FACTUAL REPORT OF GEOTECHNICAL INVESTIGATIONS

Port Otago – Project Next Generation

Factual Report of Geotechnical Investigations

Port Otago – Project Next Generation

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Executive Summary

The following report outlines the factual data related to the geotechnical investigation completed for the dredging portion of Port Otago Ltd's "Next Generation" infrastructure development. Geotechnical investigation included subsurface investigation and laboratory testing. The two main objectives of the proposed geotechnical site investigation and laboratory testing were to (1) achieve a detailed description and characterisation of the materials to be dredged, (2) determine whether or not the sediment will be contaminated.

The subsurface investigation consisted of drilling at a total of 43 locations within the existing channel from Port Chalmers past Taiaroa Head. Investigations largely encountered sand, silt, and clay as well as basalt rock at Acheron Head and Rocky Point.

Laboratory testing was completed to determine both the soil and rock mechanical and chemical properties of the sediments. Mechanical testing involved particle size analysis, atterberg limits, water content, shear strength (cohesive), solid density, and unconfined compressive strength (rock). Chemical testing included a screen level analysis for heavy metals, inorganic compounds PCB, PAH and TPH as well as the inorganic compounds cyanide and total nitrogen.

With regard to chemical testing, none of the parameters analysed exceeded the guideline values used and based on these results, the materials to be dredged are not contaminated.

The field investigation and mechanical laboratory testing allowed us to characterise the materials into 4 main units that include (1) SAND (2) clayey SILT (3) silty CLAY and (4) ROCK.

The sand unit was most commonly encountered in the channel sections near the entrance to the harbour and beyond, namely from the Harington Bend to the Entrance sections. Sand was generally described as loosely packed in cores and had a water content between ~ 20 – 30%.

The clayey silt was the most commonly encountered sediment type and was most prominent from the Swinging Basin to the Cross Channel sections. This unit's behaviour is dominated by a high silt content. These sediments were generally soft to very soft and non-plastic. Water content was between ~ 30 – 40% and had a measured shear strength between 14 – 24kPa.

Silty clay was the least common sediment type encountered and was most prominent in the area around Acheron Head. This unit had a relatively high clay content and sediments were generally soft to very soft, had a high plasticity and water content ~ 60%. The shear strength of these materials was measured to be between 12 – 22kPa.

Rock was the least common unit and was only encountered at Rocky Point and Acheron Head. This unit consisted of completely weathered basalt (cobbles and boulders) near surface and moderately weathered basalt at depth. A third borehole (B5) off Pulling Point encountered basalt cobbles but the borehole was terminated due to bad weather. It is likely that bedrock is also present at Pulling Point. Rock strength ranged from extremely weak to weak within the upper 2 to 4m and became moderately strong to very strong below this. Laboratory testing returned uniaxial rock strength values of 101 and 62MPa for B3 and B4, respectively.

Contents

1 Introduction and Scope of Work

The following report outlines the factual data related to the geotechnical investigation completed for the dredging portion of Port Otago Ltd's "Next Generation" infrastructure development. The purpose of this development is to enable larger container vessels to be serviced at Port Chalmers. The project includes the provision of new plant and container handling equipment as well as the widening and deepening of the shipping channel. The channel is to be deepened along various sections from Port Chalmers past Taiaroa Head as shown in Figure 1 below as well as in Appendix A.

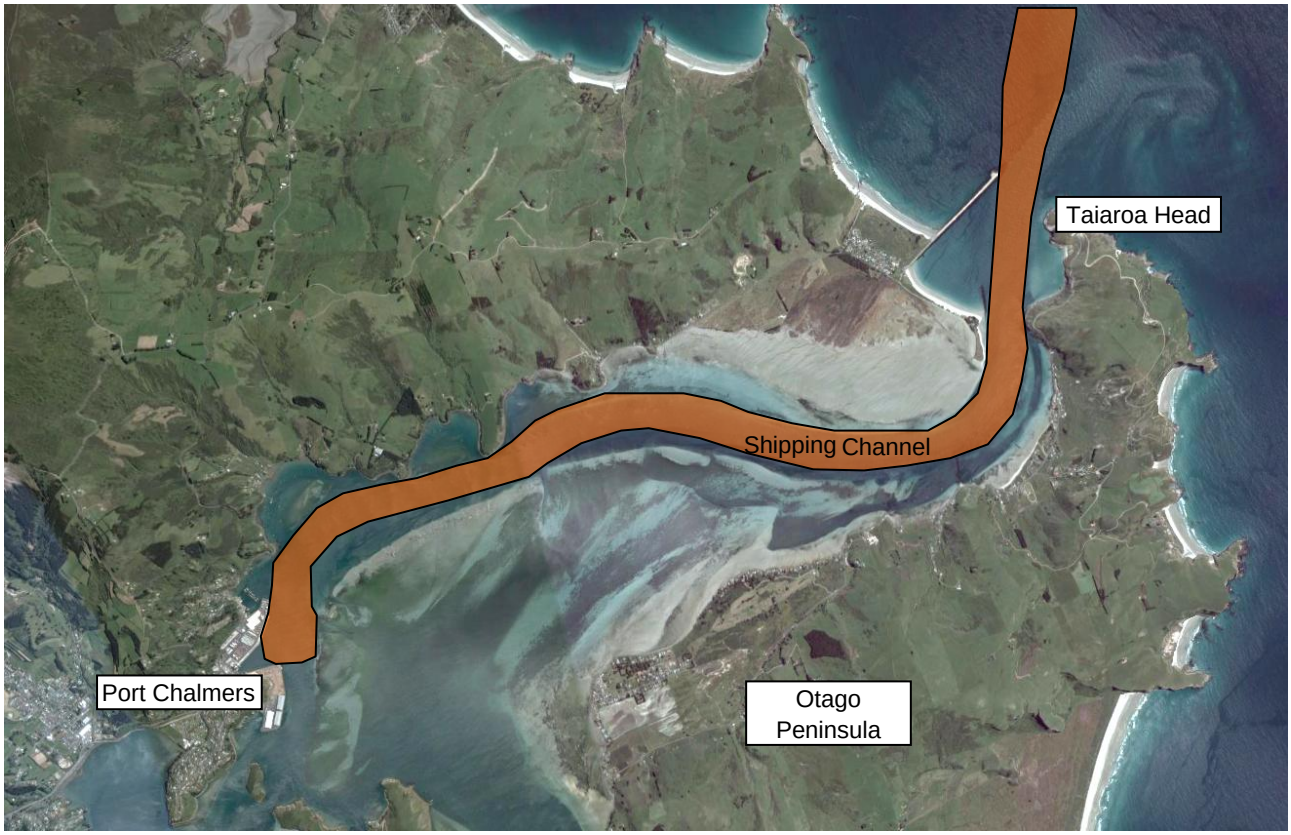


Figure 1 – Aerial photograph of the shipping channel.

The main objectives of the proposed geotechnical site investigation and laboratory testing were:

- to achieve a detailed description and characterisation of the material to be dredged
- to determine whether or not these materials will be contaminated.

In order to achieve these objectives subsurface investigation and laboratory testing were completed and the methodology and results of these investigations are outlined in this report.

2 Subsurface Investigation

The subsurface investigation consisted of using two different methods to extract the geological units for characterisation. The method depended on the materials that we expected to encounter and included:

- Vibrocoring - This method is particularly used for investigations for dredging works and involves vibrating a tube into soft sediments to obtain a fully cored sample. We were limited to a maximum core length of 3m which restricted the use of this method to locations within the existing channel. A total of 37 vibrocore holes were completed to an average depth of 2.7m with minimum and maximum depths of 0.65 and 3.16m, respectively.

- Rotary Borehole Drilling – This method was used in locations where materials of interest had a thickness greater than ~ 3m or where rock and more heavily consolidated materials were expected (eg. areas targeted for channel widening). A total of 6 rotary drilled boreholes were completed to an average depth of 8.6m with minimum and maximum depths of 2.5 and 12.1m, respectively.

Both methods were completed from a stable barge platform operated by Port Otago Ltd. Vibrocoring was completed by Quaternary Resources Ptl Ltd and rotary borehole drilling by Downer EDI Works Ltd. In total, investigations were completed at 43 locations along the sections targeted for deepening. These locations, along with their grid locations, are shown in Appendix A. Complete core logs and example photographs are presented in Appendix B.

A geological description based on logging of cores received from all 43 investigation locations is presented in Table 1. Results are summarised according to the channel sections that each hole was completed in. These channel sections are indicated in Appendix A.

Both, vibrocore and borehole drilling largely encountered sand and clayey silt with increasing plasticity being directly related to the quantity of clay present. The only boreholes that encountered bedrock were B3 and B4 at Rocky Point and Acheron Head, respectively. However, B5 at Pulling Point encountered a rounded basalt cobble at 2.4m but had to be terminated because of bad weather. It is therefore possible that bedrock could also be present at this point as well.

Table 1 – Overview of geological description of materials found in borehole grouped by channel section.

Section Name	Geological Description of Materials	Boreholes & Vibrocores in Section
Swinging Basin	Grey, sandy SILT and fine SAND. Silt is soft to very soft and non-plastic. Sand is loosely packed	B1, B2, VC1, VC1c, VC5, VC6, VC8
Deborah Bend with Rocky Point	SILT in the southern part close to Carey's Bay and silty CLAY closer to Acheron Head. Sediments soft to very soft and plastic where clay present. Completely to moderately weathered basalt in borehole 3 along the north side of the existing channel.	B3, VC9, VC10, VC12 - 14
Hamilton Bend with Acheron Head and Pulling Point	Clayey SILT with some sand, soft to very soft, non-plastic to slightly plastic. Silty CLAY, soft to very soft and plastic close to Acheron Head. Completely to moderately weathered basalt in boreholes 4 at Acheron Head. Basalt cobbles at Pulling Point	B4, B5, VC15, VC17, VC18, VC21, VC22
Taylors Bend	Clayey SILT at Dowling Bay end of section and sandy SILT at Waipuna Bay, soft to very Soft, plastic where clay content high.	VC23, VC26, VC27, VC29, VC32
Cross Channel	Clayey SILT, soft to very soft, slightly plastic sand content increasing toward eastern end of section.	VC34, VC36, VC39
Harington Bend	Fine SAND near Otakou changing to clayey SILT near Harrington Point and the Spit.	B6, VC41, VC42, VC44 - 46
Howletts	Fine SAND with some Silt near the eastern side around Pilot Beach.	VC47 - 50
Entrance	Fine SAND	VC54, VC56, VC57, VC59

3 Laboratory Testing

Laboratory testing was completed to determine the soil and rock mechanical properties of the sediments, as well as to determine the chemical contents in the sediments to be dredged. Mechanical testing was completed by the Opus Materials Testing Laboratory in Green Island, Dunedin. Chemical testing was completed by Hill's Laboratories in Hamilton. Complete laboratory tests results are presented in full in Appendix C. A summary of the type of tests and results are presented in the following sections.

3.1 Soil and Rock Mechanical Testing

The results of the mechanical testing completed at various boreholes and vibrocore holes is shown in Table 2. Testing included:

- Particle Size Analysis – Used to determine the distribution of such things as clay, silt and sand fractions in the various sediments sampled. Where sediments contained a substantial amount of fines an additional step using a hydrometer was required to separate the finer silt and clay fractions.
- Atterberg Limits – Used to describe the plasticity and liquid limits of sediments.
- Water Content – Although these sediments were all saturated, this value gives an indication of the water held within void spaces and thus gives an indication of porosity. In addition, for most types of clays and silts there are relationships between water content, shear strength and consistency. If these relationships have been established by a number of paired tests (eg. atterberg limits), then water content can be used as an indicator for shear strength and consistency.
- Unconfined Compressive Strength – Used to describe the strength of rock.
- Shear Vane – Used to test the strength of cohesive sediments.
- Solid Density – Used to describe weight and density for each of the three sediments encountered (silt, clay, sand).

Table 2 - Summary of Mechanical Testing Results for Port Otago's "Next Generation" Dredging Project

Sample (Depth in m below seabed)	Particle Size Distribution (%)			Water Content (%)	Atterberg Limits			Peak Shear Strength (kPa)		Solid Density (t/m^3)	Unconfined Compressive Strength (MPa)
	CLAY	SILT	SAND		Liquid Limit	Plastic Limit	Plasticity Index	Min	Max		
silty CLAY											
VC14 (0.8)	21	73	6	58.1	50	28	22	12	22	2.75	--
Clayey SILT											
VC1 (0.8)	12	60	28	38.1	--	--	--	--	--	--	--
VC8 (0.6)	12	78	10	35.3	37	NP	NA	14	24	--	--
VC12 (0.7)	13	73	14	38.1	--	--	--	--	--	2.76	--
VC23 (1.6)	19	69	12	42.4	--	--	--	--	--	--	--
VC45 (2.2)	18	74	8	42.5	--	--	--	--	--	--	--
VC46 (1.6)	--	--	--	37.6	42	NP	NA	--	--	--	--
VC49 (2.3)	10	50	40	31.3	--	--	--	--	--	--	--
SAND											
VC6 (0.6)	0	0	100	26.7	--	--	--	--	--	--	--
VC29 (2.15)	0	1	99	25.0	--	--	--	--	--	--	--
VC41 (2.0)	0	1	99	27.9	--	--	--	--	--	--	--
VC50 (1.6)	0	0	100	26.4	--	--	--	--	--	2.68	--
VC54 (1.8)	0	0	100	22.9	--	--	--	--	--	--	--
VC59 (1.4)	0	0	100	26.1	--	--	--	--	--	--	--
BASALT BEDROCK											
B3 (-14m below Chart Datum)	--	--	--	--	--	--	--	--	--	--	101.5
B4 (-12.75m below Chart Datum)	--	--	--	--	--	--	--	--	--	--	62.9

Notes:

-- indicates "no value" because this analysis was not completed for the sample

NP - indicates that the sample was "Non-Plastic"

NA - indicates a plastic index could not be calculated because the sample was non-plastic

3.2 Chemical Testing

Because dredged material will be removed from the shipping channel and disposed elsewhere, information regarding the presence or absence of contaminants within the dredged material is essential.

Samples were submitted from 5 different locations along the length of shipping channel where material is proposed to be dredged. These locations were selected to be representative samples of material to be dredged and included sites VC5, VC12, VC21, VC34 and VC47.

Samples were taken through the full depth of the material to be dredged and 3 composite or mixed samples were submitted from each location. The three composites included combining sediment from 0 - 500mm, 500 - 1000mm and 1000 - 1500mm depth below the existing seabed. The upper 0 - 500mm composite was analysed first and based on the results from this level, further testing of the deeper composite samples was deemed unnecessary.

The sampling, sample handling and preservation procedures for marine sediments were followed in accordance to the New Zealand Guidelines for Sea Disposal of Waste and the New Zealand Contaminated Sites Guidelines (1999).

Samples were analysed for the following parameters:

- **Heavy Metals and Metalloids** - As,Cd,Cr,Cu,Ni,Pb,Zn
- **Organic Compounds** – PCB, PAH, TPH
- **Inorganic Compounds** – CN, TN

The guideline values used for comparison are from the “Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000)” and are listed along with a summary of results in Table 3.

None of the parameters analysed exceeded the guideline values.

Table 3 - Summary of Chemical Testing for Port Otago's "Next Generation" Dredging Project

Parameter	Detection limit (mg/kg)	Guidelines (mg/kg) ANZECC[1]	Sample Concentrations (mg/kg)				
			VC5	VC12	VC21	VC34	VC47
Metals							
Arsenic	2	20	7.1	7.9	<2.0	<2.0	3.3
Cadmium	0.1	1.5	<0.10	<0.10	<0.10	<0.10	<0.10
Chromium (Total)	2	80	17	16	2.5	2.6	8.9
Copper	2	65	6.7	6	<2.0	<2.0	4.4
Lead	2	50	7.1	6.7	0.79	0.81	4.3
Nickel	0.4	21	11	10	2.2	2.1	7.2
Zinc	4	200	44	42	8.1	6.8	27
Organic Compounds							
PCB (Total)	0.02	0.023	<0.001	<0.001	<0.001	<0.001	<0.001
TPH (Total C7 - C36)	60	--	<60	<60	<60	<60	<60
PAH							
Anthracene	0.0020	0.085	0.002	<0.0020	<0.0020	<0.0020	<0.0020
Fluroanthene	0.0020	0.6	0.0021	<0.0020	<0.0020	0.002	<0.0020
Phenanthrene	0.0020	0.24	<0.0020	0.0025	<0.0020	<0.0020	0.0049
Inorganic Compounds							
Cyanide (Total)	0.1	--	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrogen (Total)	0.051	--	<0.051	<0.051	<0.051	<0.051	0.082

Notes:

- all concentrations are in mg/kg (ppm) unless otherwise stated

- nv indicates that a guideline value does not exist for the quoted reference
- only those PCB, TPH, and PAH compounds above detection limit are listed, otherwise only the total will be listed.

