

# **Rangitaiki River Stopbanks Assessment**

## **Section 4**

**Right Bank 4800 to 6300m**

Prepared for

**Environment Bay of Plenty**

**April 2009**



## Contents

1	Introduction	1
2	Site Description	2
3	Subsurface Investigations	2
4	Laboratory Test Results	3
5	Analyses	
5.1	Discussion	4
5.2	Flood Hydrograph	5
5.3	Soil Model	5
5.4	Cross Section 1	7
5.5	Cross Section 2	8
5.6	Cross Section 3	8
5.7	Cross Section 4	8
5.8	Cross Section 5	9
5.9	Cross Section 6	9
5.10	Cross Section 7	9
5.11	Cross Section 8	9
5.12	Cross Section 9	10
5.13	Cross Section 10	10
6	Conclusions	11
	References	12

## Appendices

Appendix A Hand Auger and Test Pit Logs

Appendix B Laboratory Tests

## 1 Introduction

There is a large bend in the Rangitaiki River between 4800m and 6300m from the river mouth. On the right bank there is a low lying area of farm land encompassed by the bend and East Bank Road. In the centre of this area the ground level is as low as 0.1m (Moturiki Datum) (Figure 1). During the flood of 2004 this area was flooded with sufficient depth of water to wash debris over deer fences. No seepage through or under the local stopbank was observed in the wet conditions before this inundation. The flooding of the land greatly reduced the differential head across the stopbank and consequently the risk of piping or heaving problems was diminished.

In response to the questionnaire sent out to landowners along the river in 2005, the farmer identified sponginess and seepage in the centre of the area contained by the bend (Reference 1). The crest of the stopbank around the bend is typically at RL4.6, thus in flood conditions there is a significant head difference between the river and the internal ground surface. In the 1987 earthquake there was transverse cracking over 100mm wide in the stopbank around the bend. This could have been related to the liquefaction of soils within old flow paths under the stopbank.

It was considered that the security of the stopbank along the bend in the river should be investigated due to the farmer's observations and the history of this section of stopbank. These investigations have shown that there could be potential heave and piping problems.

This report presents the following information:

- the results of insitu investigations,
- laboratory grading test results,
- the results of seepage analyses for the estimated 100 year return period flood and
- possible remedial measures.

This report is the property of our client, Environment Bay of Plenty and Ice Geo and Civil. The comments within relate only to the length of stopbank along the Rangitaiki River right bank from 4800m to 6300m. The conclusions of this report are based on the interpretation of investigations carried out at isolated points only and limited laboratory testing. Therefore some ground or other conditions, such as buried culverts, which may have an effect on the integrity of the stopbank may not have been identified.

## 2 Site Description

Old flow paths across the land contained by the bend can be identified as shallow depressions on aerial photographs and the LIDAR plot (Figure 1). The natural levee forming processes of the river have isolated the low lying basin within the bend from normal river flows and allowed the formation of a peat swamp. The ground surface is typically at RL0.1 to 0.6 and the surface of the peat is now about 1.5m below the ground surface. The East Bank Road embankment forms an artificial boundary to the basin to the east. The basin is about 800m wide parallel to the road. Pumped drainage is presently used to allow farming activities. Some sub-surface drainage has been installed to try to reduce winter pugging problems.

The ground surface rises to about RL3.0 towards the tightest part of the river bend. A house has been built on a small area rising to about RL3.6 near Cross Section 3 (Figure 2) since the aerial photograph was taken.

At the inland toe of the stopbank the difference in height from the ground to the crest of the stopbank ranges from 0.9 to 1.7m. However within 100m of the toe of the stopbank the height difference is up to 4.5m. There is a river berm around most of the bend except for the length from about Cross Section 7 to Cross Section 9 where some rock protection has been placed. The level of the river berm varies. Around the apex of the bend the berm has been lowered to provide fill for stopbank construction so that in this area it is now just above the normal river level. Elsewhere the berm level is similar to the internal ground level. The berm is typically 25m wide around the apex of the bend and 10m wide elsewhere.

## 3 Subsurface Investigations

The subsurface investigations carried out consisted of 33 hand augers and six test pits. The augers were spaced to provide 10 cross sections through the stopbank around the bend and to pick up obvious changes in ground geometry and soil conditions (Figure 2). The test pits were carried out after most of the hand augers to confirm the assumptions made about coarse sand underlying the central basin. The findings of the subsurface investigations were similar to those from investigations carried out for the raising of the stopbanks in 2002.

The hand augers were continued until the holes collapsed below ground water level, the holes squeezed in or over 4.0m depth was achieved. The hand auger and test pit logs are included in Appendix A and Figures 4 to 13 show the assumed sub surface profiles of the cross sections analysed. These profiles have been simplified to show layers of significantly different permeability, not each individual change in soil layer.

The near surface soils found along the study length are predominantly silts, clayey silts and silty fine sands. Layers of coarse sand and fine pumice lapilli were found above normal river level in augers within the elevated river levee and between RL-0.9 and RL-1.2 in the deep part of the basin. In some of the





augers an undisturbed Tarawera Ash layer could be identified. This is a medium to coarse grained black sand.

Organic material was found in bands in clayey silt and silty sand layers in several augers in the higher investigations. In the low part of the basin peat was found beneath 1.3 to 1.6m of silt and sand. The thickest layer of peat found within the depth of investigation was 0.6m. More than one layer of peat was found at some locations inter-bedded with sand and silt layers. This layering and depth to peat indicates the dynamic nature of soil deposition before the stopbank was built.

The particle size within the sand layers varied significantly and rapidly across all the investigations. Medium to coarse sands were found at most locations and at some locations pure pumice lapilli (up to 2mm) layers were found.

#### 4 Laboratory Test Results

Hydrometer particle grading tests were carried out on nine samples of subsurface soils with a range of particle gradings to enable estimation of the soil permeability using the Hazen formula:

$$k=0.01d_{10}^2$$

The grading test results are summarised in Table 1, which includes the results of some tests carried out by Beca (Reference 2).

**Table 1: Particle Grading Results**

Sample	Description	D <sub>10</sub> (mm)	D <sub>60</sub> (mm)	permeability (m/s)
HA1 1.0m	grey medium to coarse sand	0.03	0.5	$9.0 \times 10^{-6}$
HA1 2.2m	grey brown medium to coarse sand	0.08	0.47	$6.4 \times 10^{-5}$
HA2 0.8m	brown grey sandy silt	0.005	0.076	$2.5 \times 10^{-7}$
HA2 1.8m	grey fine sand	0.03	0.15	$9.0 \times 10^{-6}$
HA8 1.5m	grey medium to coarse sand	0.15	0.8	$2.25 \times 10^{-4}$
HA16 1.6m	grey brown sandy silt	0.005	0.036	$2.5 \times 10^{-7}$
HA19 0.8m	brown grey sandy silt	0.003	0.033	$9.0 \times 10^{-8}$
HA20 1.5m	brown grey silty sand	0.011	0.48	$1.2 \times 10^{-6}$
HA28 3.5m	grey medium sand	0.15	0.5	$2.25 \times 10^{-4}$
B1 0.3m	brown silty fine sand	0.0065	0.26	$4.2 \times 10^{-7}$
B1 1.2m	brown sandy silt	0.0027	0.025	$7.3 \times 10^{-8}$
B2 0.3m	brown sandy silt	0.0015	0.025	$2.3 \times 10^{-8}$
B3 0.5m	brown sandy silt	0.0045	0.07	$2.0 \times 10^{-7}$

The results of the laboratory tests are included in Appendix B.



## 5 Analyses

### 5.1 Discussion

The in situ investigations carried out provide subsoil profiles in isolated locations only. Although an effort has been made to build a degree of conservatism into the analysis of the stopbank cross sections, the subsurface investigations show considerable variation in the soil layers and it is possible that in terms of the seepage response to a flood in the river there are worse combinations of soil layers than those assumed.

The computer programme used to analyse the seepage problems, Geo-Slope Seep/W (2004), is a two dimensional programme. Therefore three dimensional effects such as seepage towards the central basin from right around the bend in the river can not be accurately modelled. The seepage analyses carried out must therefore be considered indicative only.

Four possible problems could arise due to a flood in the river:

- excessive flows under the stopbank
- piping of soils leading to collapse of the stopbank
- heave of upper soil layers resulting in rapid piping and stopbank collapse
- failure of either face of the stopbank due to high water level or draw down conditions.

The most common remedial measures for heave problems are the addition of an overlay on the ground surface or the construction of a pressure relief trench (or wells). As the basin is about 800m wide at its widest point an overlay would be very expensive. The use of controlled flooding of the central basin to reduce the head differential across the stopbank was also assessed for this river bend. This was considered possible as there are no structures present within the basin and the farmers have higher ground available for stock. The aim of the remedial measures is to achieve a minimum factor of safety against heave of 1.1 to 1.2.

The risk of piping can be reduced by increasing the length of the seepage path by the addition of overlays, or by installing a drain in the area susceptible to piping to allow seepage without the removal of soil particles. These drains can also reduce the risk of heave. The maximum hydraulic gradient considered acceptable with the light soils in this area is 0.4.

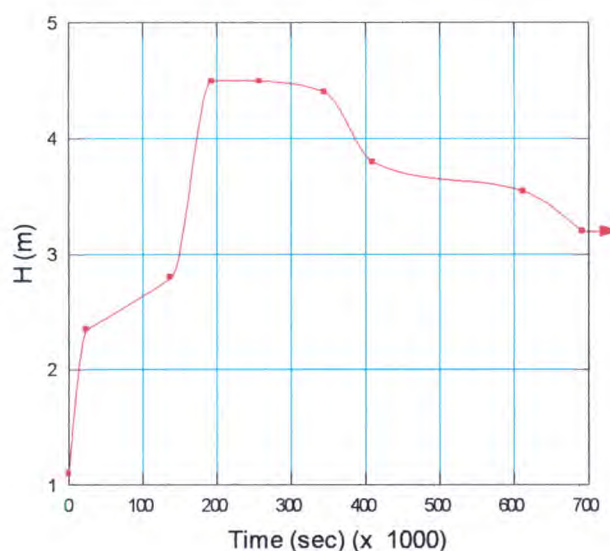
Seepage of only small volumes of water from the ground surface can significantly reduce the uplift pressures acting on a low permeability surface layer with a higher permeability layer beneath it. Seepage from the ground surface inside the stopbank has therefore been allowed for in the computer models.



## 5.2 Flood Hydrograph

EBoP has provided a 100 year return period flood flow hydrograph for the Rangitaiki River at their benchmark number R14, which is at the apex of the bend. (Figure 3). This is an eight day hydrograph which rises to a peak of RL4.6 on the third day of the flood. The crest of the stopbank varies from RL 4.5 to RL5.0 along the 1.5km study length and allows for a freeboard of about 300mm. In the analyses the hydrograph was adjusted to suit each cross section.

In the 100 year return period flood the water level stays close to the peak level for two days before beginning to drop. During the July 2004 flood the river level was very high for less than a day before there was a rapid drop due to the breach just upstream of Edgecumbe and water built up within the basin behind this section of stopbank. Therefore this flood was not a true test of this section of stopbank.



**Figure 3:** 100 year return period flood flow hydrograph

## 5.3 Soil Model

The soil layers found in the in situ investigations were simplified in the models used for the seepage analyses (Figures 4 to 13). The grading test results were compared to the field descriptions of the soils to confirm the soil categories. Below the surface layer of silt the layers were divided into silt, silty fine sand, fine to medium sand, clayey silt, medium to coarse sand and peat. Medium to coarse sands and pumice lapilli were given the same high permeability.

