	0.0219	39	0.0038	
13.2		0.600	100	0.075	83	0.0168	32	0.0029	
9.5		0.425	100	0.063	71	0.0132	23	0.0016	
Note:	"" denotes sie	eve not used and	d/or hydromet	er analysis not	tested	0.0099	16		
				Sieve Aperl	ure Size (m	m)			
			.063	150 212 300	425	36	.5	9.0	3.0
100							4 0 7		
90				\times					
80									
8 70									
u eo									
A G									
50									
ອ 40									
B 30									
å 20									

Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)

0.010

medium

SILT

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

CCREDITED

All information supplied by Client

fine

10 000

medium

GRAVEL

Date Tested:

Test Methods

10 0

0.001

CLAY

19 December 2022

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Particle Size (mm)

medium

SAND

0.100

fine

coarse

de

10 January 2023

Laboratory Manager

Date Reported:

10 January 2023

1 000

coarse

Notes

fine

IANZ Approved Signatory Designation :

Date :

PF-LAB-100 (11/07/2020)

WSP

Christchurch (Hayton Rd) Quality Management Systems Certified to ISO 9001

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accredited are outside the scope of the laboratory's accreditation

Test results indicated as not

coarse

100.000 very coarse

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PLASTICITY INDEX FOR AGGREGATES TEST REPORT

Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Contractor :	WSP Dunedin
Sampled by :	Scott Kvick
Date sampled :	13 December 2022
Sampling method :	NZS 4402: 1986 (Fine)
Sample description :	Sandy SILT with trace clay
Sample condition :	As Received
Source :	BH01 2.0-2.45m

Project No :	6-CO082.00/231A
Lab Ref No :	CH9589/1
Client Ref No :	Scott Kvick

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	Test Results
Client Ref No :	Scott Kvick
Cone penetration limit :	40
Plastic limit :	Unable to Roll Threads
Plasticity index :	NP
Sample fraction :	Fraction passing 425µm test sieve
As received water content :	29.8
Test Methods	
Water Content	NZS 4407 : 2015 Test 3.1
Cone Penetration	NZS 4407 : 2015 : Test 3.2
Plastic Limit	NZS 4407 : 2015 : Test 3.3

Date tested : 21 December 2022 Date reported : 10 January 2023



PF-LAB-053 (09/06/2021)

Date :

Plasticity Index

Designation : Laboratory Manager 10 January 2023

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81A

NZS 4407 : 2015 : Test 3.4



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WSP Christchurch (Hayton Rd) Quality Management Systems Certified to ISO 9001

52C Hayton Rd PO Box 1482, Christchurch Mail Centre, 8140, Christchurch, New Zealand

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :		Material In	vestigation						
Location :		Mt Cooee	_andfill						
Client :		Clutha Dis	trict Counci						
Client/Samp	Client/Sample Ref : Scott Kvick								
Contractor :		WSP Dune	edin						
Borehole No):	BH01	Depth	: 5.0-5.45 r	netres				
Sampled by	:	Scott Kvick	< compared with the second sec						
Date receive	ed :	15 Decemb	er 2022						
Sampling m	ethod :	NZS 4402:	1986 (Fine)						
Sample cond	dition :	Damp as re	eceived				Project No:	6-CO082.00/2	31A
Sample desc	cription :	SILT with s	ome clay ar	nd minor sa	nd		Lab Ref No:	CH9589/2	
Solid Particle	e Density (t/r	m^{3}):	2.68	Assumed			Client Ref:	Scott Kvick	
Water Conte	ent (as receiv	ved):	34.2	%					
		Sieve A	nalvsis				Hydromete	er Analysis	
Sieve Size	Passing	Sieve Size	Passing	Sieve Size	Passing	Particle Size	Passing	Particle Size	Passing
(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)
63.0		4.75		0.300	99	0.0387	81	0.0066	38
37.5		2.36	100	0.212	98	0.0284	77	0.0049	31
19.0		1.18	100	0.150	97	0.0207	73	0.0035	26
13.2		0.600	99	0.075	92	0.0153	67	0.0027	23
9.5 Note:	"" denotes sie	ve not used an	d/or hydrome	ter analysis no	90 ot tested	0.0089	48	0.0015	19
				0: 1		\ \		1	
			(C) (C)	Sieve Ape	ture Size (m	nm)			
100			0.06:	0.150	0.42	1.18	4.75 9.5 13.2	37.5	63.U
90									
80									
) 70 sse									
Ë 60 									
50 L									
e 40		AII							
30 E									
d 20									
10									
0				Destial					
0.001		0.010	(0.100 Partici	e Size (mm) 1.0	000	10.000		100.000
CLAY	fine	medium	coarse	fine n	nedium co	barse fir	ne mediur	m coarse	coarse
		SILT		5	SAND		GRAVE	EL	
						Ter .			
Particle Size Apply	sis: N75 4402-100	6: Test 2.9 / JMA	hed Grading 8	-wdromotor Ma	thad)	Notes			
Farticle Size Analy	515. INZ 3 44UZ.198	00. TESL 2.0.4 (VVB	sileo orading & l	nyorometer Me	(100)	All information	supplied by Clien	t	
				Sampling is i	not covered by	/ IANZ Accredita	tion. Results ar	poly only to sam	nple tested
Date Tested		19 Decemb	≥r 2022	This report m	av only be rer	produced in full			1.12 1001001

Designation :

Date :

an

10 January 2023

Laboratory Manager

Date Reported:

10 January 2023





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PF-LAB-100 (11/07/2020)

IANZ Approved Signatory

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PLASTICITY INDEX FOR SOILS TEST REPORT

Project :	Material Investigation
Location :	Mt Cooee Landfill
Client :	Clutha District Council
Contractor :	WSP Dunedin
Sampled by :	Scott Kvick
Date sampled :	13 December 2022
Sampling method :	NZS 4402: 1986 (Fine)
Sample description :	SILT with some clay and minor sand
Sample condition :	As Received
Sample reference:	BH01 5.0-5.45m
Sample depth:	5.0-5.45m

Project No :	6-CO082.00/231A
Lab Ref No :	CH9589/2
Client Ref No :	Scott Kvick

	Test Results	
Liquid Limit :	39	
Plastic Limit :	25	
Plasticity Index :	14	
Natural Water Content :	34.2	

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Fraction passing 425µm test sieve
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	,
Water Content	NZS 4402 : 1986, Test 2.1	All information supplied by Client

Date tested : 21 December 2022 Date reported : 10 January 2023

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Designation : Laboratory Manager Date :

PF-LAB-101 (14/10/2022)

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10 January 2023

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