[1] Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000), low trigger value

4 Characterisation Summary

With regard to chemical testing, none of the parameters analysed exceeded the guideline values.

Based on the field investigation and mechanical laboratory testing the materials to be dredged during the widening and deepening of the shipping channel can be roughly characterised into 4 main units that include (1) SAND (2) clayey SILT (3) silty CLAY and (4) ROCK.

4.1 SAND

This unit was most commonly encountered in the channel sections near the entrance to the harbour and beyond, namely from the Harington Bend to the Entrance sections and in the eastern part of the Swinging Basin. Although sand is found in both of the other sediment types, grain size distribution curves for this sediment type were between 99 – 100% sand. In addition, the vast majority of this sand fell with the "fine" sand designation (0.06 – 2mm).

Sand was generally described as loosely packed in cores and has a water content between ~ 20 – 30%.

4.2 Clayey SILT

This unit was the most commonly encountered sediment type in the upper reaches of the harbour and was most prominent from the Swinging Basin right out to the Cross Channel. The unit is dominated by the silt grain size fraction and on average had a grain size distribution of 14% clay, 67% silt, and 19% sand.

These sediments were generally soft to very soft. Samples submitted for atterberg limits showed these sediments as non-plastic. Comparison with the silty clay unit shows the importance of clay content in plasticity. As mentioned above a slightly higher clay content can influence the material properties. Water content ranged between ~ 30 – 40% and a shear strength between 14 – 24kPa was measured.

4.3 Silty CLAY

This unit was the least common sediment type and was most prominent in the area around Acheron Head. The tested sample had a grain size distribution of 21% clay, 73% silt and 6% sand. Although the largest fraction is silt, the clay percentage influences material properties. When clay content rises it dominates material behaviour and therefore this unit has clay as its dominant fraction.

The sediments in this unit were generally soft to very soft with a high plasticity and high water content ~ 60%. The shear strength of these materials is estimated to be between 12 – 22kPa.

NOTE: Strength and density qualitative descriptions described above (eg. soft to very soft) are generalisations. It is possible that vibrocoring has resulted in a slight modification of the consistency and the denseness of the materials.

4.4 ROCK

This was the least common unit and was only encountered at Rocky Point and Acheron Head. This unit consisted of completely weathered basalt near surface and moderately weathered basalt at depth. Borehole B5 encountered basalt cobbles off Pulling Point but the borehole was terminated due to bad weather. It is likely that this unit is also present at Pulling Point. Rock strength ranged from extremely weak to weak within the upper 2 to 4m and became moderately strong to very strong below this. The spacing of defect or discontinuities ranged from closely spaced to very closely spaced. Laboratory testing returned uniaxial rock strength values of 101 MPa and 62 MPa for B3 and B4, respectively.

APPENDIX A

Site Locations Geotechnical Investigations

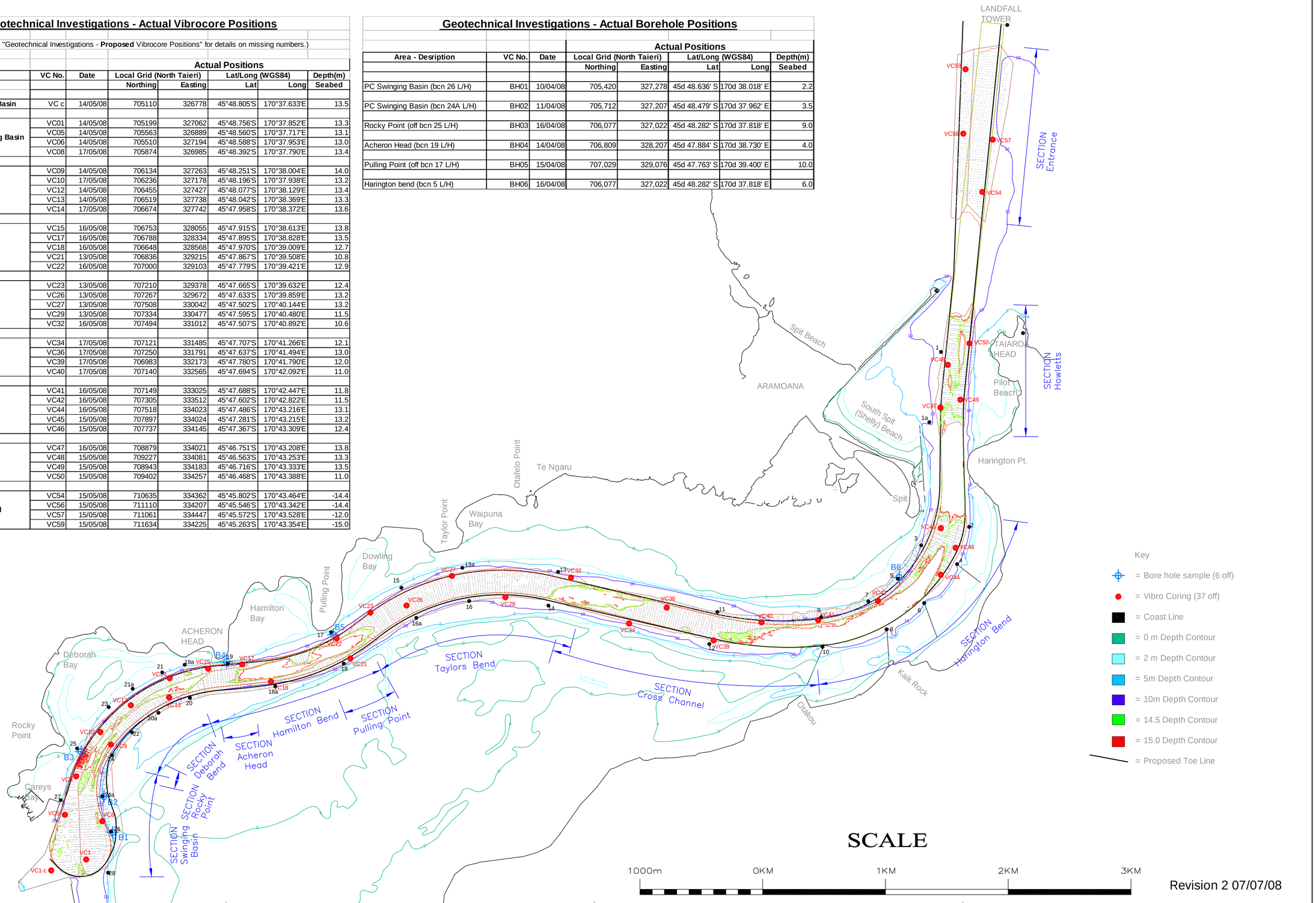
Geotechnical Investigations - Actual Vibrocore Positions

(Note - Refer to "Geotechnical Investigations - **Proposed** Vibrocore Positions" for details on missing numbers.)

Area - Desription	VC No.	Date	Actual Positions: Local Grid (North Taieri) Northing	Easting	Lat/Long (WGS84) Lat	Long	Depth(m) Seabed
Port Chalmers Inner Basin	VC c	14/05/08	705110	326778	45°48.805'S	170°37.633'E	13.5
Port Chalmers Swinging Basin	VC01	14/05/08	705199	327062	45°48.756'S	170°37.852'E	13.3
	VC05	14/05/08	705563	326889	45°48.560'S	170°37.717'E	13.1
	VC06	14/05/08	705510	327194	45°48.588'S	170°37.953'E	13.0
	VC08	17/05/08	705874	326985	45°48.392'S	170°37.790'E	13.4
Deborah Bend	VC09	14/05/08	706134	327263	45°48.251'S	170°38.004'E	14.0
	VC10	17/05/08	706236	327178	45°48.196'S	170°37.938'E	13.2
	VC12	14/05/08	706455	327427	45°48.077'S	170°38.129'E	13.4
	VC13	14/05/08	706519	327738	45°48.042'S	170°38.369'E	13.3
	VC14	17/05/08	706674	327742	45°47.958'S	170°38.372'E	13.6
Hamilton Bend	VC15	16/05/08	706753	328055	45°47.915'S	170°38.613'E	13.8
	VC17	16/05/08	706788	328334	45°47.895'S	170°38.828'E	13.5
	VC18	16/05/08	706648	328568	45°47.970'S	170°39.009'E	12.7
	VC21	13/05/08	706836	329215	45°47.867'S	170°39.508'E	10.8
	VC22	16/05/08	707000	329103	45°47.779'S	170°39.421'E	12.9
Taylors Bend	VC23	13/05/08	707210	329378	45°47.665'S	170°39.632'E	12.4
	VC26	13/05/08	707267	329672	45°47.633'S	170°39.859'E	13.2
	VC27	13/05/08	707508	330042	45°47.502'S	170°40.144'E	13.2
	VC29	13/05/08	707334	330477	45°47.595'S	170°40.480'E	11.5
	VC32	16/05/08	707494	331012	45°47.507'S	170°40.892'E	10.6
Cross Channel	VC34	17/05/08	707121	331485	45°47.707'S	170°41.266'E	12.1
	VC36	17/05/08	707250	331791	45°47.637'S	170°41.494'E	13.0
	VC39	17/05/08	706983	332173	45°47.780'S	170°41.790'E	12.0
	VC40	17/05/08	707140	332565	45°47.694'S	170°42.092'E	11.0
Harrington Point	VC41	16/05/08	707149	333025	45°47.688'S	170°42.447'E	11.8
	VC42	16/05/08	707305	333512	45°47.602'S	170°42.822'E	11.5
	VC44	16/05/08	707518	334023	45°47.486'S	170°43.216'E	13.1
	VC45	15/05/08	707897	334024	45°47.281'S	170°43.215'E	13.2
	VC46	15/05/08	707737	334145	45°47.367'S	170°43.309'E	12.4
Howletts	VC47	16/05/08	708879	334021	45°46.751'S	170°43.208'E	13.8
	VC48	15/05/08	709227	334081	45°46.563'S	170°43.253'E	13.3
	VC49	15/05/08	708943	334183	45°46.716'S	170°43.333'E	13.5
	VC50	15/05/08	709402	334257	45°46.468'S	170°43.388'E	11.0
Entrance Channel	VC54	15/05/08	710635	334362	45°45.802'S	170°43.464'E	-14.4
	VC56	15/05/08	711110	334207	45°45.546'S	170°43.342'E	-14.4
	VC57	15/05/08	711061	334447	45°45.572'S	170°43.528'E	-12.0
	VC59	15/05/08	711634	334225	45°45.263'S	170°43.354'E	-15.0

Geotechnical Investigations - Actual Borehole Positions

Area - Desription	VC No.	Date	Actual Positions: Local Grid (North Taieri) Northing	Easting	Lat/Long (WGS84) Lat	Long	Depth(m) Seabed
PC Swinging Basin (bcn 26 L/H)	BH01	10/04/08	705,420	327,278	45d 48.636' S	170d 38.018' E	2.2
PC Swinging Basin (bcn 24A L/H)	BH02	11/04/08	705,712	327,207	45d 48.479' S	170d 37.962' E	3.5
Rocky Point (off bcn 25 L/H)	BH03	16/04/08	706,077	327,022	45d 48.282' S	170d 37.818' E	9.0
Acheron Head (bcn 19 L/H)	BH04	14/04/08	706,809	328,207	45d 47.884' S	170d 38.730' E	4.0
Pulling Point (off bcn 17 L/H)	BH05	15/04/08	707,029	329,076	45d 47.763' S	170d 39.400' E	10.0
Harington bend (bcn 5 L/H)	BH06	16/04/08	706,077	327,022	45d 48.282' S	170d 37.818' E	6.0



Revision 2 07/07/08

	INITIALS	DATE
DESIGNED:	MJH	26/05/08
DRAWN:	MJH	26/05/08
CHECKED:		
APPROVED:		

PLOT DATE: 07/06/08

ISSUE DATE:

SCALES: 1:15,000

PORT OTAGO LTD P.O. Box 8, Port Chalmers, N.Z.

Project Next Generation
Geotechnical Investigations - Site Locations

PORT OTAGO LIMITED

ACAD FILE NAME: Project Next\11011

DWG No: A1. 11011

APPENDIX B

Borehole and Vibrocore Logs and Core Photographs

Opus International Consultants
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Dunedin
New Zealand
Tel. 64 3 471 5500
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Borehole No: B 1

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.636'S 170° 38.018'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 3.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-3.10					
0	HQ Triple Tube Wireline Rotary		**SAND with some silt and trace shells** black, homogenous. Loose; saturated; dilatant; sand, fine, organic rich with a strong sulphur smell.		0.00 -3.70	HQ	67%			No Piezometer Installed
			Lost core (inferred SAND from drillers comments.		0.60 -4.00					
1			**SAND with some silt and trace shells** as at 0 to 0.6m.		0.90 -5.00	HQ	67%			
2			**Lost core** (inferred SAND from drillers comments).		1.90 -5.50					
			SAND with minor shells grey to light grey, homogenous. Loose; saturated; dilatant; sand, fine to medium.		2.40 -6.10					
3			**Lost core** (inferred SAND from drillers comments).		3.00 -7.00	HQ	40%			
4			**SAND with minor shells** as at 2.4 to 3.0m.		3.90 -7.90	HQ	60%			
5			**Lost core** (inferred SAND from drillers comments).		4.80 -8.50					
			SAND with minor shells as at 2.4 to 3.0m.		5.40 -9.10				Drillers comment: becoming firmer below 5.4m.	
6			**Lost core** (inferred SAND from drillers comments).		6.00 -10.00	HQ	40%			
7			**SAND with minor shells** as at 2.4 to 3.0m.		6.90 -10.40					
			Lost core (inferred SAND from drillers comments).		7.30 -11.50	HQ	27%			
8			**SAND with minor shells** as at 2.4 to 3.0m.		8.40 -11.70					
			Lost core (Inferred SAND from drillers comments).		8.60	HQ	13%			
9										
10										

Remarks: HQ clay coring bit used for full length of borehole.

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 10/4/2008 Finish Date: 10/4/2008

Scale: As Shown

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Borehole No: B 1

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.636'S 170° 38.018'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 3.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Ground Profile: Description	Graphic Log	Depth/Elev	Samples: Type	Samples: Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
11				X		HQ	0%			
				X						
				X						
				X						
				X	-14.50					
			End of Log		11.40					
										Proposed Design Depth
12										
13										
14										
15										
16										
17										
18										
19										
20										

Vane Test: kPa 0 20 60 100
SPT: N 0 10 30 50

Remarks: HQ clay coring bit used for full length of borehole.

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 10/4/2008 Finish Date: 10/4/2008

Scale: As Shown

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Borehole No: B 2

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP001.001

Co-ordinates: 45° 48.479'S 170°37.962'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 4.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-4.10					
0	HQ Triple Tube Wireline Rotary		**SAND with trace shells** grey, homogenous. Loose; saturated; dilatant; sand, fine-medium.		0.00 -4.60					No Piezometer Installed
			Lost core (inferred SAND from drillers comments)		0.50 -5.70	HQ	31%			
2			**SAND with trace shells** as at 0 to 0.5m.		1.60 -6.20					
			Lost core (inferred SAND from drillers comments).		2.10 -7.20	HQ	33%			
3			**SAND with trace shells** greenish grey, homogenous. Loose; saturated; dilatant; sand, medium to fine.		3.10 -7.70					
4			**Lost core** (inferred SAND from drillers comments).		3.60	HQ	33%			
5						HQ	0%			
6					-10.20					
			SAND with trace shells as at 3.1m to 3.6m.		6.10 -10.70					
7			**Lost core** (inferred SAND from drillers comments).		6.60 -11.70	HQ	33%			
8			**SAND with trace shells** as at 3.1 to 3.6m.		7.60 -12.20					
			Lost core (inferred SAND from drillers comments).		8.10 -13.20	HQ	33%			
9			End of Log		9.10					
10										

Remarks: HQ clay coring bit used for full length of borehole
Proposed Design Depth 10.9m

Logged: Tim Jowett Date: 21/4/08
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 11/4/08 Finish Date: 11/4/08

Scale: As Shown

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Borehole No: B 3

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.282'S 170° 37.818'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 9.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-9.10					
0	HQ Triple Tube Wire line Rotary		**Highly weathered BASALT** grey-orange brown, weak (material), extremely closely spaced joints, typical block size 5 to 20mm; behaves as an interlocked, fine-medium GRAVEL with minor coarse gravel.		0.00					
					-9.60	HQ	50%		Occasional seam of red-brown, moderately plastic silty CLAY, wet, very soft, up to 30mm thick.	
1			**Lost core** (inferred basalt).		0.50				Drillers comment: core loss due to core dropping from catcher.	
						HQ	0%			
2					-11.10					
			Basalt as at 0.0 to 0.5m.		2.00					
			Lost core (inferred basalt).			HQ	10%		Drillers comment: core loss due to mismatch of inner tube.	
3					-12.10					
			Basalt as at 0.0 to 0.5m.		3.00					
					-12.50					
			Lost core (inferred basalt).		3.40	HQ	40%			
4					-13.10					
			Moderately Weathered BASALT dark grey with some orange-brown zones, moderately strong with some weak zones associated with more intense weathering, closely to very closely spaced joints.		4.00	HQ	100%		Joints typically planar, rough, open, dipping at between 10 to 20°, with some dipping at 60 to 70°	
									Calcite veins up to 5mm thick	
										Proposed Design Depth
6						HQ	100%			
						HQ	100%		14.0m: Sample UCS	
7					-16.50					
			End of Log		7.40					
8										
9										
10										

No Piezometer Installed

Vane Test: △ kPa △ 0 20 60 100
SPT: N 0 10 30 50

Remarks: HQ Diamond impregnated drill bit used for full length of borehole.