It was considered that due to the complex layers of deposition across the bend, subsurface flow could come from any direction and there could be influence from high permeability layers not encountered at individual test locations. The subsurface investigations showed that there were typically



high permeability layers at around RL-1.0 and that these layers were less than 1m thick. A 1 to 2m thick layer of high permeability soils was therefore assumed below the depth of the investigations if none was found at higher levels.

The permeabilities assumed were conservatively based on the grading test results for this site and grading and permeability tests for similar soils elsewhere along the river. In terms of the assessment of heave potential of the upper silt layer it is conservative to assume a permeability on the low side of that found from the tests on the upper silts and on the high side for the more permeable sand layers acting as aquifers. Table 2 summarises the saturated soil permeabilities assumed.

The Geo-Slope Seep/W (2004) computer package used for the seepage analyses contains a library of soil grading curves with corresponding hydraulic conductivity and water content versus water pressure relationships. The particle gradings observed on site were compared to those in the Seep library and the closest fit chosen as the soil model to be used in the seepage analysis.

**Table 2: Assumed Soil Permeabilities**

soil	$k_h$ (m/s)	$k_v$ (m/s)
stopbank fill	$5 \times 10^{-6}$	$2.5 \times 10^{-6}$
surface brown silt	$2 \times 10^{-7}$	$2 \times 10^{-7}$
fine sand	$2 \times 10^{-5}$	$2 \times 10^{-5}$
silty fine sand	$4 \times 10^{-6}$	$4 \times 10^{-6}$
fine to medium sand	$5 \times 10^{-5}$	$5 \times 10^{-5}$
clayey silt	$5 \times 10^{-8}$	$5 \times 10^{-8}$
medium to coarse sand and fine pumice lapilli	$5 \times 10^{-4}$	$5 \times 10^{-4}$

There was no apparent evidence of significant banding within most of the layers therefore the horizontal and vertical permeabilities were assumed to be the same for all the soils except the stopbank. It was assumed that the vertical permeability in the stopbank would be less than the horizontal due to the compaction process.

The weight of the upper silt layer was assumed to be  $15 \text{ kN/m}^3$ . As the soil will be wet during a flood the weight should be greater than that assumed. The weight of the soils below the upper silt was based on the proportion of pumice in the lower layers. Some of the grey sands near the apex of the bend are quite light.

The stopbank cross sections were generally modelled to the lowest part of the central basin. Infinite elements were then used to model flow from the river in both the initial steady state analysis and the transient flood analysis. During the initial analysis a head was specified at the infinite elements and another in the river. The inland head was based on that set by the pumped drainage

system observed on site to be at about RL0.0. The river head was set at the starting level of the 100 year flood flow hydrograph. The depth of the river bed was taken from cross sections surveyed by EBOP.

Rainfall was not modelled.

#### 5.4 Cross Section 1

Cross Section 1 is at the upstream end of the study section. The stopbank is 1.4m higher than the land on the inland side and there is an 11m wide river berm (Figure 4).

Coarse sand and fine lapilli were found in HA17 below 1.7m of clayey silt (RL-0.9) about 90m from the inland toe of the stopbank. As this layer was found in many places it was assumed that it extends under the stopbank and a steady state analysis was carried out to calibrate the model with normal river flow conditions. The model was extended to the central basin 150m from the stopbank. No heave of the surface silt layers was predicted in the central basin under normal river flow conditions.

An initial static seepage analysis was carried out assuming a ground water level of RL0.0 in the central basin and a river level of RL1.1. A transient seepage analysis was then carried out modelling the full eight days of the 100 year flood. A two hour time step was used. An allowance was made in the soil model for seepage from the ground surface inland from the stopbank.

The transient flood analysis showed that there could be a heave problem in the area of HA17 and beyond if the lapilli layer extends under the stopbank. High uplift pressures under the surface silts could be what the farmer described as sponginess in the paddocks.

If a pressure relief trench (or wells) is excavated to the lapilli layer 90m from the stopbank, the factor of safety against heave is improved. The flow from the trench could be in the order of  $2\text{m}^3$  per metre of trench per day during the flood. If trenches were excavated right around the edge of the basin about 70mm of water could pond over the period of the flood (in addition to any rain fall).

A further analysis was carried out which modelled water ponding in the central basin to reduce the head differential between the river and the basin. It was found that water had to be ponded to RL3.0 to prevent uplift. This option would require the construction of a properly engineered stopbank along the road, a controlled inlet from the river and gated culverts through the new stopbank to allow the normal pumped drainage system to operate. It is considered that a system of pressure relief wells will be more cost effective option. These wells should be about 3m deep and spaced along the edge of the basin at about 30m intervals. Some flexibility in their location could be allowed so that they create minimal interference with normal farm operations.



### 5.5 Cross Section 2

At Cross Section 2 there is a shallow depression about 300mm deep on the landward side of the stopbank (Figure 5). At right angles to the stopbank the ground falls from RL3.2 to RL1.2 over about 200m, however the ground falls more rapidly just to the east of the cross section.

Coarse sand and lapilli were found at RL0.9 under the river berm. These soils were not found within the depth of the initial investigations, HA12 and HA13 but were found at RL-1.0 in TP6. Fine to medium sand was found under the surface silt within the depression at HA12.

If lapilli are assumed below the depth of investigation in HA12 and HA13 the factor of safety against uplift of the surface silts in the depression and in the low basin is marginal. Placing an overlay within the depression to bring the ground level up to RL3.2 should increase the factor of safety against heave to above 1.1. The installation of pressure relief wells within this portion of the central basin should prevent heave of the basin floor.

### 5.6 Cross Section 3

At Cross Section 3 the stopbank is only 1m high (Figure 6). There is a 2m thick layer of silt on the inland side underlain by layers of fine to coarse sand. The only layer of lapilli found was at RL0.8 in HA9 and was 200mm thick.

The transient analysis of the 100 year design flood indicated that the factor of safety against uplift on the inside of the stopbank should be between 1.1 and 1.2.

### 5.7 Cross Section 4

At Cross Section 4 there is a shallow dip in the elevated ground between the stopbank and the small mound where the farm house is located (Figure 7). Coarse sand is virtually exposed at RL1.1 on the river side of the stopbank and was found at RL0.8 in HA7 in the dip. Its presence was confirmed by a further hand auger towards the house (HA/A) and was found to be at RL1.5. The direct connection of this highly permeable layer to the river results in high uplift pressures under the surface silt in the dip. If an overlay is placed to bring the ground level within the dip up to RL3.2 satisfactory factors of safety against uplift should be obtained. This overlay would be up to 300mm thick and could be placed around the existing large trees growing in the dip. If any of these trees fall, or are cut down, the stump should be removed and the hole backfilled with a soil with a similar permeability to the existing surface soils.

If the cross section is extended down into the basin there are the typical uplift problems within the floor of the basin and pressure relief wells are recommended.

### **5.8 Cross Section 5**

Cross Section 5 is through the same dip as Cross Section 4 (Figure 8). Pumice lapilli were found only 1.5m below the ground surface at the inland toe of the stopbank (RL1.9). The overlay to RL3.2 therefore needs to extend across this whole dip.

As there is already a direct connection between the coarse sands on the river side of the stopbank and those inland, the removal of further material from the broad part of the river berm should have minimal effect on the stopbank integrity.

### **5.9 Cross Section 6**

It appears that a band of pumice lapilli was deposited right across the apex of the river bend as lapilli were again found as high as RL 1.7 in HA1 at Cross Section 6 (Figure 9). It is possible this layer of lapilli and layers of other clean sands found in this area are the reason the ground surface is higher here than within the adjacent basin. The dip between the stopbank and the farm house is a little deeper at this cross section than at the previous two cross sections (Figures 1 and 2). The required over lay to RL3.2 will therefore be up to 600mm thick.

### **5.10 Cross Section 7**

At Cross Section 7 the ground level falls away from RL3.0 at the inland toe of the stopbank to RL 0.4 within 100m of the stopbank (Figure 10). This cross section is within a concave section of the river bank in the downstream portion of the study length. The characteristics of soil particle deposition here may be a little different to those within the upstream portion of the study length as the surface soils here seem to be generally finer than found elsewhere. A fine to medium sand was not found until RL-1.0 in HA14. If it is assumed that this sand layer is connected to the river there is potential for uplift of the surface silts in the basin as for cross sections 1 and 2. Therefore pressure relief wells should be continued around this north side of the basin.

### **5.11 Cross Section 8**

The ground surface profile at Cross Section 8 is similar to that at Cross Section 7 (Figure 11). No soil layers with high permeability were found within the depth of investigation in HA22 or HA25, on either side of the stopbank. Sand layers were found above and below a peat layer in the basin at HA20. As the sequence of soil layers in HA20 is similar to that in test pits 1 to 5 and test pit 6 it was assumed that the sand layers in HA20 are connected to those found in the test pits and the river. As before, it was found that pressure relief wells are needed to reduce the risk of heave of the upper silt layers.



## 6 Conclusions

1. There could be problems of heave of the surface soils within the low basin inside the river bend in significant floods.
2. The installation of pressure relief wells, 3m deep and at approximately 30m spacings, around the edge of the basin should reduce the potential for heave.
3. The precise location of the wells can be varied to suit farming operations.
4. Flooding of the central basin to reduce the potential for heave is considered to be impractical due to the depth of water required (up to 3m).
5. Shallow overlays are required in three areas behind the stopbank (Figure 1) to reduce the risk of heave at higher levels.
6. Further soil can be taken for fill from the outside of the river berm at the apex of the bend provided the river face of the stopbank is not destabilised.
7. The depressions caused by old tree stumps near Cross Section 10 should be excavated and backfilled with silty soil.
8. If any trees within the bend fall the stumps must be removed and the holes backfilled with silty soil.



**M. O'Halloran**  
BE, PhD, Dip BA, MIPENZ (Geotechnical), CPEng IntPE

17 April 2009

## References

- 1 Ice Geo & Civil (Sept. 2005) Rangitaiki River stopbanks, review of stability.
- 2 Beca Carter Hollings & Ferner Ltd (2002) Rangitaiki River stopbank assessment: Edgecumbe to Thornton (RHS).