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 (Driller: G. Brown)
Start Date: 16/4/2008 Finish Date: 16/4/2008

Scale: As Shown

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Borehole No: B 4

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.884'S 170° 38.730'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 4.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-4.00					
0	HQ Triple Tube Wire line Rotary		**Lost core** (inferred SAND from drillers comments)		0.00 -5.60	HQ	0%		Drillers comment: loose sediments washed away.	No Piezometer Installed
1			**Cobbles** loose; sub rounded.		1.60 -6.10	HQ	33%			
2			**Completely weathered BASALT** orange-brown, extremely weak, very closely spaced joints Weathered to SILT to silty GRAVEL with some cobbles. silt, very stiff; gravel, medium to fine, loose.		2.10 -7.10					
3			**Lost core** (inferred basalt).		3.10					
4			**Basalt** as at 1.65 to 2.1m.		-8.05	HQ	100%			
5			**Extremely to highly weathered BASALT** grey-orange brown, weak to moderately strong with some extremely weak zones, very closely to closely spaced joints. Joints generally dipping at 10 to 20°, planar, rough, open.		4.05 -9.80	HQ	100%		RQD: 31% (-8.6 to -10.1m)	
6			**Moderately weathered, BASALT** greenish to purplish grey, moderately strong, closely spaced joints. Joints generally dipping at 20 to 30°, planar, rough, open.		5.80 -11.45	HQ	100%		RQD: 77% (-10.1 to -11.6m)	
7			Joint at 40° infilled (5mm) with soft, moderately plastic, orange-brown SILT.		7.45	HQ	100%		RQD: 80% (-11.6 to -13.1m) -12.75m: Sample UCS	
8										
9						HQ	100%		RQD: 100% (-13.1 to -14.6m)	
10										

Remarks: HQ Diamond impregnated bit used for full length of borehole

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 14/4/2008 Finish Date: 14/4/2008

Scale: As Shown

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Borehole No: B 4

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.884'S 170° 38.730'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 4.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Ground Profile: Description	Graphic Log	Depth/Elev	Samples: Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
11										Proposed Design Depth
						HQ	100%		RQD: 93% (-14.6 to -16.1m)	
12					-16.10					
			End of Log		12.10					
13										
14										
15										
16										
17										
18										
19										
20										

Remarks: HQ Diamond impregnated bit used for full length of borehole

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 14/4/2008 Finish Date: 14/4/2008

Scale: As Shown

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Borehole No: B 5

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.763'S 170° 39.400'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 10.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method / Casing	Description	Graphic Log	Depth/Elev	Samples: Type	Samples: Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
		Ground Surface		-10.00					
0	HQ Triple Tube Wire line Rotary	**Lost core** (inferred SAND-SILT from drillers comments)	X	0.00	HQ	0%			No Piezometer Installed
1			X						
2		**SAND with minor shells** dark grey, homogenous. Loose; saturated; dilatant; sand, medium to fine.		-11.58 1.58	HQ	39%		Rounded basalt COBBLE at 2.4m.	
		End of Log		-12.50 2.50					
3									
4									
5									Proposed Design Depth
6									
7									
8									
9									
10									

Vane Test: kPa 0 20 60 100
SPT: N 0 10 30 50

Remarks: HQ Clay Coring bit used for full length of borehole.

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 15/4/2008 Finish Date: 15/4/2008

Scale: As Shown

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Borehole No: B 6

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.466'S 170° 42.956'E
Grid: Latitude / Longitude (WGS84)
Elevation: - 7.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test Δ kPa Δ 0 20 60 100 / SPT N 0 10 30 50	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-7.00					
0	HQ Triple Tube Wire line Rotary		**Lost core** (inferred SAND from drillers log).	X	0.00	HQ	0%		Drillers comment: core loss due to loose sediments being washed away.	No Piezometer Installed
					-8.40					
			SAND with trace shells light grey, homogenous. Loose; saturated; dilatant; sand, medium to fine.		1.40					
					-8.90					
2			**Lost core** (inferred SAND from drillers log).	X	1.90	HQ	33%			
					-9.90					
3			**SAND with trace shells** as at 1.5 to 1.9m.		2.90					
					-10.40					
			Lost core (inferred sand from drillers log).	X	3.40	HQ	33%			
4					-11.40					
			SAND with trace shells as at 1.5 to 1.9m.		4.40					
					-11.90					
5			**Lost core** (inferred SAND from drillers log).	X	4.90	HQ	33%			
					-12.90					
6			**SAND with trace shells** as at 1.5 to 1.9m.		5.90					
					-13.10					
			Lost core (inferred SAND from drillers log).	X	6.10	HQ	13%			
7					-14.40					
			SAND with trace shells as at 1.5 to 1.9m.		7.40					
					-14.60					
8			**Lost core** (inferred SAND from drillers log).	X	7.60	HQ	13%			
					-15.90					Proposed Design Depth
9			End of Log		8.90					
10										

Remarks: HQ Clay Coring bit used for full length of borehole.

Logged: Tim Jowett Date: 21/4/2008
Checked: Markus Hanz

Drill Rig: Longyear 38 Rotary (Driller: G. Brown)
Start Date: 12/4/2008 Finish Date: 12/4/2008

Scale: As Shown

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Vibrocore No: VC 1

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.756'S 170° 37.852'E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.3m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.30					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some gravel and silt** light grey, homogenous. Loosely packed; moist; sand, course; gravel, fine.		0.00 -13.40 0.10					
			SILT with some clay and minor sand dark brown, lensoidal. Soft to very soft; saturated; plastic; sand, fine; lens of shelly Silt. Sand percentage decreases with depth.					SPT not carried out	0.8m: Sample PSD	No Piezometer Installed Proposed Design Depth
1										
2			**Clayey SILT** dark brown, homogenous. Soft to very soft; saturated; plastic.		-15.00 1.70					
3					-16.45					
			End of Log		3.15					

Vane Test: △ kPa △ 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Quick, firm and steady penetration of core barrel
- Full core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 1c

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.805'S 170° 37.633'E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.9m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.90					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some silt** light grey, homogenous. Loosely packed; moist; poorly graded; sand, fine.		0.00			SPT not carried out		No Piezometer Installed
			End of Log		-13.55 0.65					
1										
2										Proposed Design Depth
3										

Vane Test: △ kPa △ 0 20 60 100
SPT: ■ N ■ 0 10 30 50

Remarks:
- Hard, slow penetration of core barrel
- Full but partially inverted core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 5

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.560'S 170° 37.717'E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.1m **Datum:** Chart Datum
Inclination: Vertical **Azimuth:** N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa (0 20 60 100) / SPT N (0 10 30 50)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.10					
0	Vibro Core	Vibro Core Aluminium Casing	**SILT with some clay and of trace sand** grey, homogenous. Soft to very soft; saturated; non plastic. Sand percentage decrease with depth. Trace sand		0.00			SPT not carried out	Mixed sample for contamination testing Mixed sample for contamination testing Mixed sample for contamination testing	No Piezometer Installed
1					-14.58		98%			
			SILT with some clay grey, homogenous. Soft to very soft; moist to saturated; plastic.		1.48					Proposed Design Depth
2					-15.97					
			End of Log		2.87					
3										

Remarks:
- Quick, then firm and steady penetration of core barrel
- Full, almost inverted core catcher

Logged: James Grindley **Date:** 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 **Finish Date:** 14/5/2008
Scale: As Shown

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Vibrocore No: VC 6

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.588'S 170° 37.953'E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.4m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.40					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND** black, homogenous. Loosely packed; moist; poorly graded.		0.00			SPT not carried out	0.6m: Sample PSD	No Piezometer Installed
					-13.59					
1			**SILT with minor sand and clay** black, homogenous. Soft to very soft; moist; plastic. Becomes less sandy with depth		1.19		94%			
2					-14.85					
			SILT with minor clay black, homogenous. Soft to very soft; moist; plastic.		2.45					Proposed Design Depth
3					-15.44					
			End of Log		3.04					

Remarks:
- Quick, then firm and steady penetration of core barrel
- Full, inverted core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 8

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.392' S 170° 37.790' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.2m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.20					
0	Vibro Core	Vibro Core Aluminium Casing	**Sandy SILT with some clay and shells** grey, homogenous. Soft ; wet to saturated.		0.00 -13.40					No Piezometer Installed
			Clayey SILT with some sand grey, homogenous. Soft; wet; slightly plastic.		0.20		36%	SPT not carried out	0.6m: Sample PSD, Atterberg, Shear Strength	
			End of Log		-14.00 0.80					Proposed Design Depth
1										
2										
3										

Remarks:
- Quick, then firm and steady penetration of core barrel
- Full core catcher, inverted on recovery leading to lost core

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 9

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.251'S 170° 38.004'E
Grid: Latitude / Longitude (WGS84)
Elevation: -14.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-14.00			Vane Test △ kPa △ 0 20 60 100; SPT ■ N ■ 0 10 30 50		
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with minor Shells** grey, homogenous. Loosely packed; moist; poorly graded.		0.00			SPT not carried out		
					-14.80					
			SILT with some sand and minor clay black, homogenous. Soft to very soft; saturated; slightly plastic; smells of organics.		0.80					Proposed Design Depth
1										
					-15.62		95%			
			SILT with some clay black, homogenous. Soft to very soft; moist; plastic.		1.62					
2										No Piezometer Installed
3					-17.10					
			End of Log		3.10					

Remarks:
- Quick penetration of core barrel
- Full but partially inverted core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 10

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.946' S 170° 37.938' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.10					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey, homogenous. Sand, medium to fine.		0.00 -13.80			SPT not carried out		
1			**Silty SAND with some shells** grey, homogenous.		0.70 -14.30		63%			No Piezometer Installed
			CLAY with some silt black, homogenous. Soft to stiff; plastic		1.20 -14.75					
			End of Log		1.65					Proposed Design Depth
2										
3										

Remarks:
- Quick, then steady and firm penetration of core barrel
- Full, inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 17/5/2008 Finish Date: 17/5/2008
Scale: As Shown

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Vibrocore No: VC 12

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.077'S 170° 38.129'E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.3m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.30					
0	Vibro Core	Vibro Core Aluminium Casing	**SILT with minor sand and clay** dark grey, homogenous. Soft to very soft; moist to saturated; non plastic.		0.00			SPT not carried out	Mixed Sample for Contamination Testing Mixed Sample for Contamination Testing 0.7m: Sample PSD, SD	No Piezometer Installed
1			**SILT with minor clay** dark grey, homogenous. Soft to very soft; moist to saturated; non plastic; contains vesicles.		-14.40 1.10		98%		Mixed Sample for Contamination Testing	
					-14.95 1.65					Proposed Design Depth
2			**Clayey SILT** black, homogenous. Soft to very soft; moist; plastic.							
3					-16.46 3.16					
			End of Log							

Remarks:
- Quick, steady and firm penetration of core barrel
- Full but partially inverted core barrel

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 13

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 48.042'S 170° 38.369'E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.3m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.30					
0	Vibro Core	Vibro Core Aluminium Casing	**SILT with some clay and trace sand** grey, homogenous. Soft to very soft; saturated; plastic. Changes with depth to become SILT with some sand and minor clay. Non plastic		0.00			SPT not carried out		No Piezometer Installed
1			**Clayey SILT** black, homogenous. Soft to very soft; moist; plastic		-14.73 1.43		93%			Proposed Design Depth
2					-16.17					
			End of Log		2.87					
3										

Vane Test: kPa, 0 20 60 100
SPT: N, 0 10 30 50

Remarks:
- Quick, steady penetration of core barrel
- Full, partially inverted core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 14/5/2008 Finish Date: 14/5/2008
Scale: As Shown

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Vibrocore No: VC 14

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.958' S 170° 38.372' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.7m Datum: Water Level
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.70					
0	Vibro Core	Vibro Core Aluminium Casing	**CLAY with some silt and shells** black, homogenous. Soft; wet; plastic.		0.00 -13.90					
			CLAY with minor silt black, homogenous. Soft; moist to wet; plastic; becomes stiff with depth		0.20			SPT not carried out	0.8m: Sample PSD, Atterberg, SD, Shear Strength	Proposed Design Depth
1										
2							98%			No Piezometer Installed
3					-16.80					
			CLAY with minor silt grey - brown. Soft; moist; plastic.		3.10					
			End of Log							

Vane Test: Δ kPa Δ — 0 20 60 100
SPT: N — 0 10 30 50

Remarks:
- Quick, steady, firm penetration of core barrel
- Full by partially inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 17/5/2008 Finish Date: 17/5/2008
Scale: As Shown

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Vibrocore No: VC 15

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.915' S 170° 36.613' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.7m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.70					
0	Vibro Core	Vibro Core Aluminium Casing	**CLAY with some silt and minor shells** grey, homogenous. Soft; wet; plastic.		0.00		96%	SPT not carried out		Proposed Design Depth
1										
2					-15.80					No Piezometer Installed
			End of Log		2.10					
3										

Vane Test: Δ kPa Δ — 0 20 60 100
SPT: N — 0 10 30 50

Remarks:
- Quick, steady, firm penetration of core barrel
- Full and inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008
Scale: As Shown

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Vibrocore No: VC 17

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.895' S 170° 38.828' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.4 Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.40					
0	Vibro Core	Vibro Core Aluminium Casing	**Silty SAND** grey, homogenous. Saturated.		0.00 -13.80					
			Sandy SILT grey, homogenous. Soft.		0.40 -14.10			SPT not carried out		
1			**Sandy SILT with some clay** grey, homogenous. Soft.		0.70		93%			No Piezometer Installed Proposed Design Depth
2					-16.35					
3			End of Log		2.95					

Vane Test: △ kPa △ 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Quick, steady, smooth penetration of core barrel
- Fully Inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008
Scale: As Shown

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Vibrocore No: VC 18

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.970' S 170° 39.009' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.9m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.90					
0	Vibro Core	Vibro Core Aluminium Casing	**CLAY with some silt** grey, homogenous. Soft; wet; plastic.		0.00		98%	SPT not carried out		No Piezometer Installed
1										
2										Proposed Design Depth
					-15.35					
			End of Log		2.45					
3										

Vane Test: kPa, 0 20 60 100
SPT: N, 0 10 30 50

Remarks:
- Quick, steady penetration of core barrel
- Empty and partially inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008
Scale: As Shown

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Vibrocore No: VC 21

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.867'S 170° 39.508'E
Grid: Latitude / Longitude (WGS84)
Elevation: -10.6m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-10.60					
0	Vibro Core	Vibro Core Aluminium Casing	**Course to medium SAND** dark grey, homogenous. Loosely packed; moist.		0.00			SPT not carried out	Mixed sample for contamination testing	No Piezometer Installed
									Mixed sample for contamination testing	
1			Becomes progressively more sandy with depth.		-11.60 1.00		91%		Mixed sample for contamination testing	
			Becomes a Shelly SAND		-12.50 1.90 -12.59					
2			**SILT with some sand** grey; homogenous. Loosely packed; moist; non plastic.		1.99 -12.88					
			SILT with minor clay grey, homogenous. Soft to very soft; moist to saturated; slightly plastic.		2.28 -13.50					
			End of Log		2.90					
3			Proposed design depth at 4.4m							

Remarks:
- Initially hard, then firm, steady and even penetration of core barrel
- Empty, inverted core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 13/5/2008 Finish Date: 13/5/2008
Scale: As Shown

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Vibrocore No: VC 22

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.779' S 170° 39.421' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.8m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.80					
0	Vibro Core	Vibro Core Aluminium Casing	**Sandy SILT with trace clay and shells** grey, homogenous. Soft; wet to saturated.		0.00 -13.30			SPT not carried out		
1			**Sandy SILT with some clay** grey. Soft; plastic.		0.50 -14.30		88%			No Piezometer Installed
2			**SILT with some sand, clay and shells** grey. Soft; slightly plastic.		1.50 -15.45					Proposed Design Depth
			End of Log		2.65					
3										

Vane Test: kPa, 0 20 60 100
SPT: N, 0 10 30 50

Remarks:
- Quick, steady, smooth penetration of core barrel
- Full and completely inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008
Scale: As Shown

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Vibrocore No: VC 23

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.665'S 170° 39.632'E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.10					
0	Vibro Core	Vibro Core Aluminium Casing	**SILT with some sand, clay and minor shells** dark brown, homogenous. Soft to very Soft; moist; plastic.		0.00					No Piezometer Installed
			Fine sand and shells decrease with depth					SPT not carried out		
1			No sand, minor shells		-13.10 1.00		98%		1.6m: Sample PSD	
2					-14.95 2.85					Proposed Design Depth
			End of Log							
3										

Vane Test: △ kPa △ 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Slow and steady penetration of core barrel
- Empty core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 13/5/2008 Finish Date: 13/5/2008
Scale: As Shown

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Vibrocore No: VC 26

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.633'S 170° 39.859'E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.2m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.20					
0	Vibro Core	Vibro Core Aluminium Casing	**Gravely SAND** grey, homogenous. Loosely packed; moist to saturated; poorly graded; sand, course to fine; gravel, angular broken shells.		0.00 -13.35					
			Clayey SILT with minor sand grey, homogenous. Soft to very soft; moist to saturated; slightly plastic.		0.15			SPT not carried out		
1					-14.77		105%			No Piezometer Installed
			SAND with minor shells grey, homogenous. Loosely packed; moist to saturated; poorly graded; sand, medium to fine.		1.57					Proposed Design Depth
2					-15.44					
			Lenses of silty sand		2.24 -15.58					
					2.38					
3					-16.30					
			End of Log		3.10					

Vane Test: kPa 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Slow, firm and steady penetration of core barrel
- Empty core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 13/5/2008 Finish Date: 13/5/2008
Scale: As Shown

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Vibrocore No: VC 27

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.502'S 170° 40.144'E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.1m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test Δ kPa Δ 0 20 60 100 / SPT N 0 10 30 50	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.10					
0	Vibro Core	Vibro Core Aluminium Casing	**Shelly SAND** grey with white shells, homogenous. Loosely packed; moist too saturated; sand, angular.		0.00 / -13.20 / 0.10					
			SILT with minor sand; grey; lensoidal. Soft; moist to saturated; non plastic. Lenses, medium to fine SAND with some silt and broken shells					SPT not carried out		
1			Lenses of sand become lenses of silt and shells		-14.30 / 1.20		90%			No Piezometer Installed
										Proposed Design Depth
2					-15.45 / 2.35					
			End of Log							
3										

Remarks:

- Slow penetration of core barrel
- Full core catcher

Logged: James Grindley Date: 14 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 13/5/2008 Finish Date: 13/5/2008

Scale: As Shown

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Vibrocore No: VC 29

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.595'S 170° 40.480'E
Grid: Latitude / Longitude (WGS84)
Elevation: -11.5m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-11.50					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some broken shells** light grey, lensoidal. Loosely packed; moist to saturated; poorly graded; sand, medium to fine; lenses of shelly sand (Old shell beds).		0.00		138%	SPT not carried out	2.15m: Sample PSD	No Piezometer Installed
1										
2					-14.30					
			End of Log		2.80					
			Proposed design depth 3.5m							
3										

Vane Test: kPa, 0 20 60 100
SPT: N, 0 10 30 50

Remarks:
- Slow and steady penetration of core barrel, then hit something hard
- Empty core catcher

Logged: James Grindley Date: 15 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 13/5/2008 Finish Date: 13/5/2008
Scale: As Shown

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Vibrocore No: VC 32

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.507' S 170° 40.892' E
Grid: Latitude / Longitude (WGS84)
Elevation: -10.8m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-10.80					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** light grey - brown, homogenous. Moist; sand, medium to fine.		0.00			SPT not carried out		No Piezometer Installed
					-11.60					
1			**SAND** light grey - brown. Moist; sand, medium to fine.		0.80		91%			
2										
3			End of Log		-13.80 3.00					
			Proposed design depth 4.2m							

Remarks:
- Smooth, even and steady penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008
Scale: As Shown

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Vibrocore No: VC 34

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.707' S 170° 41.266' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.2m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.20					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey, homogenous. Moist; sand, medium to fine.		0.00			SPT not carried out	Mixed sample for contamination testing	
					-12.85					
			Clayey SILT with minor sand grey, homogenous. Slightly plastic; sand, fine.		0.65				Mixed sample for contamination testing	
1									Mixed sample for contamination testing	No Piezometer Installed
							98%			
2										
					-14.84					
			End of Log		2.64					Proposed Design Depth
3										

Vane Test: 0 20 60 100 kPa
SPT N: 0 10 30 50

Remarks:
- Quick, then firm, steady penetration of core barrel
- Full but partially inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 17/5/2008 Finish Date: 17/5/2008
Scale: As Shown

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Vibrocore No: VC 36

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.637' S 170° 41.494' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.3m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.30					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some gravel and silt** green, homogenous. Loosely packed Moist; poorly graded; sand, medium to fine; grains of gravel and sand are primarily broken shells.		0.00 -13.40 0.10					
			Clayey SILT with trace sand green, homogenous. Soft to very soft; moist to saturated; slightly plastic.					SPT not carried out		
1					-14.37					No Piezometer Installed
			SILT with some clay and minor sand green, homogenous. Soft; moist; non plastic; sand, angular, course to fine.		1.07		93%			
					-14.98					
			SAND with some silt, minor shells, and trace clay green, homogenous. Loosely packed; moist; well graded; shells, broken and angular.		1.68					
2										
					-15.66					
			End of Log		2.36					Proposed Design Depth
3										

Remarks:
- Quick then slow penetration of core barrel
- Full with partial Invert of core catcher

Logged: James Grindley Date: 21 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 17/5/2008 Finish Date: 17/5/2008

Scale: As Shown

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Vibrocore No: VC 39

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.780' S 170° 41.790' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.4m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Ground Profile: Description	Graphic Log	Depth/Elev	Samples: Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.40					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey, homogenous. Wet to saturated; sand, medium.		0.00			SPT not carried out		No Piezometer Installed
					-13.30					
1			**SAND with some silt and shells** grey. Loosely packed wet; sand, fine.		0.90		94%			
					-14.20					
2			**SAND with silt and trace clay** Homogenous. Sand, fine		1.80					
3					-15.45					Proposed Design Depth
			End of Log		3.05					

Remarks:
- Firm and steady, then hard penetration of core barrel
- Full, but partially invert core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 17/5/2008 Finish Date: 17/5/2008

Scale: As Shown

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Vibrocore No: VC 40

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.694' S 170° 42.092' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.00					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey, homogenous. Saturated; sand, medium.		0.00 -12.30					No Piezometer Installed
1			**SAND with some shells** grey. Wet; sand, medium to fine.		0.30 -13.10			SPT not carried out		
			SAND with some silt and shells grey. Moist to wet; sand, fine.		1.10 -13.70		109%			
2			**SAND with some silt and shells** grey. Moist to wet; sand, fine.		1.70 -15.10					
3			End of Log Proposed design depth 3.5m		3.10					

Vane Test: kPa 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Quick, then firm and steady penetration of core barrel
- Full but partially Inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 17/5/2008 Finish Date: 17/5/2008
Scale: As Shown

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Vibrocore No: VC 41

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.688' S 170° 42.447' E
Grid: Latitude / Longitude (WGS84)
Elevation: -11.7m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa 0 20 60 100 / SPT N 0 10 30 50	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-11.70					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND** grey - brown. Saturated; sand, medium.		0.00			SPT not carried out		No Piezometer Installed
					-12.20					
			SAND with trace silt and shells grey - black, homogenous. Wet; sand, medium to fine.		0.50		100%			
1										
2									2.0m: Sample PSD	
					-14.20					
			SAND with minor silt and shells grey, homogenous. Wet; sand, medium to fine.		2.50					
3					-14.85					
			End of Log Proposed design depth 4.8m		3.15					

Remarks:
- Steady, even, firm penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008

Scale: As Shown

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Vibrocore No: VC 42

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.602' S 170° 42.822' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.5m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.50					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey - brown, homogenous. Wet; sand, medium.		0.00			SPT not carried out		No Piezometer Installed
					-13.90		99%			
			Shelly SAND grey - brown. Wet; sand, medium.		1.40 -14.05					
			SAND with some shells grey. Moist to wet; sand, medium to fine.		1.55 -15.30					
			End of Log		2.80					
			Proposed design depth 4m							

Vane Test: kPa 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Quick, steady penetration of core barrel
- Empty, partially Inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008
Scale: As Shown

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Vibrocore No: VC 44

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.486' S 170° 43.216' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.5m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.50					
0	Vibro Core	Vibro Core Aluminium Casing	**Shells with some sand**		0.00					No Piezometer Installed
					-13.70					
			Clayey SILT with some sand grey, homogenous. Wet; slightly plastic; sand, fine.		0.20		128%	SPT not carried out		
1										
2										
					-16.15					
			End of Log		2.65					
3										Proposed Design Depth

Remarks:
- Hard penetration of core barrel
- Partial Inverted core catcher

Logged: Markus Hanz Date: 24 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 16/5/2008 Finish Date: 16/5/2008

Scale: As Shown

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Vibrocore No: VC 45

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.281' S 170° 43.215' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.2m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.20					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with minor Shells** grey - black. Moist to wet; sand, fine to medium.		0.00 -13.80			SPT not carried out		No Piezometer Installed
1			**Silty SAND with some clay** grey - black. Moist to saturated; slightly plastic; sand, fine.		0.60 -14.80		80%			
2			**Clayey SILT** grey - black. Moist to saturated; slightly plastic.		1.60 -15.75				2.2m: Sample PSD	
3			End of Log		2.55					Proposed Design Depth

Remarks:
- Hard, slow - steady penetration of core barrel
- Fully inverted core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008
Scale: As Shown

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Vibrocore No: VC 46

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 47.465' S 170° 43.307' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.8m Datum: Mean Sea Level
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa 0 20 60 100 / SPT N 0 10 30 50	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.80					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with minor Shells** grey, homogenous. Saturated; sand, medium to fine.		0.00 -13.00					No Piezometer Installed
			Silty SAND with minor shells grey - black. Wet.		0.20 -13.40			SPT not carried out		
1			**Clayey SILT with some shells** grey. Moist to wet; plastic.		0.60		100%		1.6m: Shear Strength	
2					-15.70					
			End of Log		2.90					
3			Proposed design depth 3.7m							

Remarks:
- Hard, steady penetration of core barrel
- Full but inverted core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008
Scale: As Shown

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Vibrocore No: VC 47

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 46.751' S 170° 43.208' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.7m **Datum:** Chart Datum
Inclination: Vertical **Azimuth:** N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.70					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND** dark green, lensoidal. Loosely packed; moist; sand, coarse to fine; lenses, black sand, smells of organics.		0.00			SPT not carried out	Mixed sample for contamination testing Mixed sample for contamination testing	No Piezometer Installed
1			**Shelly SAND** grey homogenous. Loosely packed; moist; gap graded; sand, course to fine; shells, whole, 40mm diameter.		-13.70 1.00				Mixed sample for contamination testing	
			Clayey SAND grey, homogenous. Loosely packed; moist; well graded; sand, course to fine.		-13.95 1.25		100%			
2										
			End of Log		-15.60 2.90					
3			Proposed design depth 3.8m							

Remarks:
- Firm, steady and even penetration of core barrel
- Empty core catcher

Logged: James Grindley **Date:** 5 June 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 16/5/2008 **Finish Date:** 16/5/2008
Scale: As Shown

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Vibrocore No: VC 48

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 46.563' S 170° 43.253' E
Grid: Latitude / Longitude (WGS84)
Elevation: -12.9m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test (kPa) / SPT (N)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-12.90					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey - brown, homogenous. Moist; sand, medium.		0.00			SPT not carried out		No Piezometer Installed
1					-14.10					
			SAND grey, homogenous. Moist to wet; sand, medium to fine.		1.20		110%			
2					-15.70					
			SAND with some clay grey - black. Wet; sand, medium to fine.		2.80					
3					-15.95					
			End of Log		3.05					
			Proposed design depth 3.6m							

Remarks:

- Quick, firm - steady penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008
Scale: As Shown

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Vibrocore No: VC 49

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 46.716' S 170° 43.333' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.6m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa / SPT N	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.60					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** grey - black, homogenous. Wet; sand, medium to fine.		0.00			SPT not carried out		No Piezometer Installed
					-14.40					
1			**SAND with some silt and minor shells** grey - black, homogenous. Wet.		0.80		98%			
					-15.30					
2			**Clayey SILT with minor shells** grey - black. Slightly plastic.		1.70				2.3m: Sample PSD	Proposed Design Depth
3					-16.70					
			End of Log		3.10					

Remarks:
- Initially hard, steady penetration of core barrel
- Empty, partially Inverted core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008
Scale: As Shown

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Vibrocore No: VC 50

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 46.468' S 170° 43.388' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.0m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa (0 20 60 100) / SPT N (0 10 30 50)	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.00					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND** greyish brown, homogenous. Dry to moist; sand, medium, uniform.		0.00 -13.65			SPT not carried out		
			SAND grey - black, homogenous. Moist, sand, medium to fine.		0.65		107%		1.6m: Sample PSD, SD	No Piezometer Installed –
1										
2										
3			End of Log Proposed design depth 3.5m		-16.00 3.00					

Remarks:
- Quick, firm - steady penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008

Scale: As Shown

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Vibrocore No: VC 54

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 45.802' S 170° 23.464' E
Grid: Latitude / Longitude (WGS84)
Elevation: -13.8m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-13.80					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** brown, homogenous. Wet; sand, medium to fine.		0.00			SPT not carried out		No Piezometer Installed
					-14.45					
			SAND with some shells grey, homogenous. Wet; sand, medium, uniform.		0.65		107%		1.8m: Sample PSD	
1										
2					-15.95					
			SAND grey. Wet; sand, medium to fine; lenses of shells at 2.2m.		2.15					
					-16.80					
3			End of Log		3.00					
			Proposed design depth 3.7m							

Vane Test: kPa, 0 20 60 100
SPT: N, 0 10 30 50

Remarks:
- Quick, steady - firm penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008
Scale: As Shown

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Vibrocore No: VC 56

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 45.546' S 170° 43.342' E
Grid: Latitude / Longitude (WGS84)
Elevation: -14.4m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test kPa 0 20 60 100 / SPT N 0 10 30 50	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-14.40					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND with some shells** brown, homogenous. Moist; sand, medium to fine.		0.00			SPT not carried out		
					-15.15					
			SAND with some shells grey, homogenous. Moist to wet; sand, medium to fine.		0.75		105%			No Piezometer Installed
1										
2										
					-17.35					
3			End of Log		2.95					Proposed Design Depth

Remarks:
- Quick penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz

Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008

Scale: As Shown

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Vibrocore No: VC 57

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 45.572' S 170° 43.528' E
Grid: Latitude / Longitude (WGS84)
Elevation: -11.9m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-11.90					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND** brownish , homogenous. Moist; sand, medium.		0.00		82%	SPT not carried out		No Piezometer Installed
					-13.60					
			SAND grey - brown, homogenous. Moist; sand, medium to fine.		1.70					
					-14.50					
			End of Log		2.60					
			Proposed design depth 4.6m							

Vane Test: △ kPa △ 0 20 60 100
SPT: N 0 10 30 50

Remarks:
- Quick, steady - firm penetration of core barrel
- Empty core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008
Scale: As Shown

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Vibrocore No: VC 59

Project Name: Project Next Generation
Client: Port Otago
Location: Otago Harbour
Project No. 6CGP00.01

Co-ordinates: 45° 45.263' S 170° 43.354' E
Grid: Latitude / Longitude (WGS84)
Elevation: -15.4m Datum: Chart Datum
Inclination: Vertical Azimuth: N/A

Depth	Drilling Method	Casing	Description	Graphic Log	Depth/Elev	Type	Recovery	Vane Test / SPT	Additional Lab Tests/Notes	Piezometer Installation
			Ground Surface		-15.40					
0	Vibro Core	Vibro Core Aluminium Casing	**SAND** grey - brown, homogenous. Moist to wet; sand, medium.		0.00			SPT not carried out		
					-16.35					
1			**SAND with some silt** grey, homogenous. Moist to wet; sand, medium to fine.		0.95		93%		1.4m: Sample PSD	No Piezometer Installed
2										Proposed Design Depth
					-18.40					
3			End of Log		3.00					