Figure 4: Cross Section 1

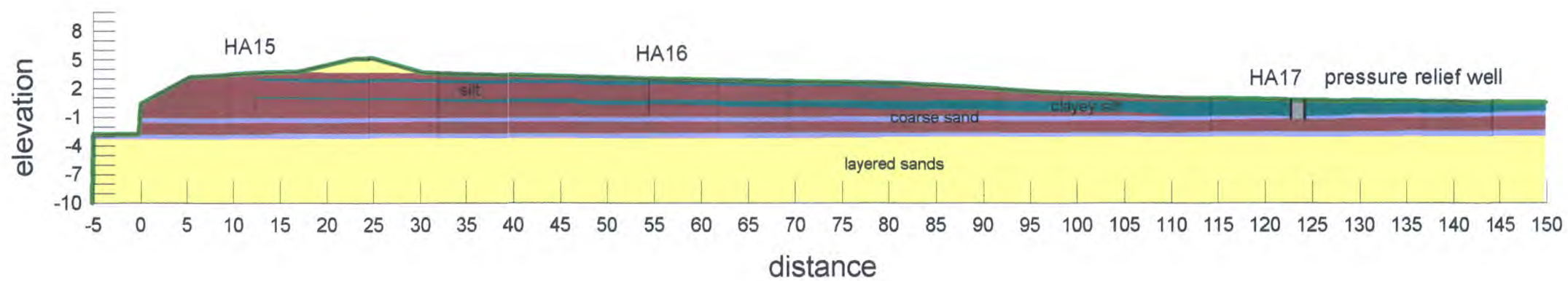


Figure 5: Cross Section 2

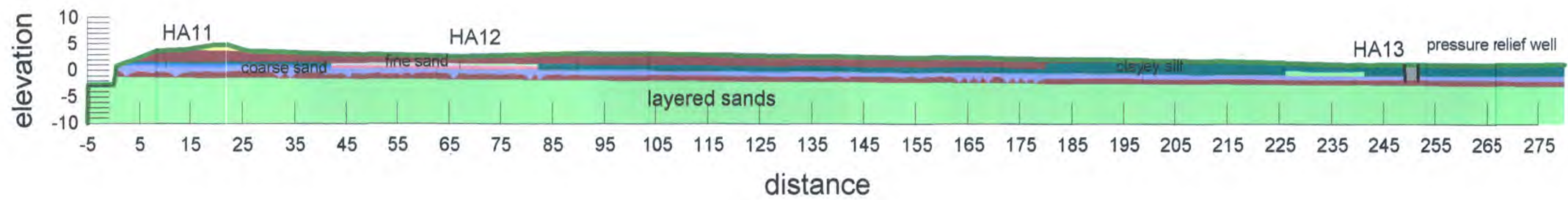


Figure 6: Cross Section 3

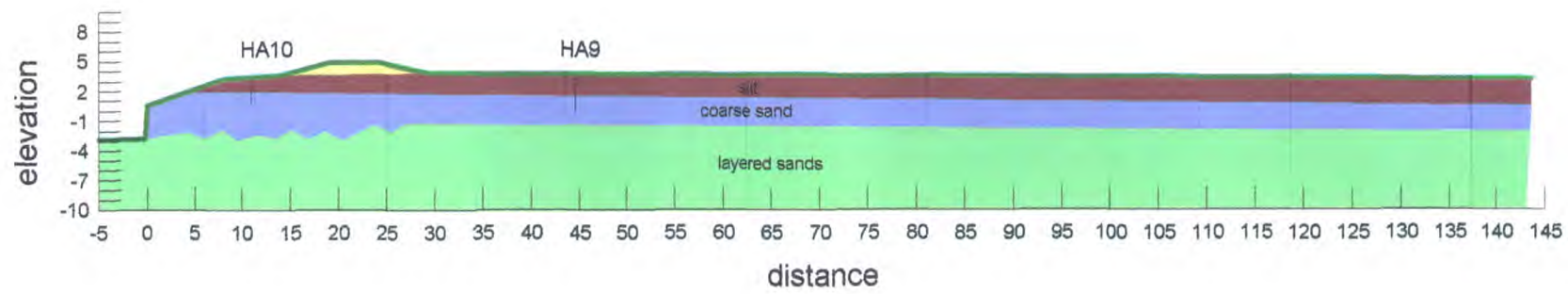




Figure 7: Cross Section 4

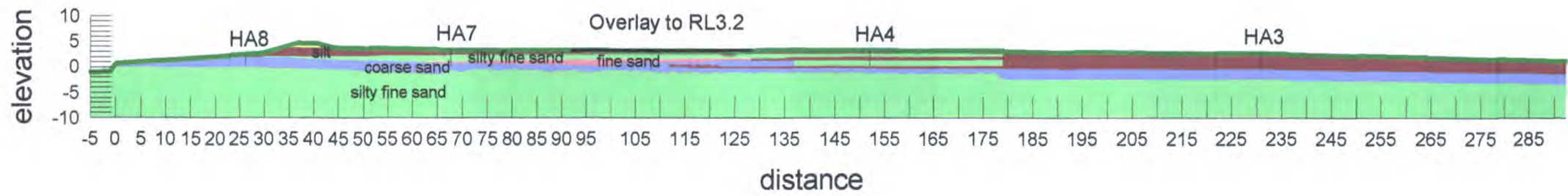


Figure 8: Cross Section 5

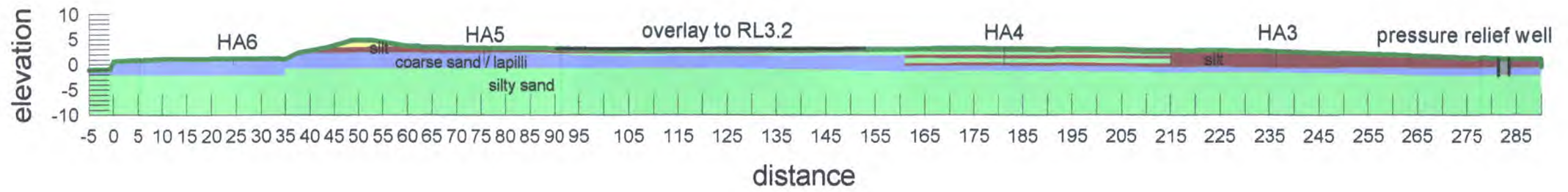


Figure 9: Cross Section 6

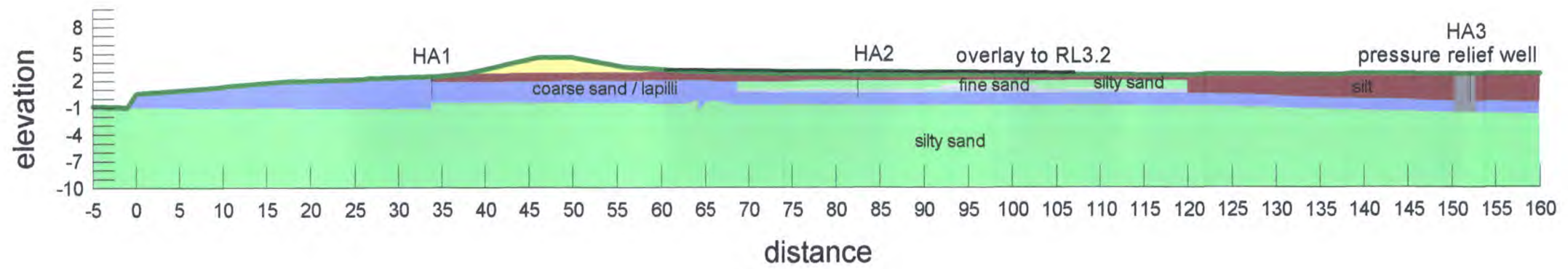




Figure 10: Cross Section 7

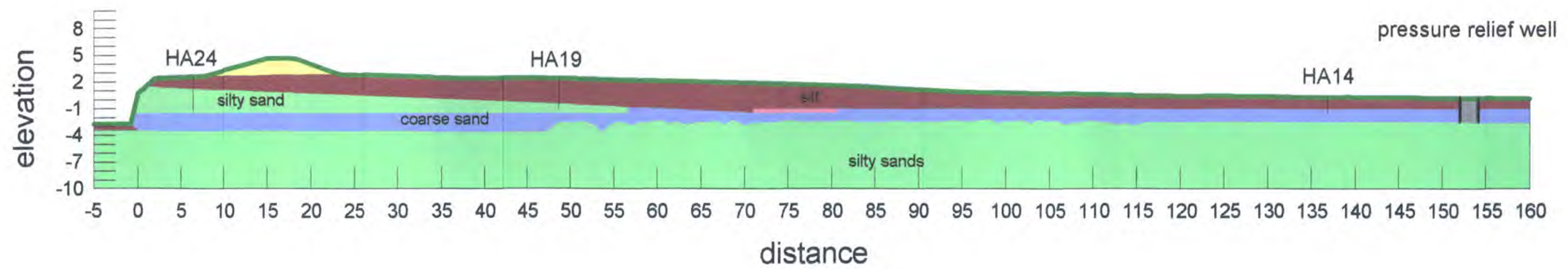
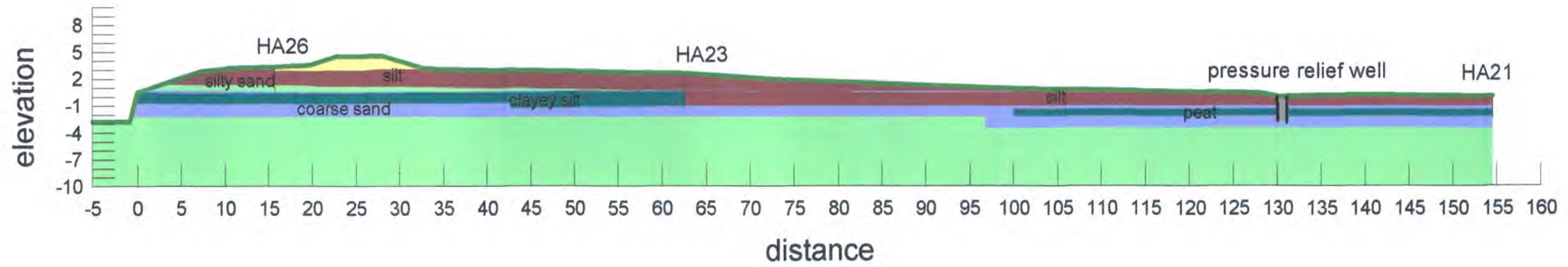


Figure 12: Cross Section 9



## **Appendix A**

### **Hand Auger and Test Pit Logs**



# Hand Auger Log

Test Number: HA1

Job Name: Rangitikei Stopbanks  
Section 4

Date: 21/4/06

Tested by: M.O.H

Blows/50mm		soil description	
m	Cu(kPa)		
0.2		x x	brown sandy silt
0.4		x x	0.2 brown fine → med. pure SAND + lapilli → 2mm
0.6		x x	0.4 brown fine sandy silt
0.8		x x	0.6 bands brown fine → med SAND + lapilli and silty SAND with charcoal pieces
1.0		x x	0.8 pumice lapilli → 2mm
1.2		x x	1.0 grey medium → coarse SAND + fine lapilli → 2mm
1.4		x x	1.5 grey silty bands → 50mm
1.6		x x	1.7 pumice lapilli → 2mm
1.8		x x	1.9 brown medium to coarse SAND + fine lapilli wet
2.0		x x	2.5 EOB collapse
2.2		x x	
2.4		x x	
2.6		x x	
2.8		x x	
3.0		x x	
3.2		x x	
3.4		x x	
3.6		x x	
3.8		x x	
4.0		x x	

# Hand Auger Log

Test Number: HA2

Job Name: Rangitikei Stopbanks  
Section 4

Date: 21/4/06

Tested by: N.O.H

Blows/50mm													C <sub>u</sub> (kPa)	soil description
m	0	2	4	6	8	10	12							
0.2													X X	brown SILT
													X	
0.4													X X	0.3 grey SILT
													X	
0.6													X X	0.6 grey silty fine SAND/ sandy SILT
													X X	
0.8													X	
													X	
1.0													X	
													X	
1.2													X	1.1 grey silty fine SAND
													X	
1.4													X	
													X	
1.6													X	
													X	
1.8													X	1.6 grey fine SAND
													X	
2.0													X	1.9 fine lapilli → 1mm
													X	
2.2													X	2.0 sandy fine lapilli
													X	
2.4													X	
													X	
2.6													X	2.5 EOB collapse
													X	
2.8													X	
													X	
3.0													X	
													X	
3.2													X	
													X	
3.4													X	
													X	
3.6													X	
													X	
3.8													X	
													X	
4.0													X	

020406080100120

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HA3

Job Name: Rangitahi Stopbanks  
Section 4

Date: 21/4/06

Tested by: M.O.H

Blows/50mm										soil description	
m	0	2	4	6	8	10	12	Cu(kPa)			
0.2										X X	brown SILT
										X	
0.4										X	0.3 grey SILT with orange
										X	mottles, moist
0.6										X	
0.8										X	
										X	
1.0										X	
1.2										X	
										X	
1.4										X	
										X	
1.6										X	
										X	
1.8										X	
										X	
2.0										X X	1.9 grey fine sand, silt
										X	
2.2										X X	
										X	
2.4										X X	2.3 dark grey silt, rare
										X	finer
2.6										X	
										X	
2.8										X	
										X	
3.0										X	
										X	
3.2										X X X	3.1 grey fine sand, silt
											3.2 EOB, losing sample
3.4											
3.6											
3.8											
4.0											



# Hand Auger Log

Test Number: HA4

Job Name: Rangitahi Stopbanks  
Section 4

Date: 21/4/06

Tested by: T.O.H

		Blows/50mm														soil description
m		0	2	4	6	8	10	12	Cu(kPa)							
										X	X					brown SILT
0.2										X						
										X	X					0.2 grey SILT with orange mottles
0.4										X						
										X	X					0.4 light brown fine sandy SILT
0.6										X						
										X						0.6 grey silty fine SAND
0.8										X	X					with orange mottles
										X						
1.0										X	X					
										X						
1.2										X	X					
										X						
1.4										X	X					1.3 grey SILT
										X						
1.6										X	X					
										X						
1.8										X	X					
										X						
2.0										X	X					2.0 grey silty fine SAND
										X						
2.2										X	X					
										X						
2.4										X						
										X						
2.6										X	X					
										X						
2.8										X	X					
										X						
3.0										X						3.0 grey SILT
										X	X					
3.2										X	X					
										X						
3.4										X	X					
										X						
3.6										X						3.5 EOB losing sample
3.8																
4.0																

# Hand Auger Log

Test Number: HA 5

Job Name: Rangitikei Stopbanks  
Section 4

Date: 21/4/06

Tested by: M O'H

Blows/50mm												Cu(kPa)	soil description
m	0	2	4	6	8	10	12						
0.2												X X X	brown SILT
0.4												X X X	0.2 grey SILT with orange mottles
0.6												X X X	
0.8												X X X	
1.0												X X X	0.9 grey well graded SAND with fine lapilli → 1mm
1.2													
1.4													
1.6													1.5 fine lapilli → 2mm
1.8													1.7 as 0.9m
2.0													
2.2													
2.4													2.4 fine lapilli → 3mm
2.6													2.6 as 0.9m
2.8													2.7 rare hard gravel → 6mm wet
3.0													2.8 sandy Lapilli
3.2													3.2. EOB losing sample
3.4													
3.6													
3.8													
4.0													

# Hand Auger Log

Test Number: HA6

Job Name: Rangitikei Stopbanks  
Section 4

Date: 21/4/06

Tested by: M.O.H

Blows/50mm		C <sub>u</sub> (kPa)		soil description					
m	0	2	4	6	8	10	12	C <sub>u</sub> (kPa)	
0.2									brown silty fine med SAND
0.4									0.2 brown SILT
0.6									0.3 silty gravelly SAND, old track?
0.8									0.4 orange fine lapilli with sand & gravel
1.0									
1.2									1.1 EOB collapse
1.4									
1.6									
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									
3.2									
3.4									
3.6									
3.8									
4.0									

C<sub>u</sub> (kPa)



# Hand Auger Log

Test Number: HA7

Job Name: Rangitikei Stopbanks  
Section 4

Date: 21/4/06

Tested by: M.O.H

Blows/50mm										soil description
m	0	2	4	6	8	10	12	C <sub>u</sub> (kPa)		
									X X	brown SILT
0.2									X	
									X X	0.2 grey SILT with orange mottles
0.4									X X	
									X X	
0.6									X X	
									X X	
0.8									X X	
									X X	1.0 grey silty fine SAND
1.0									X X	
									X X	
1.2									X X	
									X X	
1.4									X X	
									X X	
1.6									X X	
									X X	
1.8									X X	
									X X	2.0 grey silty fine → med. SAND, some lapilli
2.0									X X	
									X X	2.3 grey fine → medium SAND
2.2									X X	
									X X	2.6 orange hard gravelly fine → loose SAND
2.4									X X	
									X X	
2.6									X X	
									X X	3.1 grey fine lapilli → 2mm
2.8									X X	
									X X	3.3 EOB, collapse
3.0									X X	
									X X	
3.2									X X	
									X X	
3.4									X X	
									X X	
3.6									X X	
									X X	
3.8									X X	
									X X	
4.0									X X	
									X X	

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HA8

Job Name: Rangitake Stopbanks  
Section 4

Date: 21/4/06

Tested by: M.O.H

Blows/50mm		soil description	
m	C <sub>u</sub> (kPa)		
0.2		X X	brown fine sandy SILT
0.4		X X	0.3 grey medium → coarse SAND
0.6			
0.8			0.7 grey fine → coarse SAND
1.0			
1.2			1.2 orange hard rounded gravelly fine → coarse pum. SAND
1.4			1.4 medium → grey coarse pum. SAND
1.6			+ fine lapilli
1.8			
2.0			2.0 EOB
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			
3.6			
3.8			
4.0			

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HA9

Job Name: Rangitikei Stopbanks  
Section 4

Date: 21/4/06

Tested by: M.O.H

Blows/50mm												Cu(kPa)	soil description
m	0	2	4	6	8	10	12						
0.2												X X	brown SILT
0.4												X X	0.3
0.6												X X	grey SILT with orange
0.8												X X	micelles
1.0												X X	
1.2												X X	
1.4												X X	
1.6												X X	
1.8												X X	
2.0												X X	2.0 grey silt, fine SAND
2.2												X X	2.2 grey fine coarse SAND &
2.4												X X	fine lapilli → 2mm
2.6												X X	2.3
2.8												X X	grey fine SAND
3.0												X X	2.9 grey fine lapilli → 2mm
3.2												X X	3.1 grey fine → coarse SAND
3.4												X X	& fine lapilli
3.6												X X	3.3 grey fine SAND
3.8												X X	3.4 fine → coarse SAND &
4.0												X X	fine lapilli, some fine sand
												X X	bands → 20mm
												X X	3.8 EOB



# Hand Auger Log

Test Number: HA 10

Job Name: Rangitahi Stopbanks  
Section 4

Date: 21/4/06

Tested by: HCH

Blows/50mm												C <sub>u</sub> (kPa)	soil description
m	0	2	4	6	8	10	12						
0.2												X X	Light brown SILT
0.4												X X	becoming grey with depth
0.6												X X	
0.8												X X	0.8 moist
1.0												X X	
1.2												X	1.2 30mm Tarawera Ash
1.4												X X	1.4
1.6													orange fine → coarse SAND some fine lapilli
1.8													1.8 grey medium → coarse SAND
2.0													hard rounded gravel → 6mm
2.2													fine pumice → 30mm
2.4													100mm layer high pumice content, pumice → 10mm
2.6													2.6 fine
2.8													
3.0													
3.2													
3.4													
3.6													
3.8													
4.0													

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HA11

Job Name: Rangitikei Superhighway  
Section 4

Date: 21/04/06

Tested by: M.O.H

Blows/50mm											
m	0	2	4	6	8	10	12	$C_u$ (kPa)	soil description		
0.2									X X	brown SILT	
0.4									X X	0.3	
0.6									X	grey fine sandy SILT	
0.8									X X	with orange mottles	
1.0									X		
1.2									X X		
1.4									X X		
1.6									X	1.5 some purple lapilli	
1.8									X	→ 3mm.	
2.0									X X		
2.2									X -	2.1 grey clayey SILT	
2.4									- X	moist, plastic	
2.6									X -	2.5 grey medium to coarse	
2.8									X	sands & fine lapilli	
3.0									X	3.0 fine lapilli → 2mm	
3.2									X		
3.4									X		
3.6									X	3.5 FOTS	
3.8									X		
4.0									X		

020406080100120

$C_u$  (kPa)

# Hand Auger Log

Test Number: HA12

Job Name: Rangitikei Stopbanks  
Section 4

Date: 24/4/06

Tested by: M. O'H

Blows/50mm		soil description	
m	Cu(kPa)		
0.2		X X	brown SILT
0.4		X X	0.3 grey SILT with orange mottles
0.6		X X	
0.8		X X	
1.0		X X	
1.2		X X	
1.4		X X	1.3 grey silty fine SAND, moist
1.6		X X	1.5 grey fine SAND
1.8		X X	1.8 grey fine to medium SAND
2.0		X X	
2.2		X X	
2.4		X X	
2.6		X X	2.5 FCB collapse
2.8		X X	
3.0		X X	
3.2		X X	
3.4		X X	
3.6		X X	
3.8		X X	
4.0		X X	

# Hand Auger Log

Test Number: HA13

Job Name: Rangitachi Stopbanks  
Section 4

Date: 24/4/06

Tested by: M.O'H

Blows/50mm		Cu(kPa)		soil description					
m	0	2	4	6	8	10	12	Cu(kPa)	
0.2								X-	grey clayey SILT with orange mottles, wet - surface water
								- X	
0.4								X	
								X	
0.6								P	
								S	
0.8								X	
								X	
1.0								X-	
								X	
1.2								X	
								-X	
1.4								X	1.3 grey silty fine SAND
								X	
1.6								X	1.5 FOB, losing sample
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									
3.2									
3.4									
3.6									
3.8									
4.0									



# Hand Auger Log

Test Number: HA 14

Job Name: Rangitiki Stopbanks  
Section 4

Date: 24/4/06

Tested by: M.O'H

Blows/50mm										soil description	
m	0	2	4	6	8	10	12	Cu(kPa)			
0.2								X	X	brown SILT	
								X			
0.4								X			
								X			
0.6								X		0.4 grey clayey SILT with orange mottles	
								X			
0.8								X		brownish with some charcoal	
								X			
1.0								X		0.9 grey clayey SILT with orange mottles	
								X			
1.2								X		1.2 light brown SILT	
								X			
1.4								X		1.4 light grey fine to medium grained SAND	
								X			
1.8								X		1.8 EOB losing sample	
2.0								X			
2.2								X			
2.4								X			
2.6								X			
2.8								X			
3.0								X			
3.2								X			
3.4								X			
3.6								X			
3.8								X			
4.0								X			

# Hand Auger Log

Test Number: HA15

Job Name: Rangitapu Stopbanks  
Section 4

Date: 24/4/06

Tested by: M.O.H

Blows/50mm													C <sub>u</sub> (kPa)	soil description	
m	0	2	4	6	8	10	12								
													X X		brown SILT
0.2													X		
													X X	0.2	brown fine sandy SILT
0.4													X		
													X X		
0.6													X	0.6	dark grey clayey SILT,
													- X	damp	
0.8													X -		
													X X	0.8	grey SILT with orange
1.0													X	mottles	
													X		
1.2													X		
													X X	1.2	grey fine sandy SILT
1.4													X		with orange mottles
													X		
1.6													X		
													X		
1.8													X		
													X		
2.0													X X		
													X		
2.2													X		
													X		
2.4													X		
													X		
2.6													X X	2.5	brown clayey SILT, plastic
													X X	2.6	grey fine sandy SILT
2.8													X		
													X X		
3.0													X X	3.0	grey SILT
													X		
3.2													X X	3.2	grey fine sandy SILT
													X X		
3.4													X X	3.4	grey SILT
													X		
3.6													X	3.6	some timber
													X		
3.8													X	3.8	EOB
													X		
4.0															

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HA16

Job Name: Rangitikei Stopbanks  
Section 4

Date: 24/4/06

Tested by: M.O.H

Blows/50mm													soil description	
m	0	2	4	6	8	10	12	Cu(kPa)						
0.0									X X				0.0	brown SILT
0.2									X				0.2	grey clayey SILT with orange mottles, moist
0.4									X -					
0.6									X				0.6	grey SILT with orange mottles, wet
0.8									- X					
1.0									X X					
1.2									X				1.2	grey clayey SILT with orange mottles
1.4									X					
1.6									X				1.6	grey silty fine SAND
1.8									X X				1.8	light brown sandy SILT
2.0									X				2.0	grey fine sandy SILT with orange mottles
2.2									X X				2.2	grey SILT with orange mottles
2.4									X				2.4	brown clayey SILT, plastic
2.6									X				2.6	grey clayey SILT
2.8									X				2.8	grey silty fine SAND
3.0									X X				3.0	grey SILT
3.2									X				3.2	some timber
3.4									X					
3.6									X					
3.8									X				3.8	EOB
4.0									X					
	0	20	40	60	80	100	120							