Vane Test: kPa, 0 20 60 100
SPT: N, 0 10 30 50

Remarks:
- Firm steady penetration
- Empty Core catcher

Logged: Markus Hanz Date: 18 May 2008
Checked: Markus Hanz

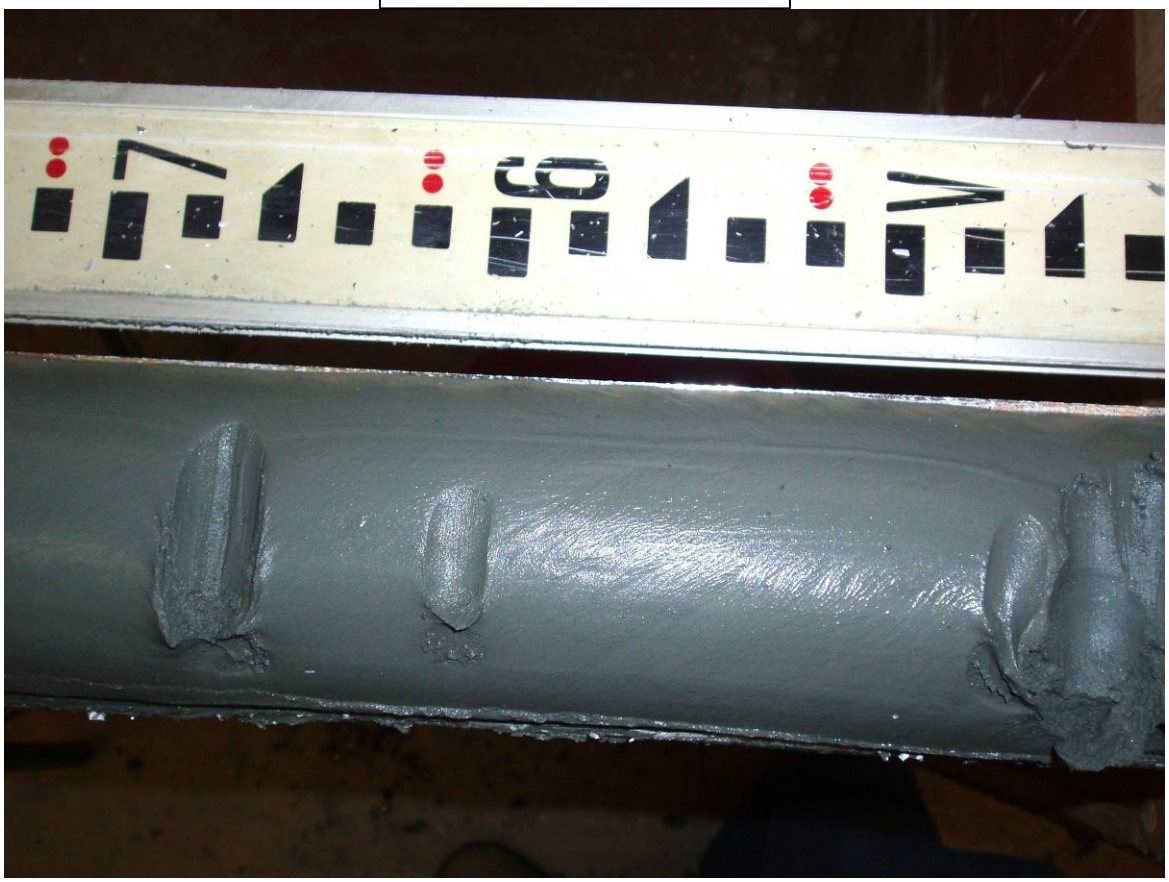
Drill Rig: Vibro Core
Start Date: 15/5/2008 Finish Date: 15/5/2008

Scale: As Shown

VC14 – Silty CLAY

VC18 – Silty CLAY

VC1 – clayey SILT

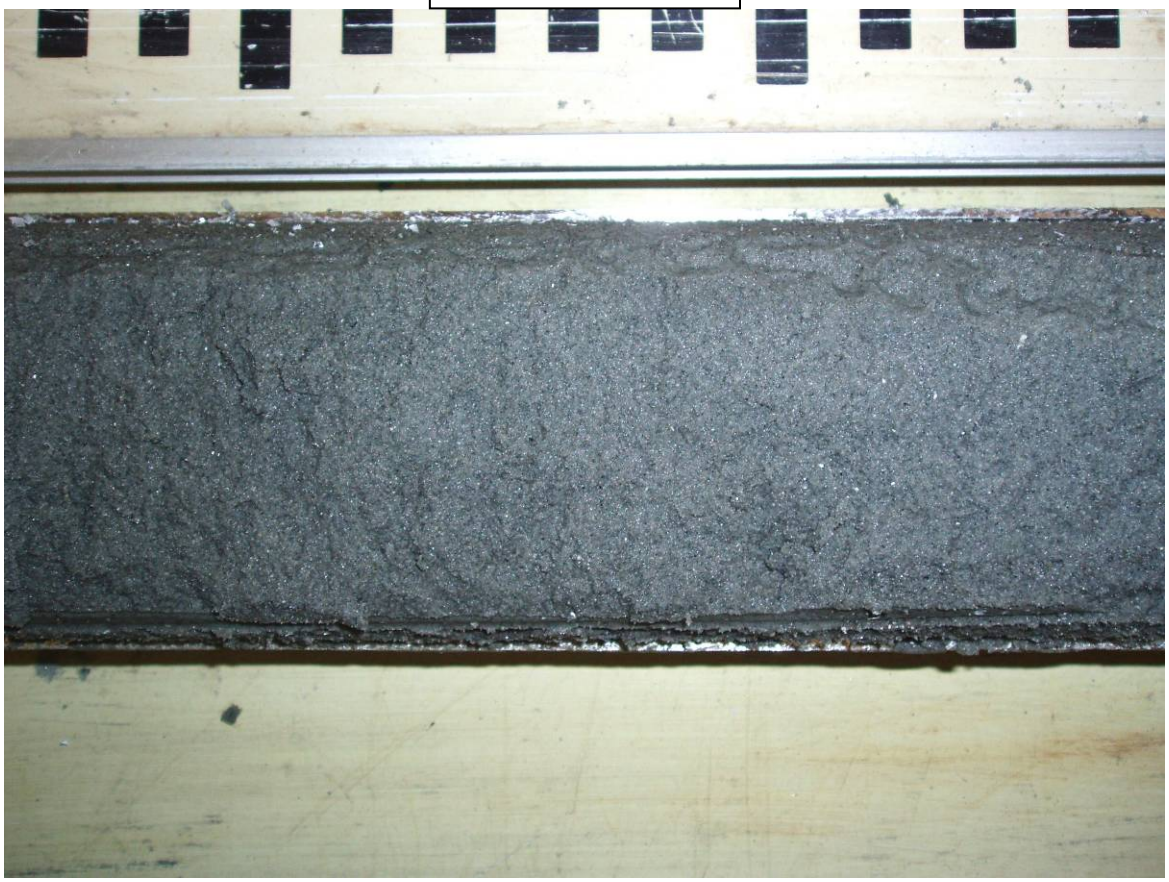


VC12 – clayey SILT

VC36 – Clayey SILT

VC46 – clayey SILT

VC29 - SAND



VC50 - SAND

VC54 - SAND

VC32 - SAND

B3 – Basalt Cobbles and Highly Weathered Basalt

B3 – Moderately Weathered Basalt

B4 – Completely Weathered Basalt

B4 – Moderately Weathered Basalt

APPENDIX C

Soil/ Rock Mechanical and Chemical Laboratory Testing Results

Soil and Rock Mechanical

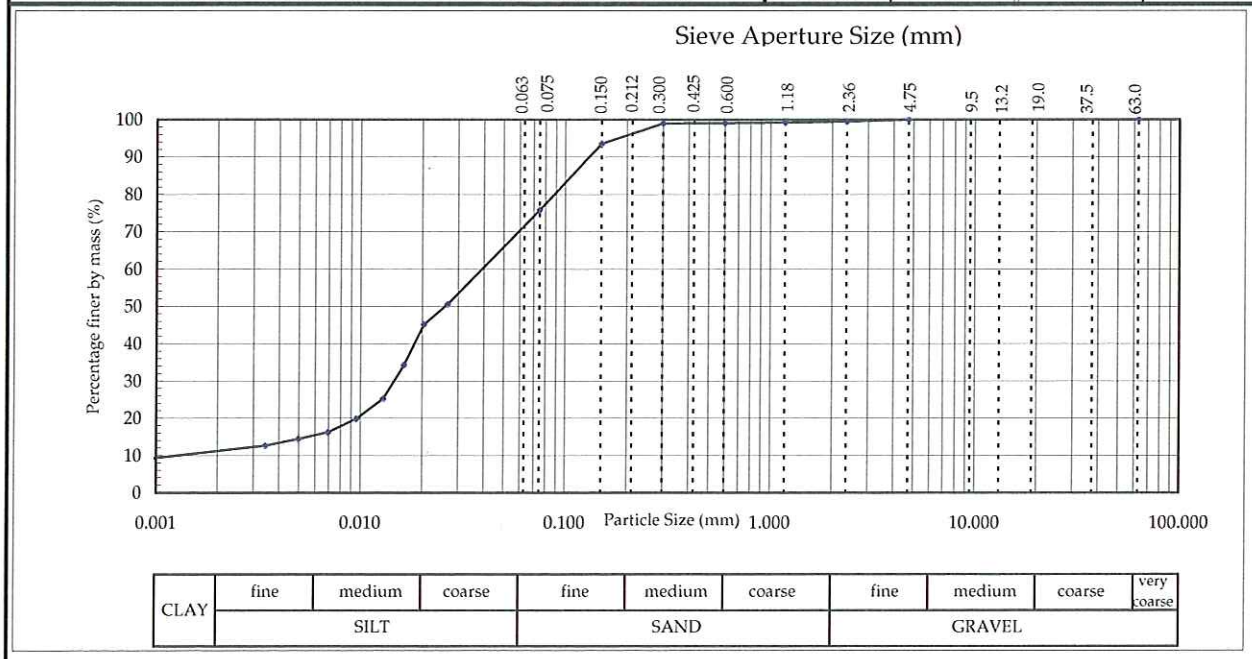
Particle Size Distribution

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 1 - 0.8m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**05/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.70 assumed**
Water Content (as received):	**38.1 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	0.0266	51	0.0050	14
37.5	--	2.36	99	0.212	--	0.0203	45	0.0034	13
19.0	--	1.18	99	0.150	94	0.0163	34	0.0009	9
13.2	--	0.600	99	0.075	76	0.0129	25	--	--
9.5	--	0.425	--	0.063	--	0.0095	20	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0069	16		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 9.0

Date Tested: 12/06/08

11/07/08

Sampling is not covered by IANZ Accreditation

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IANZ Approved Signatory Denys Searls
Designation : Laboratory Manager
Date : 07/07/08

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

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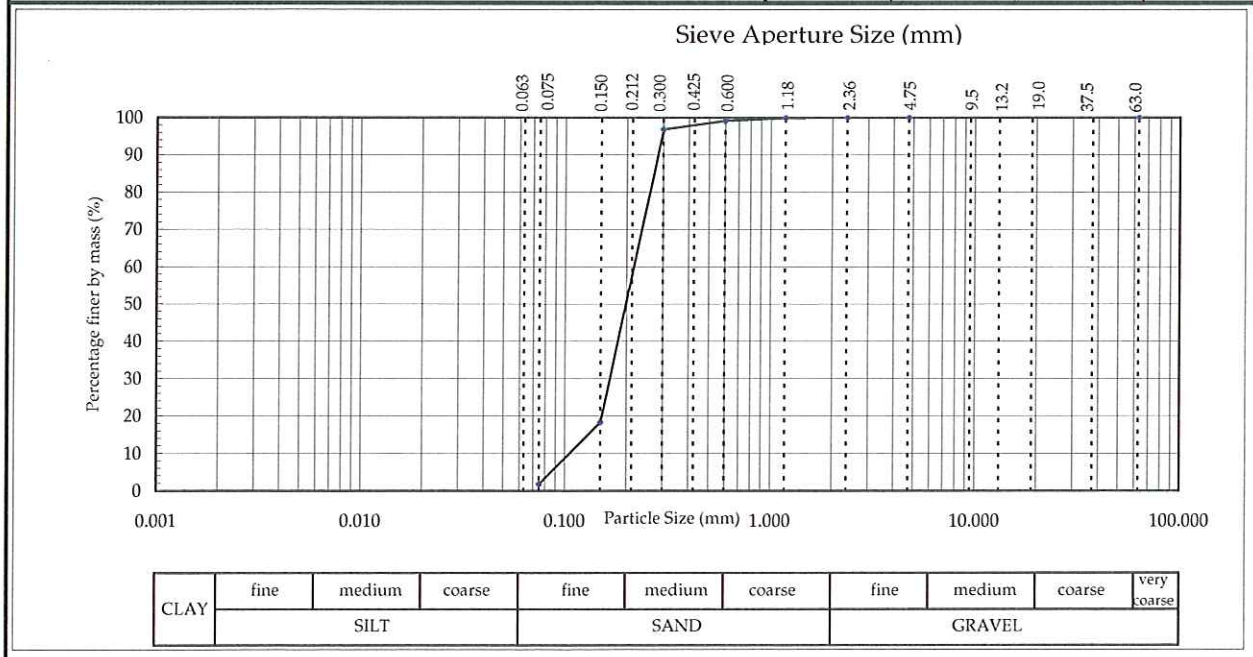
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC6 - 0.6m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**assumed**
Water Content (as received):	**26.7 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	97	--	--	--	--
37.5	--	2.36	100	0.212	--	--	--	--	--
19.0	--	1.18	100	0.150	18	--	--	--	--
13.2	--	0.600	99	0.075	2	--	--	--	--
9.5	--	0.425	--	0.063	--	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 12/06/08

11/07/08

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IANZ Approved Signatory Denys Searls
Designation : Laboratory Manager
Date : 7/07/08

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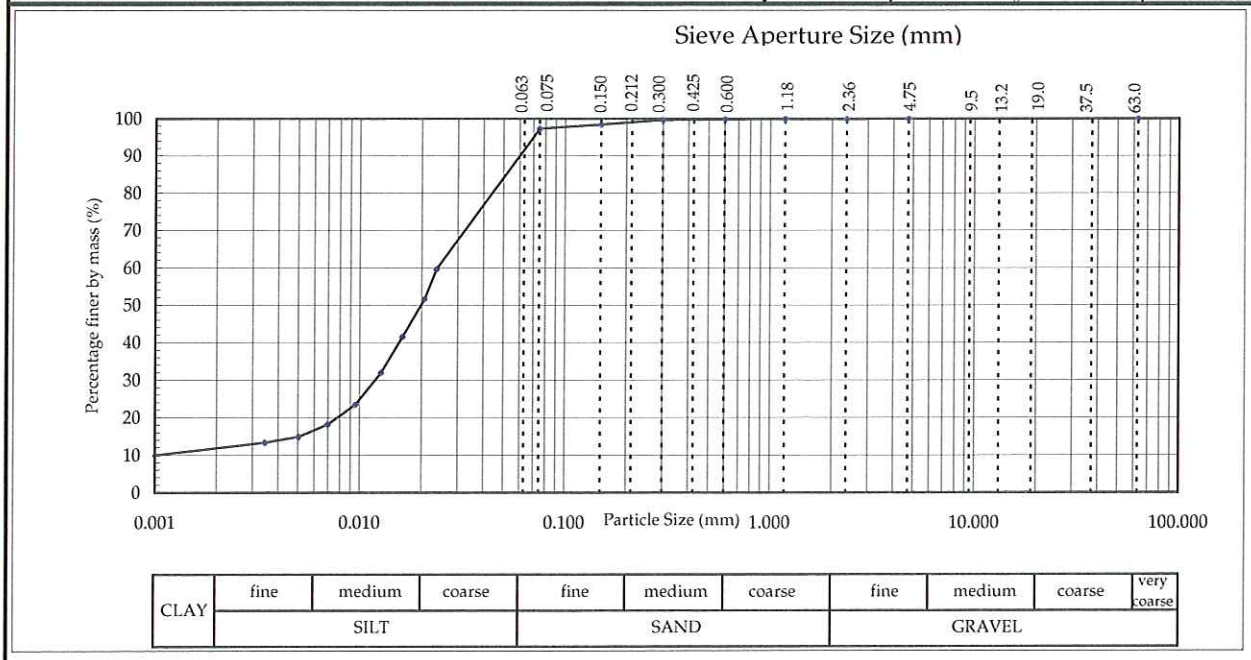
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 8 - 0.6m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.70 assumed**
Water Content (as received):	**35.3 %**

Project No: **6-CGP00.01 015LD**
Lab Ref No: **OPU.D8-07**
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	0.0236	60	0.0050	15
37.5	--	2.36	100	0.212	--	0.0207	52	0.0035	13
19.0	--	1.18	100	0.150	98	0.0161	42	0.0009	10
13.2	--	0.600	100	0.075	97	0.0127	32	--	--
9.5	--	0.425	--	0.063	--	0.0095	23	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0070	18		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 9.0

Date Tested: 12/06/08

11/07/08

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Designation : Laboratory Manager
Date : 7/07/08

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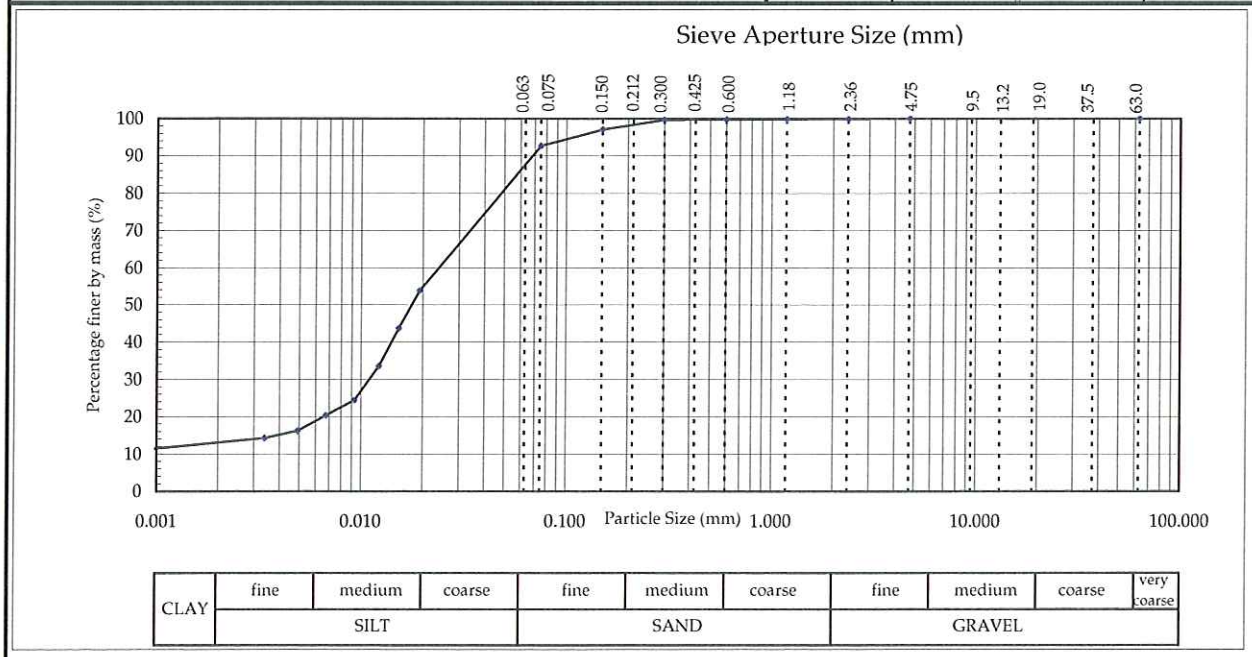
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 12 - 0.7m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.75 assumed**
Water Content (as received):	**38.1 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	0.0193	54	0.0034	14
37.5	--	2.36	100	0.212	--	0.0153	44	0.0009	11
19.0	--	1.18	100	0.150	97	0.0122	34	--	--
13.2	--	0.600	100	0.075	93	0.0093	24	--	--
9.5	--	0.425	--	0.063	--	0.0067	20	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0049	16		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 9.0

Date Tested: 12/06/08

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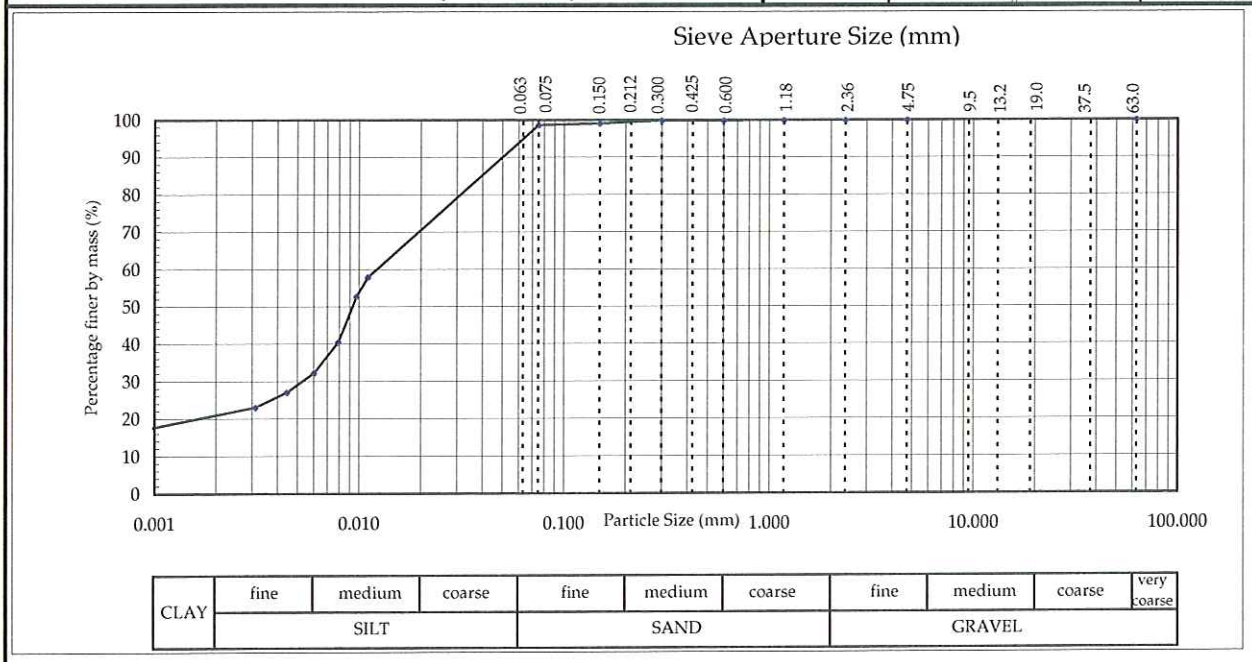
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Port Otago**
Client :	**Port Otago**
Client/Sample Ref :	**VC 14 - 0.8m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**In suspension**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.70** **assumed**
Water Content (as received):	**58.1** **%**

Project No: **6-CGP00.01 015LD**
Lab Ref No: **OPU.D8-07**
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	0.0110	58	0.0008	17
37.5	--	2.36	100	0.212	--	0.0097	53	--	--
19.0	--	1.18	100	0.150	99	0.0079	40	--	--
13.2	--	0.600	100	0.075	99	0.0060	32	--	--
9.5	--	0.425	--	0.063	--	0.0045	27	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0031	23		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 9.0

Date Tested: 12/06/08

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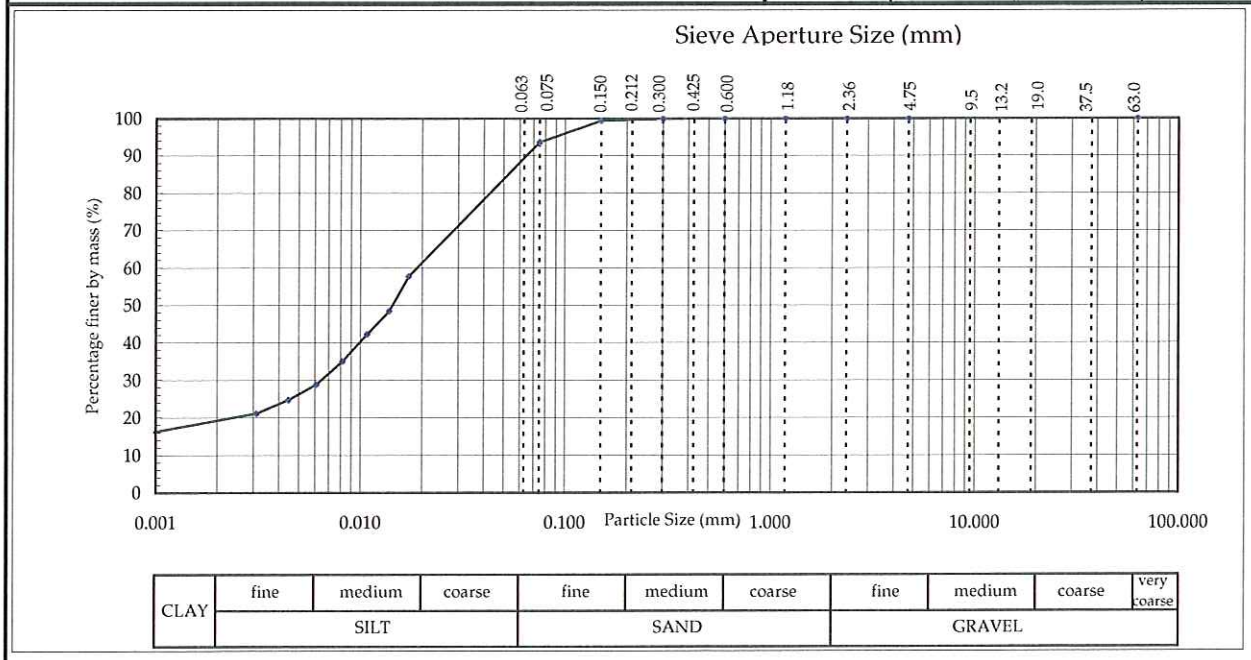
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 23 - 1.6m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.75 assumed**
Water Content (as received):	**42.4 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	0.0172	58	0.0031	21
37.5	--	2.36	100	0.212	--	0.0138	48	0.0008	15
19.0	--	1.18	100	0.150	99	0.0108	42	--	--
13.2	--	0.600	100	0.075	94	0.0082	35	--	--
9.5	--	0.425	--	0.063	--	0.0061	29	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0045	25		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 9.0

Date Tested: 12/06/08

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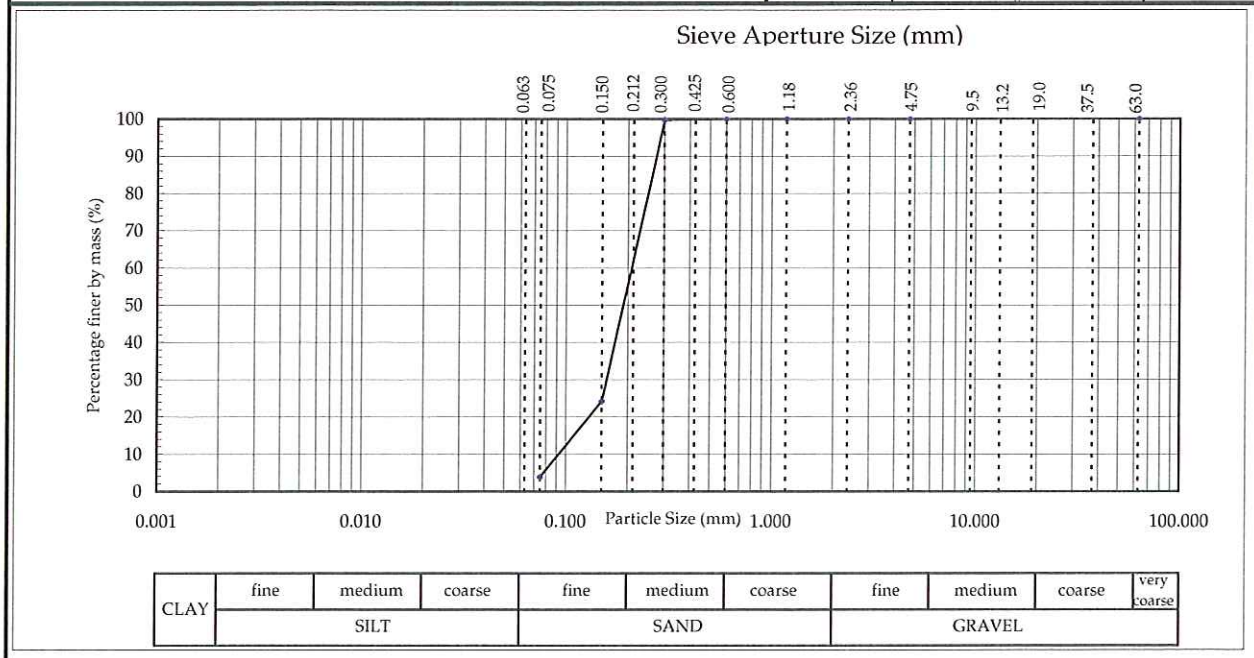
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 29 - 2.15m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**NA assumed**
Water Content (as received):	**25.0 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	--	--	--	--
37.5	--	2.36	100	0.212	--	--	--	--	--
19.0	--	1.18	100	0.150	24	--	--	--	--
13.2	--	0.600	100	0.075	4	--	--	--	--
9.5	--	0.425	--	0.063	--	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 12/06/08

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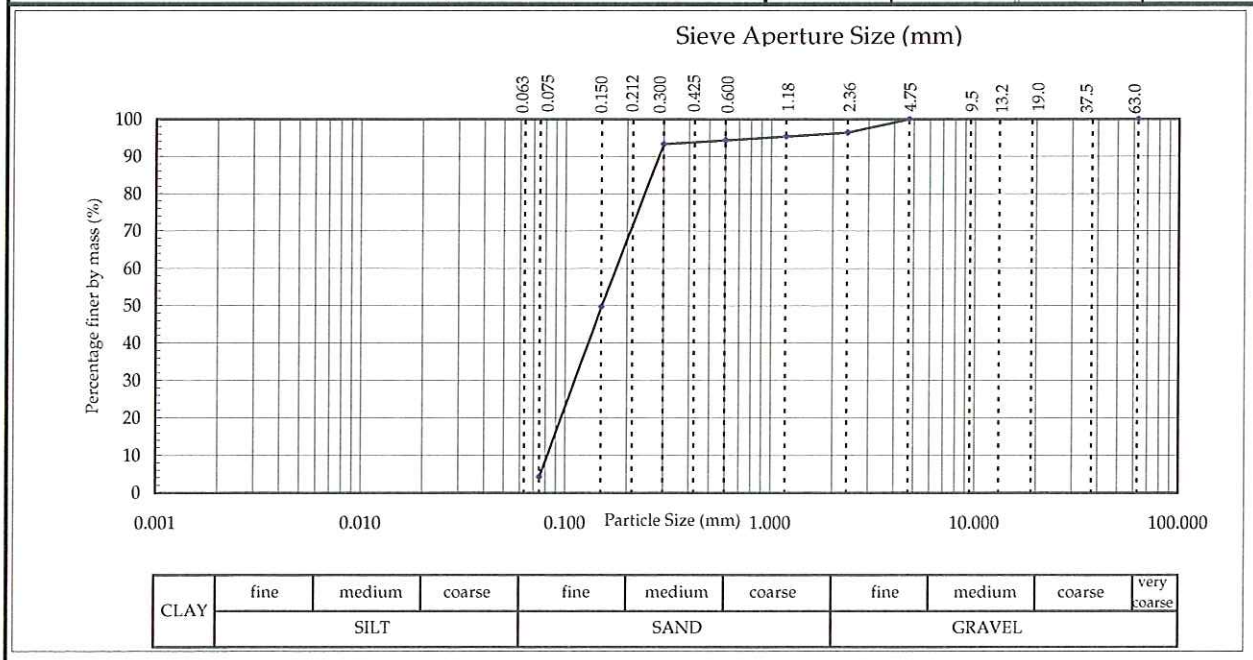
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 41 - 2.0m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**NA** assumed
Water Content (as received):	**27.9** %

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	93	--	--	--	--
37.5	--	2.36	96	0.212	--	--	--	--	--
19.0	--	1.18	95	0.150	50	--	--	--	--
13.2	--	0.600	94	0.075	4	--	--	--	--
9.5	--	0.425	--	0.063	--	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 12/06/08