# Hand Auger Log

Test Number: HA 17

Job Name: Rangitikei Stopbanks  
Section 4

Date: 24/4/06

Tested by: MCH

Blows/50mm		soil description	
m	Cu(kPa)		
0.0		X X	0.1 brown SILT
0.2		X X	0.2 brown silty GRAVEL
0.4		X -	grey clayey SILT with orange mottles
0.6		X -	
0.8		X	
1.0		X -	
1.2		X -	1.1 brown clayey SILT
1.4		X -	1.2 grey clayey SILT with orange mottles
1.6		X -	1.4 some timber & organic material
1.8		X -	1.7 coarse SAND & fine lapilli → 2mm
2.0			1.9 EOB
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			
3.6			
3.8			
4.0			



# Hand Auger Log

Test Number: HA18

Job Name: Rangitiki Stopbanks  
Section 4

Date: 24/4/06

Tested by: M.O.H

Blows/50mm		soil description	
m	Cu(kPa)		
0.2		X X	brown SILT
0.4		X X	
0.6		X X	0.4 grey clayey SILT with orange mottles
0.8		X X	
1.0		X X	0.9 light brown pumice SILT
1.2		X X	1.1 20mm organic layer
1.4		X X	1.15 grey SILT
1.6		X X	1.3 grey fine-med. SAND
1.8		X X	1.3 PEAT, some sand pockets
2.0		X X	clayey - low perm
2.2		X X	2.0 light grey SILT
2.4		X X	
2.6		X X	
2.8		X X	2.8 EOB
3.0			
3.2			
3.4			
3.6			
3.8			
4.0			



# Hand Auger Log

Test Number: HAZO

Job Name: Rangitahi Stopbanks  
Section 4

Date: 24/4/06

Tested by: TICH

Blows/50mm											soil description
m	0	2	4	6	8	10	12	C <sub>u</sub> (kPa)			
0.2											X X X 0.2 brown SILT grey clayey SILT, orange mottled
0.4											X - X X - X
0.6											X X - X
0.8											X X - X
1.0											X X 1.1 brown clayey SILT with fibrous organic material in bands
1.2											X X X 1.2 light brown pumice SILT with organic bands
1.4											X X 1.4 grey fine - med. SAND
1.6											X 1.6 PEAT, black organic clay with fibres, low perme
1.8											X X 2.0
2.0											X X 2.2
2.2											X X 2.4
2.4											X X 2.6
2.6											X X 2.8
2.8											X X 3.0
3.0											X X 3.2
3.2											X X 3.4
3.4											X X 3.6
3.6											X X 3.8
3.8											X X 4.0
4.0											X X 4.2

# Hand Auger Log

Test Number: H421

Job Name: Rangitakei Stopbanks  
Section 4

Date: 24 / 06

Tested by: M.O'H

Blows/50mm													C <sub>u</sub> (kPa)	soil description
m	0	2	4	6	8	10	12							
0.2													X X	brown SILT
0.4													X X	0.3 grey clayey SILT with orange mottles
0.6													X X	0.7 light grey pumice SILT with orange mottles, organic bands
0.8													X X	0.9 grey / brown SILT
1.0													X X	1.2 grey fine-med. SAND
1.2													X X	1.5 PE 4T, black organic clay, fibrous
1.4													X X	2.0 grey SILT
1.6													X X	2.3 grey fine SAND
1.8													X X	2.4 same topsoil
2.0													X X	2.5 FCB losing sample.
2.2													X X	
2.4													X X	
2.6													X X	
2.8													X X	
3.0													X X	
3.2													X X	
3.4													X X	
3.6													X X	
3.8													X X	
4.0													X X	

# Hand Auger Log

Test Number: HAZZ

Job Name: Rangitikei Stopbanks  
Section 4

Date: 24/4/06

Tested by: F.L.O'H

Blows/50mm													soil description	
m	0	2	4	6	8	10	12	Cu(kPa)						
0.2									X	X			brown SILT	
0.4									X	X			0.3 grey clayey SILT with orange mottles	
0.6									X	X			0.6 grey fine sandy SILT, with orange mottles, moist	
0.8									X	X				
1.0									X	X			1.0 grey SILT, some clay with orange mottles	
1.2									X	X				
1.4									X	X				
1.6									X	X				
1.8									X	X				
2.0									X	X			2.1 grey SILT	
2.2									X	X				
2.4									X	X			2.4 grey fine sandy SILT	
2.6									X	X			2.5 grey silty fine SAND	
2.8									X	X				
3.0									X	X			3.0 grey SILT	
3.2									X	X			3.2 grey silty fine SAND	
3.4									X	X			3.4 grey SILT, organic smell some brown bands	
3.6									X	X				
3.8									X	X				
4.0									X	X			4.0 EOB	



# Hand Auger Log

Test Number: HAZ3

Job Name: Rangitaihi Stopbanks  
Section 4

Date: 24/4/06

Tested by: M.O.H

Blows/50mm													C <sub>u</sub> (kPa)	soil description
m	0	2	4	6	8	10	12							
0.2													X X	brown SILT
													X	
0.4													X	0.3 orange stained grey
													- X	clayey SILT
0.6													X	
													X	
0.8													X -	
													X	
1.0													X	1.0 grey silty fine SAND
													X X	
1.2													X	1.0 grey SILT with orange
													X	mottles
1.4													X	
													X	
1.6													X X	1.5 grey clayey SILT with
													X -	orange mottles
1.8													X X	1.7 grey fine sandy SILT
													X	
2.0													X	1.9 grey fine SAND
													X	1.95 grey SILT
2.2													X	
													X	2.2 grey silty fine SAND
2.4													X	
													X	
2.6													X	2.6 grey SILT, some
													X	organic bands
2.8													X	
													X	
3.0													X	
													X	
3.2													X	
													X	
3.4													X	3.3 light brown hum. SILT - c.f. above PEAT
													X	3.4 grey SILT - c.f. below PEAT
3.6													X	
													X	3.6 50mm organic rich band
3.8													X	3.65 light grey fine hum. SAND
													X	3.8 EOB last sample.
4.0													X	

C<sub>u</sub> (kPa)

020406080100120

# Hand Auger Log

Test Number: **HA24**

Job Name: **Rangitachi Stopbanks  
Section 4**

Date: **24/4/06**

Tested by: **T.O'H**

Blows/50mm		soil description	
m	C <sub>u</sub> (kPa)		
0.2		X	grey fine SILT
		X	
0.4		X	
		X	
0.6		X	0.6 grey silty fine SAND
		X	
0.8		X	0.7 grey fine sandy SILT, moist
		X	
1.0		X	
		X	
1.2		X	
		X	
1.4		X	1.3 grey silty fine SAND, moist
		X	
1.6		X	
		X	
1.8		X	
		X	
2.0		X	
		X	
2.2		X	
		X	
2.4		X	
		X	
2.6		X	
		X	
2.8		X	
		X	
3.0		X	
		X	
3.2		X	
		X	
3.4		X	
		X	
3.6		X	
		X	
3.8		X	3.9 EOB
		X	
4.0			

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HAZ5

Job Name: Rangitahi Stopbanks  
Section 4

Date: 24/4/06

Tested by: NCH

Blows/50mm										C <sub>u</sub> (kPa)	soil description
m	0	2	4	6	8	10	12				
0.2										X	brown fine sandy SILT
										X	
0.4										X	
										X	
0.6										X	0.8 grey fine sandy SILT, with orange mottles, rare pumice → 2mm
										X	
0.8										X	
										X	
1.0										X	1.2 grey SILT with orange mottles
										X	
1.2										X	
										X	
1.4										X	2.1 grey clayey SILT with orange mottles
										X	
1.6										X	
										X	
1.8										X	2.8 grey silty fine SAND as HAZ4
										X	
2.0										X	
										X	
2.2										X	3.5 rare fine organic material
										X	
2.4										X	
										X	
2.6										X	3.9 EOB
										X	
2.8										X	
										X	
3.0										X	
										X	
3.2										X	
										X	
3.4										X	
										X	
3.6										X	
										X	
3.8										X	
										X	
4.0										X	

# Hand Auger Log

Test Number: HA26

Job Name: Rangitikei Stopbanks  
Section 4.

Date: 18/5/06

Tested by: M.O.H

Blows/50mm													soil description	
m	0	2	4	6	8	10	12	Cu(kPa)						
0.2									X					brown silty fine SAND, some grit, Tararua Ash?
0.4									X					0.4 grey SILT
0.6									X					
0.8									X					0.8 orange stained grey fine sandy SILT
1.0									X					
1.2									X					1.1 orange stained grey clayey SILT
1.4									X					
1.6									X					
1.8									X					1.8 30mm fine SAND layer
2.0									X					2.0 grey silty fine SAND
2.2									X					
2.4									X					
2.6									X					
2.8									X					2.7 grey fine -> med. SAND some silt
3.0									X					2.8 grey banded SILT + fine sandy SILT
3.2									X					3.0 some fine organic material
3.4									X					
3.6									X					
3.8									X					3.8 E.O.B
4.0									X					
	0	20	40	60	80	100	120	Cu (kPa)						

# Hand Auger Log

Test Number: HAZ7

Job Name: Rangitahi Stopbanks  
Section 4

Date: 18/5/06

Tested by: M O'H

Blows/50mm										soil description	
m	0	2	4	6	8	10	12	C <sub>u</sub> (kPa)			
										XX	brown SILT
0.2										XX	0.1 grey SILT
										X	
0.4										X	
										XX	
0.6										X	0.5 grey silty fine SAND
										X	
0.8										X	
										X	
1.0										X	1.0 grey fine → medium SAND
1.2											
1.4											
1.6											
1.8											
2.0											
2.2											
2.4											
2.6											2.6 grey medium SAND
2.8										0	
3.0										3	
3.2											3.2 FOB, collapse
3.4											
3.6											
3.8											
4.0											
	0	20	40	60	80	100	120	C <sub>u</sub> (kPa)			



# Hand Auger Log

Test Number: HA28

Job Name: Rangitiki Stopbanks  
Section 4

Date: 18/5/06

Tested by: M.O.H

Blows/50mm												C <sub>u</sub> (kPa)	soil description
m	0	2	4	6	8	10	12						
0.2												0.2 X	brown SILT with silt & fine rounded gravel → 2mm
0.4												0.4 X	0.3 grey SILT with orange mottles
0.6												0.6 X	0.6 light grey/cream silty fine SAND
0.8												0.8 X	0.8 grey fine sandy SILT with orange mottles
1.0												1.0 X	
1.2												1.2 X	
1.4												1.4 X	
1.6												1.6 X	1.5 grey silty fine SAND
1.8												1.8 X	
2.0												2.0 X	
2.2												2.2 X	
2.4												2.4 X	
2.6												2.6 X	2.5 grey fine SAND
2.8												2.8 X	
3.0												3.0 X	
3.2												3.2 X	3.1 grey medium → coarse SAND, wet
3.4												3.4 X	
3.6												3.6 X	
3.8												3.8 X	3.8 EOB, collapse
4.0													

# Hand Auger Log

Test Number: HAZ9

Job Name: Rangitaihi Stopbanks  
Section 4

Date: 18/5/06

Tested by: M.O.H

Tomo 0.2 → 0.6m deep  
± 1.5m diameter

Blows/50mm		C <sub>u</sub> (kPa)		soil description					
m	0	2	4	6	8	10	12	C <sub>u</sub> (kPa)	
0.2									X X
									X
0.4									X
									X X
0.6									
0.8									
1.0									
1.2									
1.4									
1.6									
1.8									
2.0									
2.2									
2.4									
2.6									
2.8									
3.0									
3.2									
3.4									
3.6									
3.8									
4.0									