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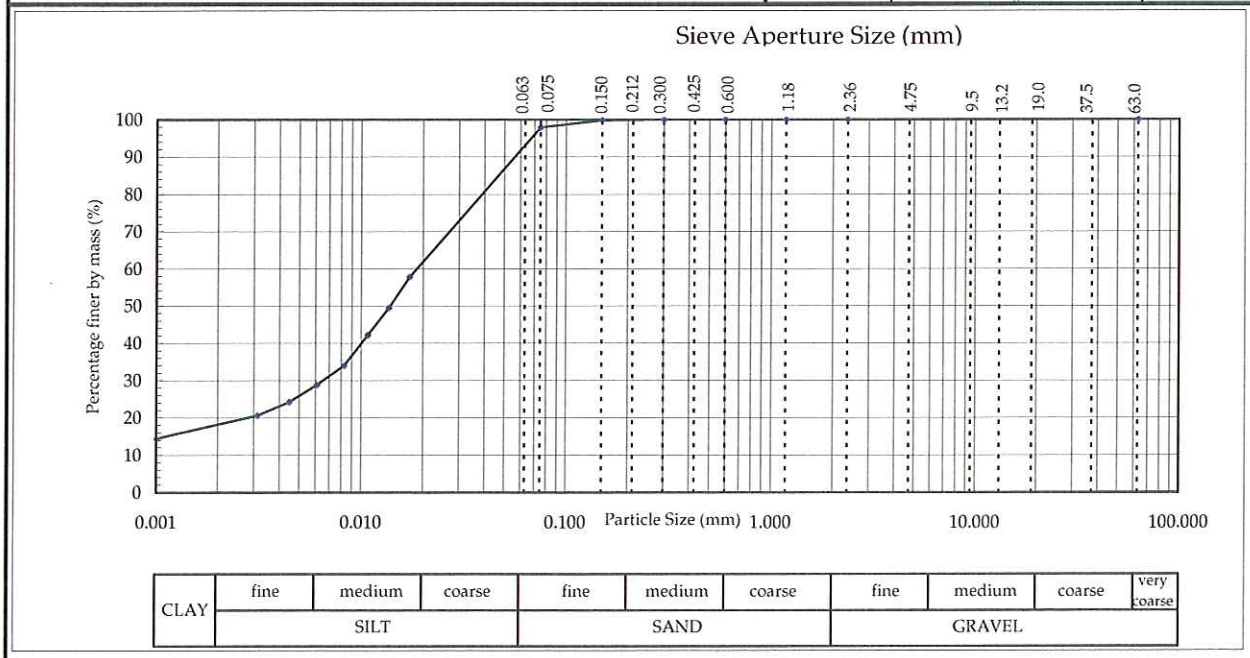
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 45 - 2.2m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.75 assumed**
Water Content (as received):	**42.5 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	0.0172	58	0.0031	21
37.5	--	2.36	100	0.212	--	0.0136	50	0.0008	13
19.0	--	1.18	100	0.150	100	0.0108	42	--	--
13.2	--	0.600	100	0.075	98	0.0083	34	--	--
9.5	--	0.425	--	0.063	--	0.0061	29	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0045	24		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 10.0

Date Tested: 12/06/08

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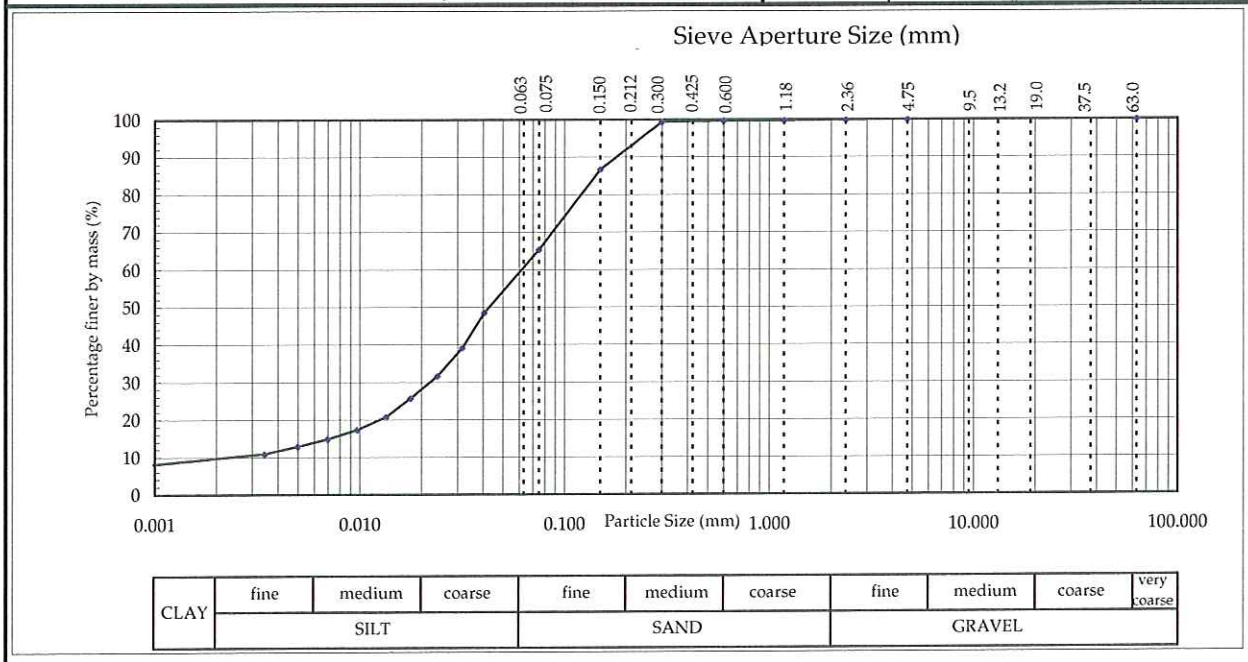
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 49 - 2.3m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**2.75 assumed**
Water Content (as received):	**31.3 %**

Project No: **6-CGP00.01 015LD**
Lab Ref No: **OPU.D8-07**
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	0.0405	49	0.0070	15
37.5	--	2.36	100	0.212	--	0.0316	39	0.0050	13
19.0	--	1.18	100	0.150	87	0.0239	32	0.0034	11
13.2	--	0.600	100	0.075	65	0.0177	26	0.0009	8
9.5	--	0.425	--	0.063	--	0.0134	21	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0097	17		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 10.0

Date Tested: 12/06/08

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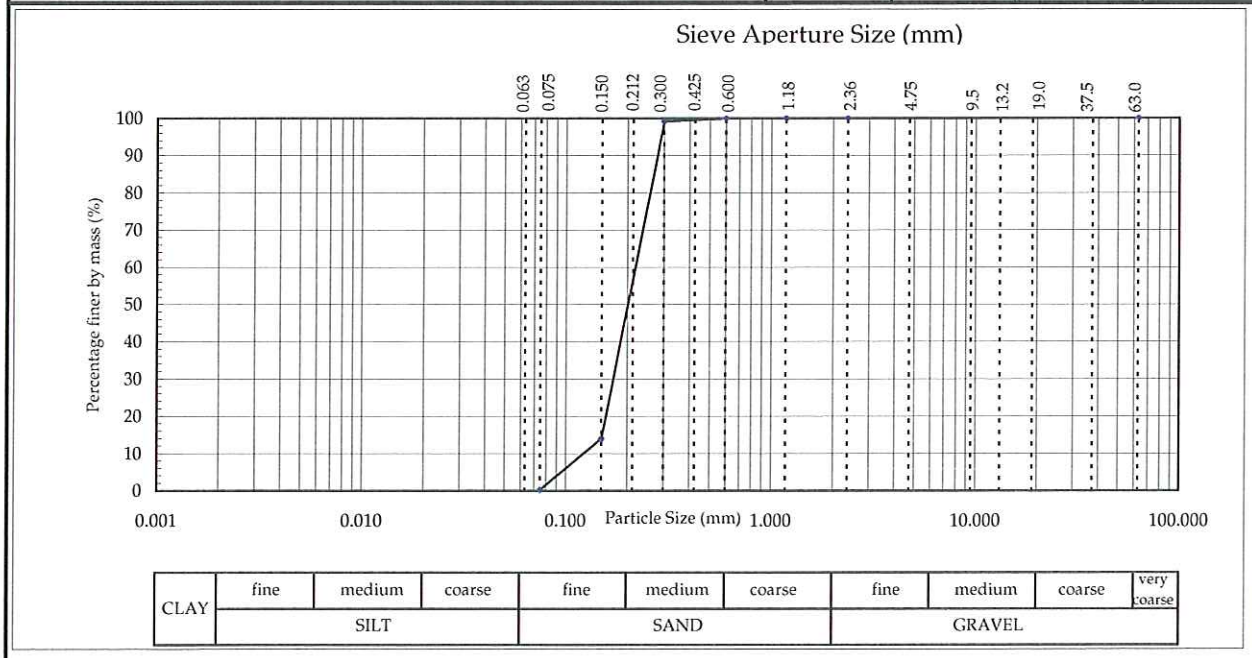
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 50 - 1.6m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**NA assumed**
Water Content (as received):	**26.4 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	--	--	--	--
37.5	--	2.36	100	0.212	--	--	--	--	--
19.0	--	1.18	100	0.150	14	--	--	--	--
13.2	--	0.600	100	0.075	0	--	--	--	--
9.5	--	0.425	--	0.063	--	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 12/06/08

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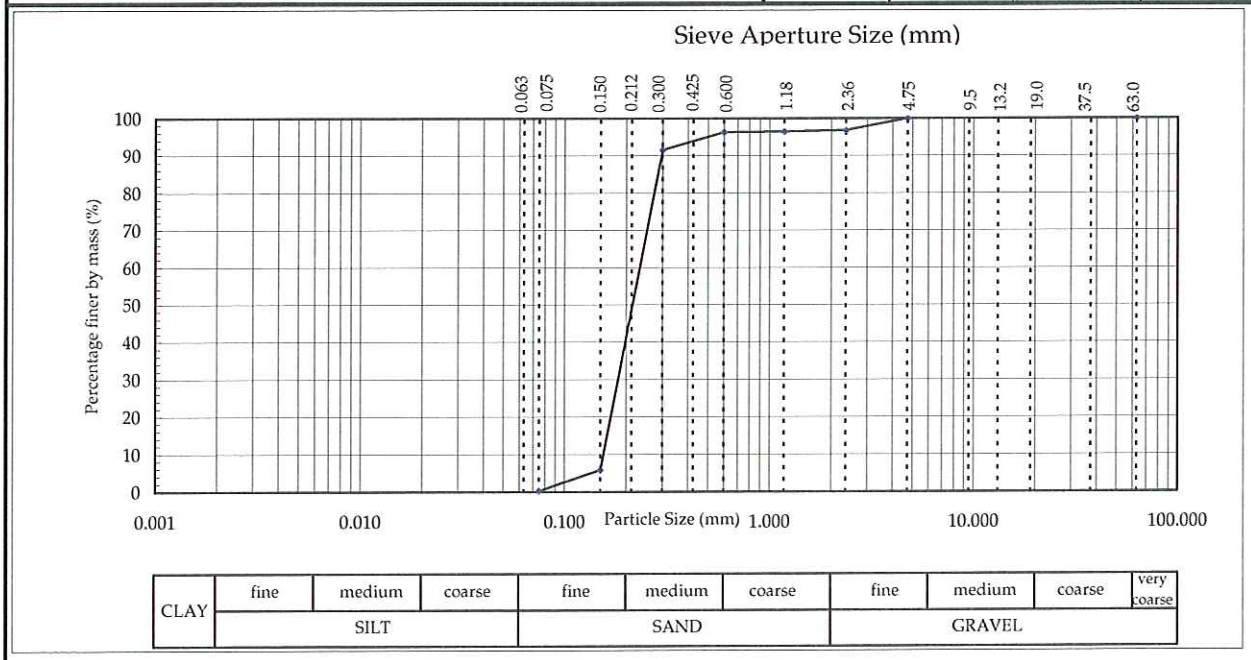
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 54 - 1.8m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**NA assumed**
Water Content (as received):	**22.9 %**

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	92	--	--	--	--
37.5	--	2.36	97	0.212	--	--	--	--	--
19.0	--	1.18	97	0.150	6	--	--	--	--
13.2	--	0.600	96	0.075	0	--	--	--	--
9.5	--	0.425	--	0.063	--	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 12/06/08

11/07/08

Sampling is not covered by IANZ Accreditation

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IANZ Approved Signatory Denys Searls
Designation : Laboratory Manager
Date : 7/07/08

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csf 2100 (8/02)

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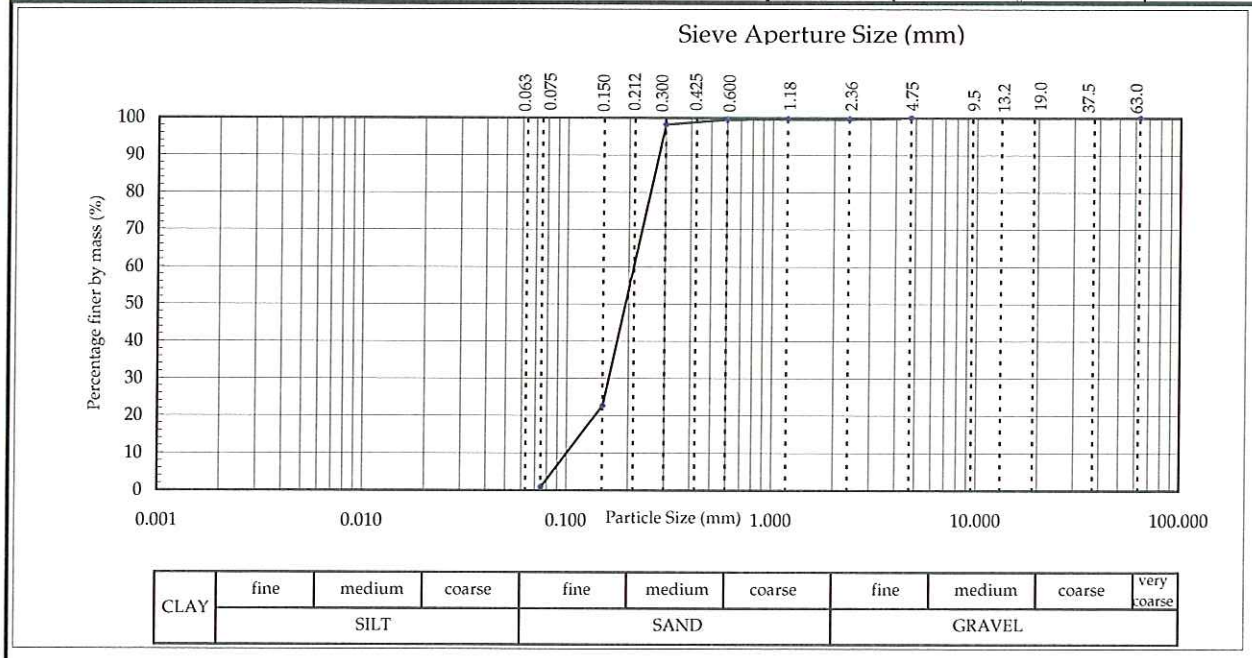
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project :	**Project Next Generation**
Location :	**Deep Water Channel**
Client :	**Port Otago**
Client/Sample Ref :	**VC 59 - 1.4m below seabed level**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date received :	**5/04/08**
Sampling method :	**Vibro Core**
Sample condition :	**Moist**
Sample description :	**Marine Sediments**
Solid Particle Density (t/m^3):	**NA** assumed
Water Content (as received):	**26.1** %

Project No:	**6-CGP00.01 015LD**
Lab Ref No:	**OPU.D8-07**
Client Ref:	

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	98	--	--	--	--
37.5	--	2.36	100	0.212	--	--	--	--	--
19.0	--	1.18	100	0.150	23	--	--	--	--
13.2	--	0.600	100	0.075	1	--	--	--	--
9.5	--	0.425	--	0.063	--	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 12/06/08

11/07/08

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Atterberg Limits

PLASTICITY INDEX TEST REPORT

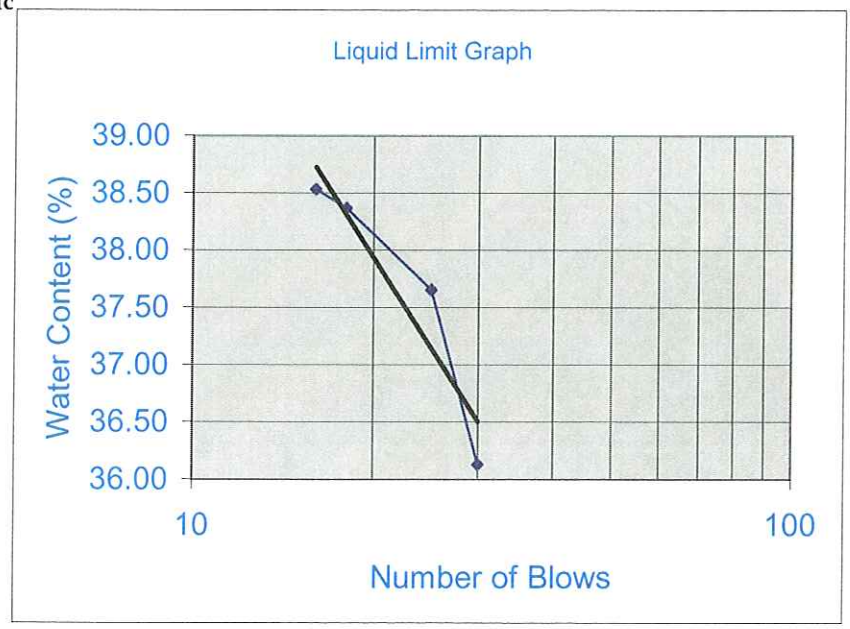
Project :	**Project Next Generation**
Location :	**VC 8 - 0.6m below seabed level**
Client :	**Port Otago**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date sampled :	**5/04/08**
Sample condition :	**Moist**
Sample description :	**Marine Sediment**
Sampling method:	**Vibro Core**
Tested by:	**Jon**

Project No :	6-CGPOO.01 015LD
Lab Ref No :	OPU.D8/07
Client Ref No	

Test Results

Test Method.
NZS 4402: 1986 Tests 2.2, 2.3, 2.4

Fraction Tested	Whole soil
Sample History:	Natural
Liquid Limit:	**37**
Plastic Limit:	**Non Plastic**
Plasticity Index:	**NA**
As received WC %	**35.3**



Note: Liquid Limit is the water content value corresponding to 25 blows on the graph.

Date tested : 12/06/08

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PLASTICITY INDEX TEST REPORT

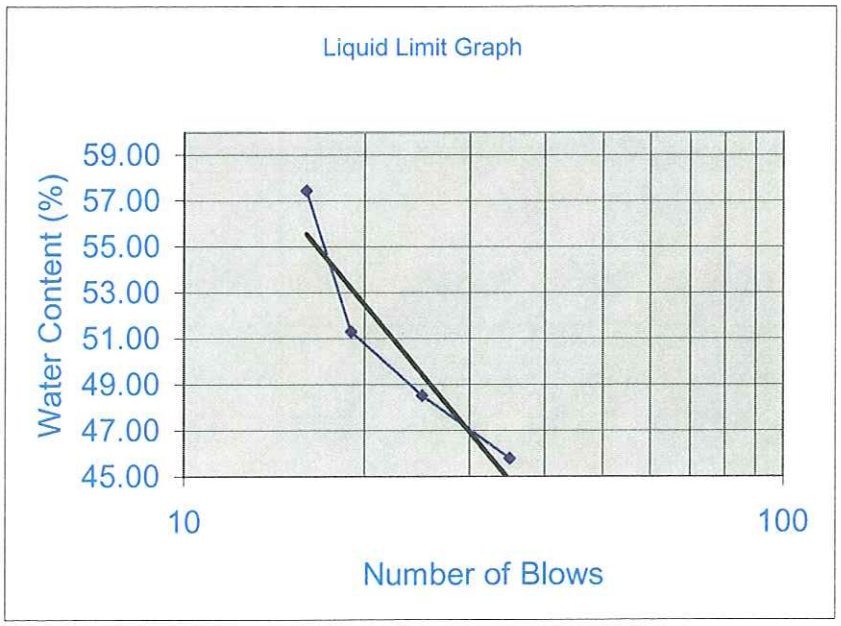
Project :	**Project Next Generation**
Location :	**VC 14 - 0.8m below seabed level**
Client :	**Port Otago**
Contractor :	**N/A**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**
Date sampled :	**5/04/08**
Sample condition :	**Moist**
Sample description :	**Marine Sediment**
Sampling method:	**Vibro Core**
Tested by:	**Jon**

Project No :	6-CGPOO.01 015LD
Lab Ref No :	OPU.D8/07
Client Ref No	

Test Results

Test Method.
NZS 4402: 1986 Tests 2.2, 2.3, 2.4

Fraction Tested	Whole soil
Sample History:	Natural
Liquid Limit:	**50**
Plastic Limit:	**28**
Plasticity Index:	**22**
As received WC %	**52.5**



Note: Liquid Limit is the water content value corresponding to 25 blows on the graph.

Date tested : 12/06/08

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PLASTICITY INDEX TEST REPORT

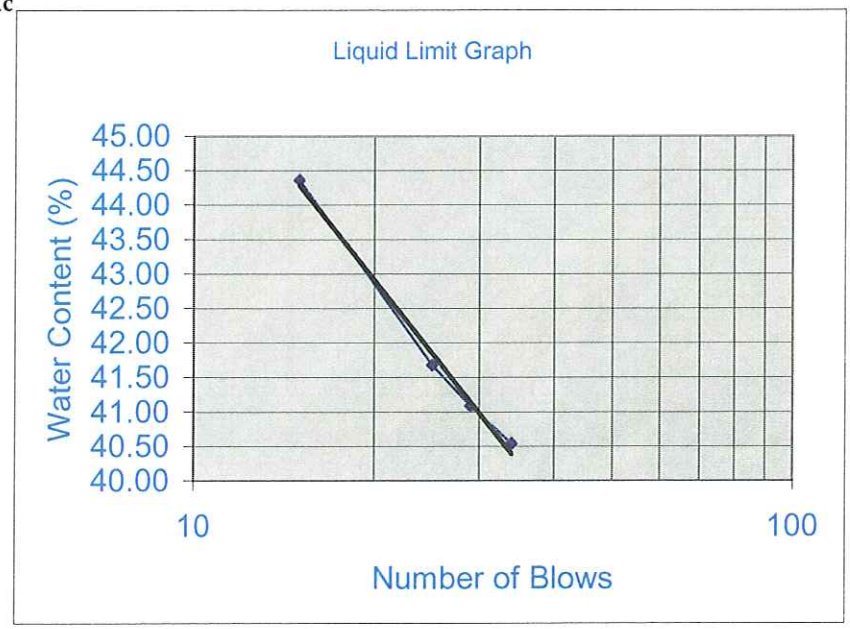
Project :	Project Next Generation
Location :	VC 46 - 1.6m below seabed level
Client :	Port Otago •
Contractor :	N/A
Sampled by :	Quaternary Resources Ptl Ltd (Bobby)
Date sampled :	5/04/08
Sample condition :	Moist
Sample description :	Marine Sediments
Sampling method:	Vibro Core
Tested by:	Jon

Project No :	6-CGPOO.01 015LD
Lab Ref No :	OPU.D8/07
Client Ref No	

Test Results

Test Method.
NZS 4402: 1986 Tests 2.2, 2.3, 2.4

Fraction Tested	Whole soil
Sample History:	Natural
Liquid Limit:	42
Plastic Limit:	Non Plastic
Plasticity Index:	NA
As received WC %	37.6



Note: Liquid Limit is the water content value corresponding to 25 blows on the graph.

Date tested : 12/06/08

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Designation : *Laboratory Manager*
Date : 7/07/08

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Unconfined Compressive Strength

UCS REPORT

Project :	Project Next Generation
Location :	Otago Harbour
Client :	Port Otago Ltd
Contractor :	Downer EDI Works Ltd
Sampled by :	Downer EDI Works Ltd
Date sampled :	25/05/08
Sampling method :	Taken from core
Sample description :	60mm Core Sample
Sample condition :	Moist
Bore Number:	3
Test Depth:	14.0m below chart datum

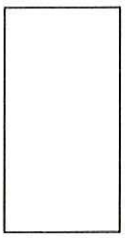
Project No :	6-CGP00.01 015LD
Lab Ref No :	OPU.D8/06
Client Ref No :	

Test Results

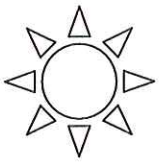
Depth	(m)	14.15			
Height	(mm)	121.6	Area	(mm	2941.66
Diameter	(mm)	61.2	Volume	(c	357.71
Height/Diameter Ratio		1.99	Correction		0.943
Mass in Air	(g)	938			
Mass in Water	(g)	586			
Volume	(cc)				
Wet Density	(t/m^3)	2.62			
Dry Density	(t/m^3)	2.62			
Failure Load	(N)	319827			
Failure Stress	(kPa)	108723.24			
Corrected Stress	(kPa)	101472.1			
Deformation	(mm)	1.3			
Strain	(ΔL/Lo)	0.0103			

Water Content

Before Test



After Test



Rate of axial Compression: 1mm/min

Mode of Failure Brittle/explosive

Test Method: NZS 4402: 1986 Test 6.3.1

Date tested : 5/05/08
Date reported : 5/05/08

Authorised Signatory:
Denys Searls *Laboratory Manager*
11/07/08

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UCS WORKSHEET

Project :	**Project Next Generation**
Location :	**Otago Harbour**
Client :	**Port Otago Ltd**
Contractor :	**Downer EDI Works Ltd**
Sampled by :	**Downer EDI Works Ltd**
Date sampled :	**25/05/08**
Sampling method :	**Taken from core**
Sample description :	**60mm Core Sample**
Sample condition :	**Moist**
Bore Number:	**4**
Test Depth:	**12.75m below chart datum**

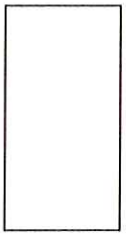
Project No :	**6-CGP00.01 015LD**
Lab Ref No :	**OPU.D8/06**
Client Ref No :	

Test Results

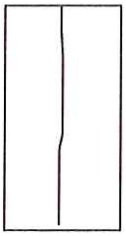
Depth	(m)	14.15			
Height	(mm)	121.6	Area	(mm	2941.66
Diameter	(mm)	61.2	Volume	(cc	357.71
Height/Diameter Ratio		1.99	Correction		
Mass in Air	(g)	938			
Mass in Water	(g)	586			
Volume	(cc)				
Wet Density	(t/m^3)	2.62			
Dry Density	(t/m^3)	2.62			
Failure Load	(N)	185000			
Failure Stress	(kPa)	62889.62			
Corrected Stress	(kPa)	0.0			
Deformation	(mm)	1.3			
Strain	($\Delta L/Lo$)	0.0103			

Water Content

Before Test



After Test



Rate of axial Compression: 1mm/min

Mode of Failure Brittle

Test Method: NZS 4402: 1986 Test 6.3.1

Date tested : 5/05/08
Date reported : 5/05/08

Authorised Signatory:
Denys Searls *Laboratory Manager*
11/07/08

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Shear Strength – Cohesive Sediments

TEST REPORT

Project No :	6-CGPOO.01 015LD
Lab Ref No :	OPU.D8/07
Client Ref No :	

Project :	**Project Next Generation**	Date sampled:	**05/04/08**
Location :	**Dunedin**	Sampling method :	**Vibrating Core**
Client :	**Port Otago Ltd**	Sample Description:	**Silt-clay**
Contractor :	**N/A**	Sample condition :	**Moist-wet**
Sampled by :	**Quaternary Resources Ptl Ltd (Bobby)**		

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Test Results

Shear Stress Results (N.Z Geotechnical Soc Inc 8/2001) VC8 - 0.6m below seabed level

Pilcon shear vane number		CL-600						
Peak vane reading		1.5	2.0	2.0	2.5			
Remoulded vane reading		0.8	1.0	1.0	1.3			
Peak shear strength	kPa	14	19	19	24	-	-	-
Remoulded shear strength	kPa	7	10	10	12	-	-	-

Shear Stress Results (N.Z Geotechnical Soc. Inc 8/2001) VC14 - 0.8m below seabed level

Pilcon shear vane number		CL-600						
Peak vane reading		1.3	1.5	1.5	2.3			
Remoulded vane reading		0.8	0.8	0.8	1.0			
Peak shear strength	kPa	12	14	14	22	-	-	-
Remoulded shear strength	kPa	7	7	7	10	-	-	-

Date tested : 10/06/08
11/07/08

Approved
Denys Searls
Designation : *Laboratory Manager*
Date : 23/06/08

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Solid Density

DETERMINATION OF SOLID DENSITY REPORT

Project No :	6-CGPOO.01 015LD
Lab Ref No:	OPU D8/07
Client Ref No	

Project :	Project Next Generation
Location :	Dunedin
Client / Contractor :	Port Otago
Client Ref :	VC 12, VC 14, VC 50
Sampled By :	Quaternary Resources Ptl Ltd (Bobby)
Date Received :	5/04/08
Sampling Method	not stated
Sample Description :	Marine Sediments
Sample Condition :	moist - wet
Tested By	Jon
Date Tested	17/06/08

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TEST RESULTS

VC 12 - 0.7m below seabed level	Value	**2.76 t/m^3**
	Material Used	**SILT**
	History	**Oven Dried**
VC 14 - 0.8m below seabed level	Value	**2.75 t/m^3**
	Material Used	**CLAY**
	History	**Oven Dried**
VC50 - 1.6m below seabed level	Value	**2.68 t/m^3**
	Material Used	**SAND**
	History	**Oven Dried**

Testing carried out in accordance with: **NZS 4402 : 1986 Test 2.7.2**

Checked By: Denys
Date Checked: 17/06/08
Date Reported: 11/07/08
IANZ Approved Signatory - Denys Searls

Designation : *Laboratory Manager*

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Opus International Consultants Ltd	**Lab No:**	643983 SPv1
Contact:	Greene, Shane	**Date Registered:**	29-May-2008
	c/o Opus International Consultants Ltd	**Date Reported:**	12-Jun-2008
	Private Bag 1913	**Quote No:**	32850
	DUNEDIN	**Order No:**	
		Client Reference:	Port Otago Ltd, Port
		Submitted By:	Hanz, Markus

Sample Type: Sediment

Sample Name:		VC05 0-0.5m 27-May-2008 7:00 pm	VC21 0-0.5m 27-May-2008 6:30 pm	VC12 0-0.5m 27-May-2008 6:45 pm	VC34 0-0.5m 27-May-2008 4:50 pm	VC47 0-0.5m 27-May-2008 11:40 am
Lab Number:		643983.1	643983.4	643983.7	643983.10	643983.13
Individual Tests						
Total Cyanide*	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Nitrogen	g/100g dry wt	< 0.051	< 0.051	< 0.051	< 0.051	0.082
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	7.1	< 2.0	7.9	< 2.0	3.3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	17	2.5	16	2.6	8.9
Total Recoverable Copper	mg/kg dry wt	6.7	< 2.0	6.0	< 2.0	4.4
Total Recoverable Lead	mg/kg dry wt	7.1	0.79	6.7	0.81	4.3
Total Recoverable Nickel	mg/kg dry wt	11	2.2	10	2.1	7.2
Total Recoverable Zinc	mg/kg dry wt	44	8.1	42	6.8	27
Polycyclic Aromatic Hydrocarbons Trace in Soil						
Acenaphthene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Acenaphthylene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Anthracene	mg/kg dry wt	0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Benzo[a]anthracene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Benzo[k]fluoranthene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Chrysene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Fluoranthene	mg/kg dry wt	0.0021	< 0.0020	< 0.0020	0.0020	< 0.0020
Fluorene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Naphthalene	mg/kg dry wt	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	mg/kg dry wt	< 0.0020	0.0025	< 0.0020	< 0.0020	0.0049
Pyrene	mg/kg dry wt	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Poychlorinated Biphenyls Trace in Soil						
PCB-101	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-105	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-110	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-114	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-118	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-121	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-123	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-126	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010

Sample Type: Sediment						
Sample Name:		VC05 0-0.5m 27-May-2008 7:00 pm	VC21 0-0.5m 27-May-2008 6:30 pm	VC12 0-0.5m 27-May-2008 6:45 pm	VC34 0-0.5m 27-May-2008 4:50 pm	VC47 0-0.5m 27-May-2008 11:40 am
Lab Number:		643983.1	643983.4	643983.7	643983.10	643983.13
Poychlorinated Biphenyls Trace in Soil						
PCB-128	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-138	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-141	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-149	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-151	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-153	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-156	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-157	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-159	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-167	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-169	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-170	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-180	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-189	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-194	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-206	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-209	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-28 + PCB-31	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-44	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-49	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-52	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-60	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-77	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-81	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB-86	mg/kg dry wt	< 0.00099	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total PCB (Sum of 33 congeners)	mg/kg dry wt	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total Petroleum Hydrocarbons in Soil						
Dry Matter	g/100g as rcvd	75	80	74	80	77
C7 - C9	mg/kg dry wt	< 8.5	< 8.8	< 9.0	< 8.5	< 9.2
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	< 30	< 30	< 30	< 30	< 30
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 60	< 60	< 60	< 60	< 60

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Environmental Solids Sample Preparation*	Air dried at 35°C and sieved, <2mm fraction.	-	1, 4, 7, 10, 13
Heavy metal screen level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1, 4, 7, 10, 13
Polycyclic Aromatic Hydrocarbons Trace in Soil	Sonication extraction, SPE cleanup, GC-MS SIM analysis	-	1, 4, 7, 10, 13
Poychlorinated Biphenyls Trace in Soil	Sonication extraction, SPE cleanup, GPC cleanup (if required), GC-MS analysis	-	1, 4, 7, 10, 13
Total Petroleum Hydrocarbons in Soil	Sonication extraction, Silica cleanup, GC-FID analysis	-	1, 4, 7, 10, 13
Dry Matter (Org)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1, 4, 7, 10, 13
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2	-	1, 4, 7, 10, 13
Total Cyanide Distillation*	Distillation of sample as received. APHA 4500-CN^- C & E 21st ed. 2005.	-	1, 4, 7, 10, 13

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Total Cyanide*	Distillation, colorimetry. APHA 4500-CN^- C & E 21st ed. 2005.	0.10 mg/kg dry wt	1, 4, 7, 10, 13
Total Nitrogen	Catalytic Combustion (900°C, O_2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.050 g/100g dry wt	1, 4, 7, 10, 13

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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