0.5  
tree roots  
⇒ hole due to timber rotting

C<sub>u</sub> (kPa)

# Hand Auger Log

Test Number: HA30

Job Name: Rangitahi Stopbank  
Section 4

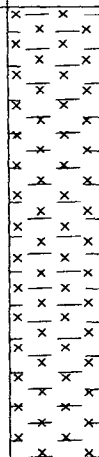
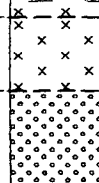
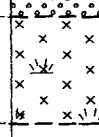
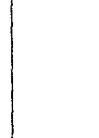
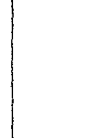
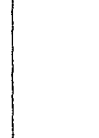
Date: 18/5/06

Tested by: M.O.H

Blows/50mm		soil description	
m	Cu(kPa)		
0.2	X	X	brown SILT
0.4	X	X	0.3 grey clayey SILT with orange mottles
0.6	X	X	
0.8	X	X	
1.0	X	X	
1.2	X	X	1.1 light brown pum. SILT, some organic material
1.4	X	X	1.3 light grey fine to med. pum. SAND
1.6	X	X	1.5 black PEAT, organic clay, some fibres, low perm
1.8	X	X	
2.0	X	X	
2.2	X	X	2.1 light grey pum. SILT
2.4	X	X	2.3 FCB
2.6			
2.8			
3.0			
3.2			
3.4			
3.6			
3.8			
4.0			

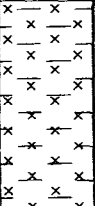
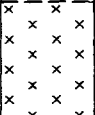





Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **TP1**  
 Elevation: 1.0  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
0.5			grey with orange mottles <b>clayey SILT</b>	
1.0				
1.3	-0.3		light grey <b>pumice SILT</b> with some fibres and rotten timber	
1.5	-0.5		<b>pumice lapilli</b> to 3mm	
2.0	-0.8		brown <b>organic SILT</b> some clay, spongy	
2.2	-1.1		EOP	
2.5				
3.0				
3.5				
4.0				

Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **TP2**  
 Elevation: 0.6  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

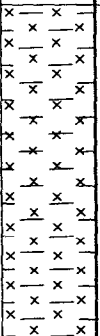
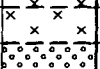
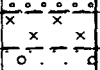
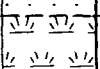
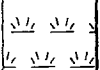
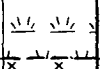
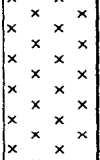
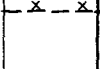
Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
0.5			grey with orange mottles <b>clayey SILT</b>	
1.0	0		light grey <b>pumice SILT</b> with some fibres and rotten timber	
1.0	-0.35		<b>pumice lapilli</b> to 3mm	
1.0	-0.5		brown <b>organic SILT</b> some clay, spongy	
1.0	-0.7		grey medium to coarse <b>pumice SAND</b>	
1.5	-0.9		black <b>PEAT</b> homogeneous, fibrous	
1.5	-1.2		EOP	
2.0				
2.5				
3.0				
3.5				
4.0				

HAND AUGER TEST PITS.GPJ HAND AUGER BASIC.GDT 15/4/09



Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **TP3**  
 Elevation: 0.6  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
0.5			grey with orange mottles <b>clayey SILT</b>	
1.0	-0.4		light grey <b>pumice SILT</b> with some fibres and rotten timber	
	-0.5		<b>pumice lapilli</b> to 3mm	
	-0.6		brown <b>organic SILT</b> some clay, spongy	
	-0.7		grey medium to coarse <b>pumice SAND and fine lapilli</b>	
1.5	-0.8		black <b>PEAT</b> homogeneous, fibrous, some timber, fresh low perm	
2.0	-1.3		light grey <b>pumice SILT</b> , stiff	
2.5	-1.8		EOP	
3.0				
3.5				
4.0				

Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

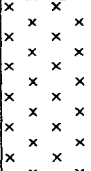
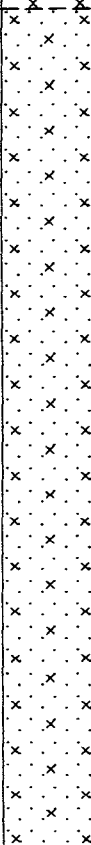
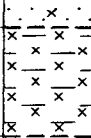
Test: **TP4**  
 Elevation: 2.3  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
0.2		x x x x x	brown <b>SILT</b>	
0.5		x x x x x	grey with orange mottles <b>clayey SILT</b> , moist, plastic	
1.0		x x x x x		
1.5		x x x x x		
1.6		x x x x x	blue grey <b>SILT</b> , some organics and rotten timber to 50mm, firm	
2.0		x x x x x		
2.5		x x x x x		
2.8		x x x x x	light grey <b>pumice SILT</b>	
3.0		x x x x x		
3.1		x x x x x	brown <b>organic SILT</b> some clay, spongy	
3.2		x x x x x	grey medium to coarse <b>pumice SAND and fine lapilli</b>	
3.5		x x x x x	black <b>PEAT</b> homogeneous, fibrous, some timber, fresh low perm	
4.0		x x x x x	light grey <b>pumice SILT</b> , stiff, EOP	

HAND AUGER TEST PITS.GPJ HAND AUGER BASIC.GDT 15/4/09

Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **TP5**  
 Elevation: 3.0  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
0.5	2.5		brown <b>SILT</b> with organics	
1.0			grey with orange mottles <b>SILT</b> and <b>silty fine SAND</b> , moist, plastic	
1.5				
2.0				
2.5				
3.0	0.1		blue grey <b>clayey SILT</b> , with bands fibrous organic material and fine <b>sandy SILT</b>	
3.5	0.2		EOP	
4.0				

HAND AUGER TEST PITS GPJ HAND AUGER BASIC.GDT 15/4/09

## Section 4 Langdon's Environment Bay of Plenty

Test: **TP6**  
Elevation: 0.6  
Date: 30/03/2009  
Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
0.5			grey with orange mottles <b>clayey SILT</b>	
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				

Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **HA/A**  
 Elevation: 3.0  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
2.7		x x x x x	brown <b>SILT</b> with organincs, damp, firm	
0.5		x x x x x	grey with orange mottles <b>SILT some clay</b> , damp	
2.4		x x x x x	grey with orange mottles fine <b>sandy SILT</b> , damp	
2.3		x x x x x	grey with orange mottles <b>silty fine SAND</b> , damp	
1.0		x x x x x		
1.8		x x x x x	fine <b>SAND</b> with some coarse lenses	
1.5	1.5		orange stained fine <b>pumice lapilli</b> to 1.5mm	
1.4	1.4		grey medium to coarse <b>SAND</b> , dry	
1.1	1.1		EOP	
2.0				
2.5				
3.0				
3.5				
4.0				

HAND AUGER TEST PITS.GPJ HAND AUGER BASIC.GDT 15/4/09



Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **HA/B**  
 Elevation: 2.6  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
		x x x x x	brown <b>SILT</b> with organics	
2.3		x x x x x		
2.2		x x x x x	grey with orange mottles <b>clayey SILT</b> , damp	
0.5		x x x x x	grey with orange mottles <b>SILT</b> , damp	
		x x x x x		
1.8		x x x x x		
		x x x x x	grey <b>silty fine SAND</b> , damp	
1.0	1.6	x x x x x	grey fine <b>SAND</b>	
1.5				
0.9			grey fine to medium <b>SAND</b>	
0.7			grey coarse <b>SAND</b> , fine lapilli to 1.5mm	
2.0	0.55			
0.5			black fibrous <b>PEAT</b>	
			grey <b>coarse SAND</b> and fine lapilli, wet	
0.3				
			EOP	
2.5				
3.0				
3.5				
4.0				

HAND AUGER TEST PITS.GPJ HAND AUGER BASIC.GDT 15/4/09

Project: **Section 4 Langdon's**  
 Client: Environment Bay of Plenty  
 Location:  
 Number:

Test: **HA/C**  
 Elevation: 3.2  
 Date: 30/03/2009  
 Logged by: M. O'Halloran

Depth (m)	Elev(m)	Graphic Log	Description	Sample
0.0				
		x x x x x	brown <b>SILT</b> with organics	
0.5	2.8	x x x x x	grey SILT, damp	
1.0	2.2	x x x x x	grey fine sandy SILT, damp, light	
1.5	1.6	x x x x x	grey with orange mottles <b>SILT</b> , moist	
2.0	1.2	x x x x x	grey <b>silty fine sand</b> , moist	
2.5	0.9	x x x x x	grey fine <b>SAND</b> , wet	
3.0	0.7	x x x x x	grey fine to medium <b>SAND</b> , wet	
3.5	0.2	x x x x x	grey medium to coarse <b>pumice SAND</b> and fine lapilli	
4.0			EOB collapsing	

## **Appendix B**

### **Laboratory Tests**

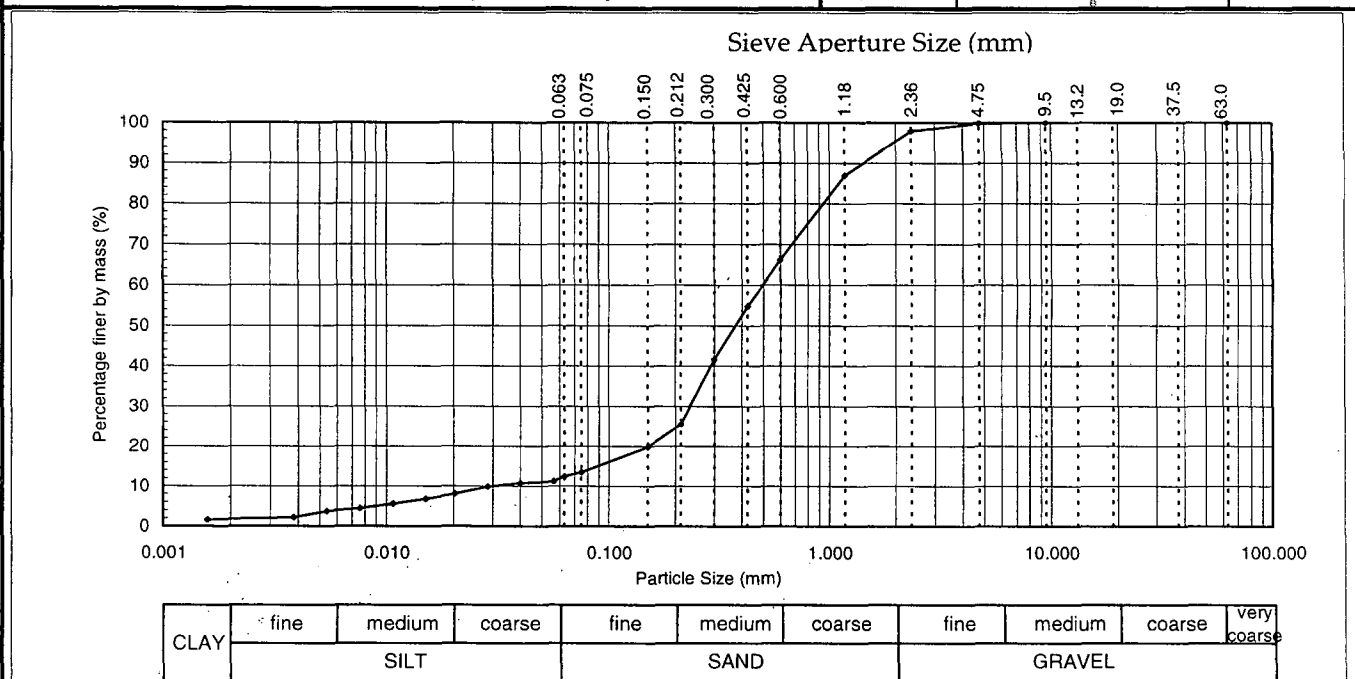
**PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)  
TEST REPORT**

Project : Rangitaiki Stopbanks Section 4  
 Location : Rangitaiki  
 Client : Ice Geo & Civil Ltd, Papamoa  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: HA1 Depth: 1.00 metres  
 Sampled by : M. O'Halloran  
 Date received : 26/05/06  
 Sampling method : Auger  
 Sample condition : As received  
 Sample description : Grey medium - coarse SAND  
 Solid Particle Density ( $t/m^3$ ): 2.60 Assumed  
 Water Content (as received): 32.5 %



Project No: 2-68229.82  
 Lab Ref No: 06/229/004  
 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	42	0.0564	11	0.0076	4
37.5	--	2.36	98	0.212	26	0.0400	11	0.0054	4
19.0	--	1.18	87	0.150	20	0.0285	10	0.0038	2
13.2	--	0.600	66	0.075	13	0.0204	8	0.0016	2
9.5	100	0.425	55	0.063	12	0.0150	7	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0107	6		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: 30/05/06

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: 1/06/06

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician

Date : 1/06/06



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

# PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)

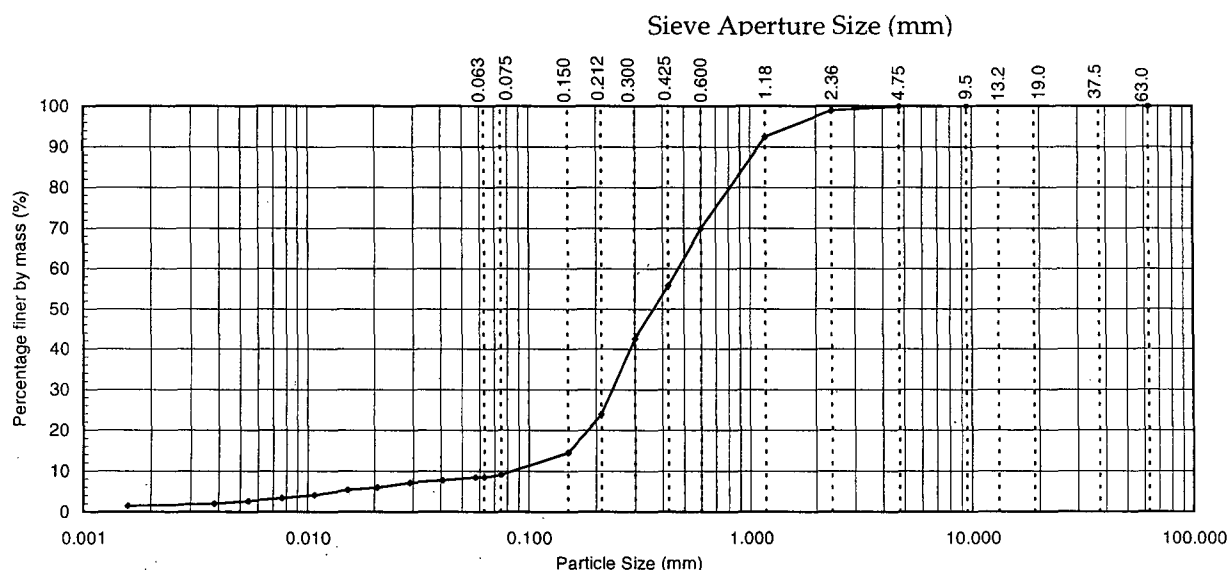
## TEST REPORT



Project : Rangitaiki Stopbanks Section 4  
 Location : Rangitaiki  
 Client : Ice Geo & Civil Ltd, Papamoa  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: HA1 Depth: 2.20 metres  
 Sampled by : M. O'Halloran  
 Date received : 26/05/06  
 Sampling method : Auger  
 Sample condition : As received  
 Sample description : Greyish brown medium - coarse SAND  
 Solid Particle Density ( $t/m^3$ ): 2.60 Assumed  
 Water Content (as received): 58.7 %

Project No: 2-68229.82  
 Lab Ref No: 06/229/004  
 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	43	0.0575	8	0.0077	3
37.5	--	2.36	99	0.212	24	0.0408	8	0.0054	3
19.0	--	1.18	92	0.150	14	0.0290	7	0.0038	2
13.2	--	0.600	70	0.075	9	0.0207	6	0.0016	1
9.5	100	0.425	56	0.063	8	0.0151	5	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0108	4		



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	very coarse
	SILT			SAND			GRAVEL			

Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0 Whatmans Full Range pH indicator paper

Date Tested: 30/05/06

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: 1/06/06

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician

Date : 1/06/06



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



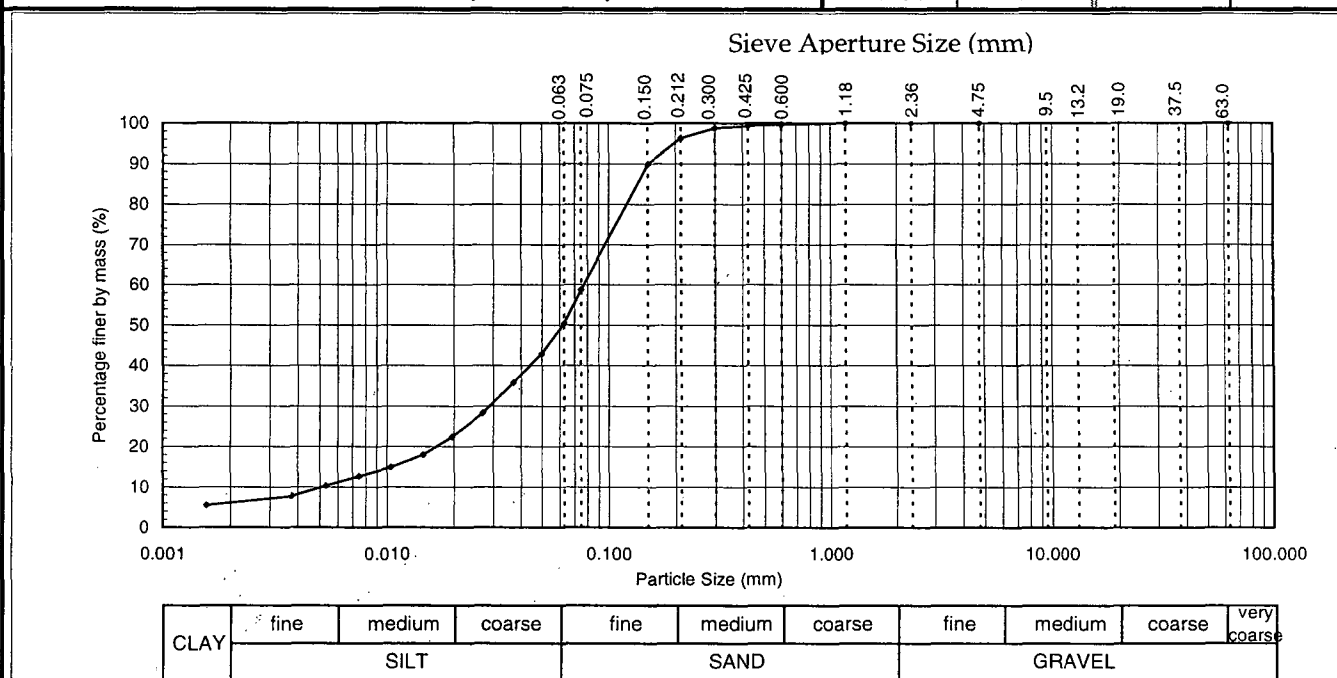
**PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)**  
**TEST REPORT**



Project : **Rangitaiki Stopbanks Section 4**  
 Location : **Rangitaiki**  
 Client : **Ice Geo & Civil Ltd, Papamoa**  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: **HA 2**      Depth: **0.80 metres**  
 Sampled by : **M. O'Halloran**  
 Date received : **26/05/06**  
 Sampling method : **Auger**  
 Sample condition : **As received**  
 Sample description : **Brownish grey sandy SILT**  
 Solid Particle Density (t/m<sup>3</sup>): **2.60**      Assumed  
 Water Content (as received): **37.2**      %

Project No: **2-68229.82**  
 Lab Ref No: **06/229/004**  
 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	0.0500	43	0.0074	13
37.5	--	2.36	100	0.212	96	0.0367	36	0.0053	10
19.0	--	1.18	100	0.150	90	0.0269	28	0.0038	8
13.2	--	0.600	100	0.075	59	0.0196	22	0.0016	5
9.5	--	0.425	99	0.063	50	0.0146	18	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0104	15		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: **30/05/06**

**Sampling is not covered by IANZ Accreditation**  
**This report may only be reproduced in full**

Date Reported: **1/06/06**

**IANZ Approved Signatory**

Designation : **Senior Civil Engineering Technician**  
 Date : **1/06/06**



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

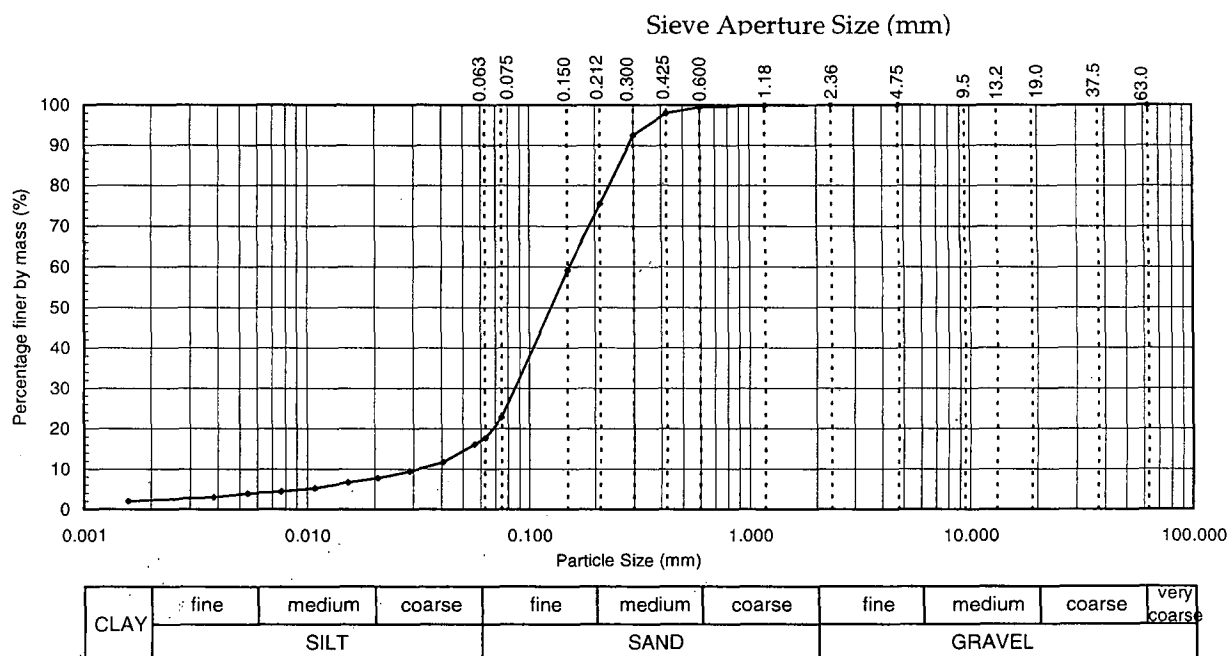
# PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT



Project : **Rangitaiki Stopbanks Section 4**  
 Location : **Rangitaiki**  
 Client : **Ice Geo & Civil Ltd, Papamoa**  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: **HA2**      Depth: **1.80 metres**  
 Sampled by : **M. O'Halloran**  
 Date received : **26/05/06**  
 Sampling method : **Auger**  
 Sample condition : **As received**  
 Sample description : **Grey fine SAND**  
 Solid Particle Density ( $t/m^3$ ): **2.60**      Assumed  
 Water Content (as received): **40.3** %

Project No: **2-68229.82**  
 Lab Ref No: **06/229/004**  
 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	0.0562	16	0.0077	4
37.5	--	2.36	100	0.212	75	0.0406	12	0.0054	4
19.0	--	1.18	100	0.150	59	0.0290	9	0.0038	3
13.2	--	0.600	99	0.075	23	0.0207	8	0.0016	2
9.5	--	0.425	98	0.063	18	0.0152	7	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0108	5		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: 30/05/06

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: 1/06/06

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician

Date : 1/06/06



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

# PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)

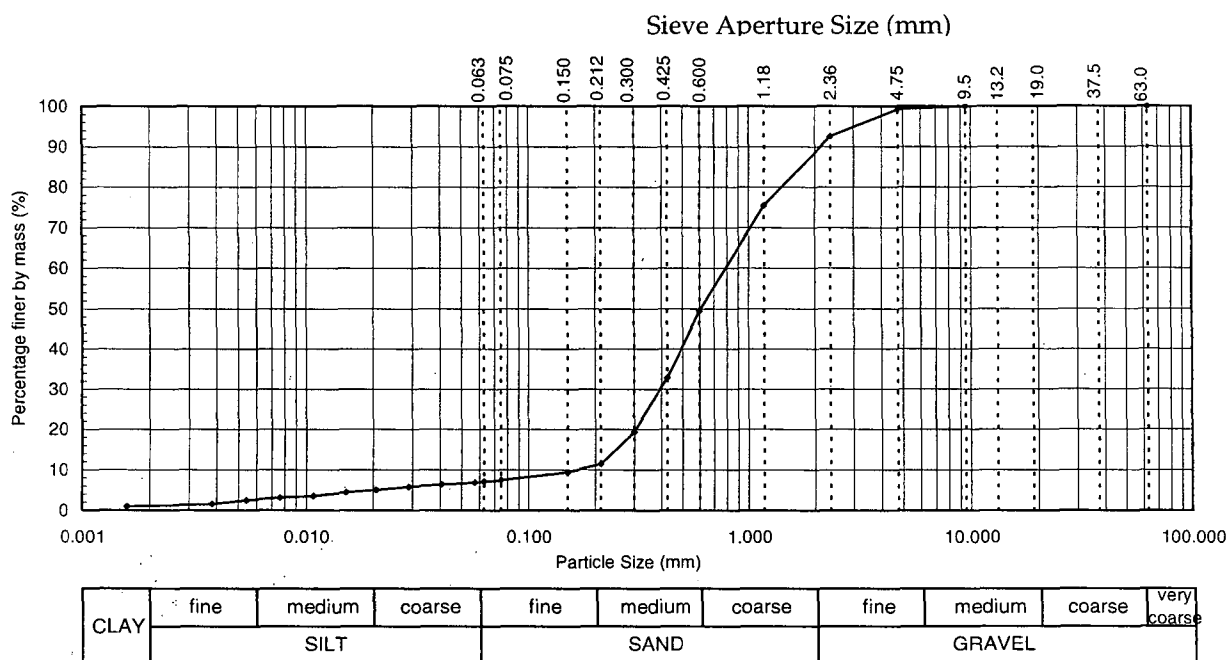
## TEST REPORT



Project : **Rangitaiki Stopbanks Section 4**  
 Location : **Rangitaiki**  
 Client : **Ice Geo & Civil Ltd, Papamoa**  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: **HA8**      Depth: **1.50 metres**  
 Sampled by : **M. O'Halloran**  
 Date received : **26/05/06**  
 Sampling method : **Auger**  
 Sample condition : **As received**  
 Sample description : **Grey medium - coarse SAND**  
 Solid Particle Density ( $t/m^3$ ): **2.60**      Assumed  
 Water Content (as received): **31.5**      %

Project No: **2-68229.82**  
 Lab Ref No: **06/229/004**  
 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	99	0.300	19	0.0573	7	0.0076	3
37.5	--	2.36	92	0.212	11	0.0407	6	0.0054	2
19.0	--	1.18	75	0.150	9	0.0289	6	0.0038	2
13.2	--	0.600	49	0.075	7	0.0206	5	0.0016	1
9.5	100	0.425	33	0.063	7	0.0151	4	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0107	4		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: **30/05/06**

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: **1/06/06**

IANZ Approved Signatory

Designation : **Senior Civil Engineering Technician**

Date : **1/06/06**



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

# PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)

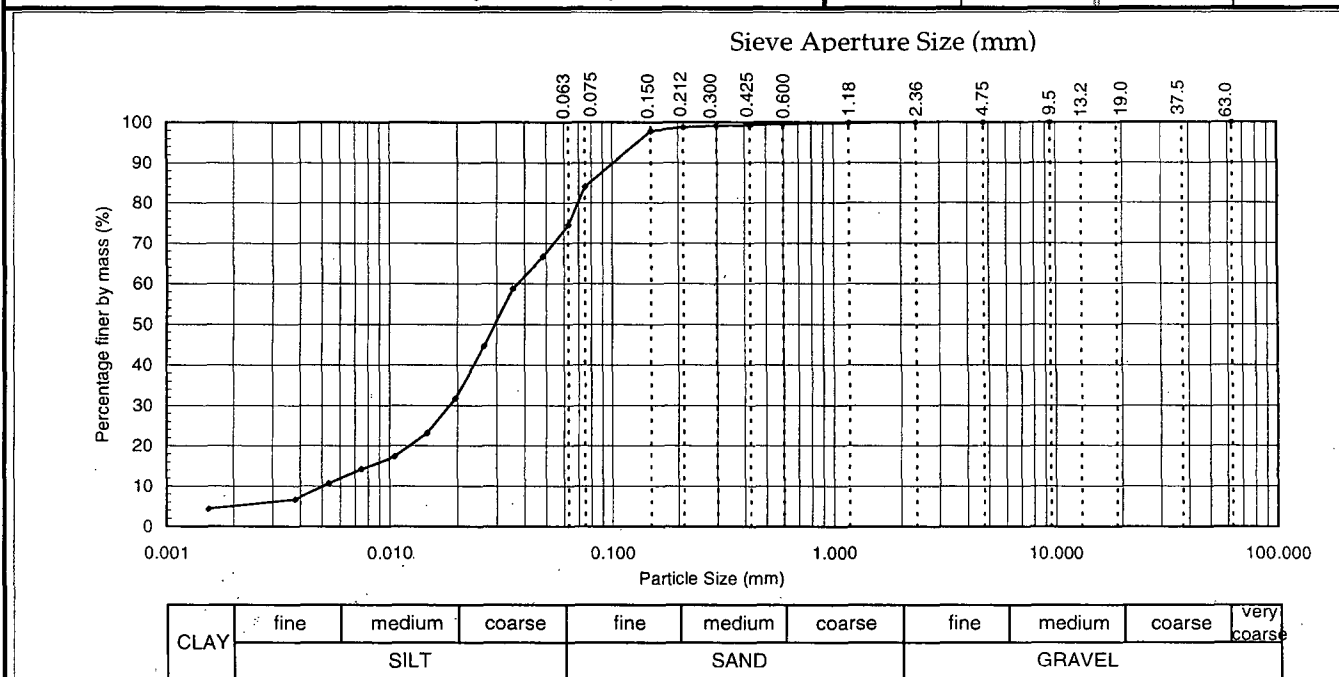
## TEST REPORT



Project : **Rangitaiki Stopbanks Section 4**  
 Location : **Rangitaiki**  
 Client : **Ice Geo & Civil Ltd, Papamoa**  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: **HA 16**      Depth: **1.60 metres**  
 Sampled by : **M. O'Halloran**  
 Date received : **26/05/06**  
 Sampling method : **Auger**  
 Sample condition : **As received**  
 Sample description : **Greyish brown sandy SILT**  
 Solid Particle Density (t/m<sup>3</sup>): **2.60**      Assumed  
 Water Content (as received): **54.3** %

Project No: **2-68229.82**  
 Lab Ref No: **06/229/004**  
 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	0.0486	67	0.0075	14
37.5	--	2.36	100	0.212	99	0.0355	59	0.0053	11
19.0	--	1.18	100	0.150	98	0.0265	45	0.0038	7
13.2	--	0.600	100	0.075	84	0.0196	32	0.0015	4
9.5	100	0.425	99	0.063	74	0.0147	23	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0106	17		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: 31/05/06

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: 2/06/06

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*  
 Date : 2/06/06



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

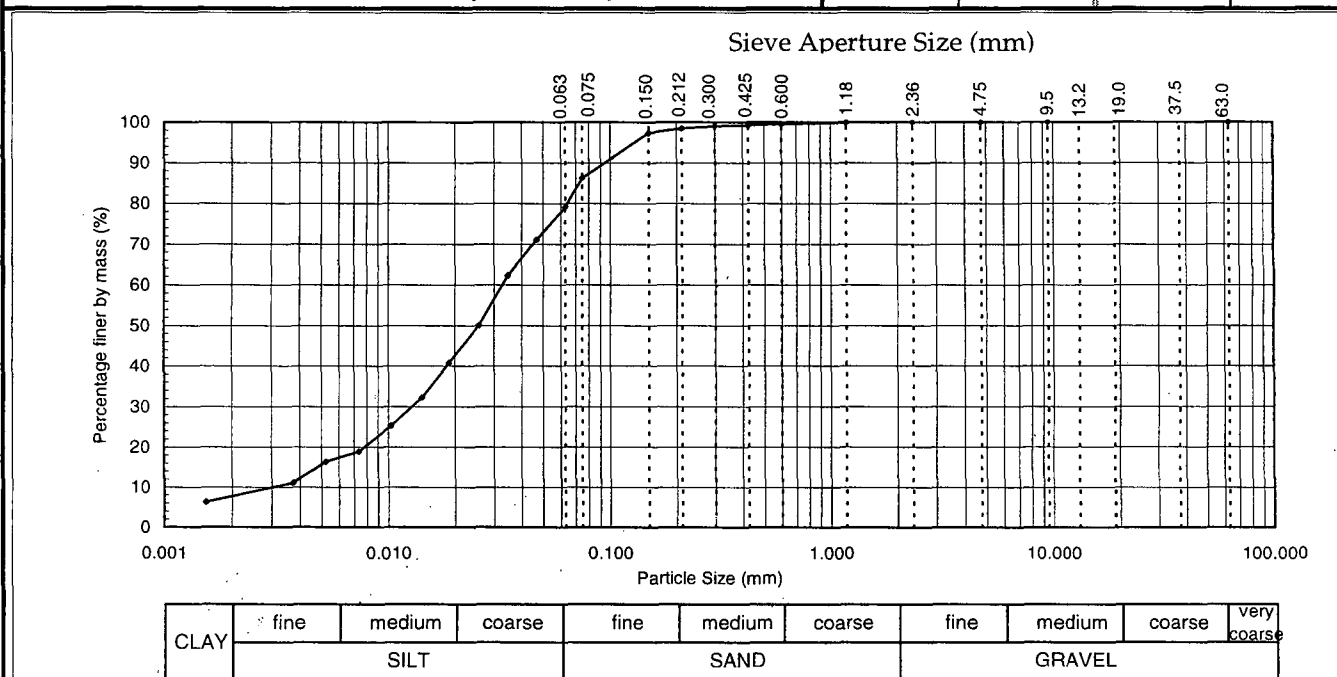
# PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT



Project : Rangitaiki Stopbanks Section 4  
 Location : Rangitaiki  
 Client : Ice Geo & Civil Ltd, Papamoa  
 Client/Sample Ref :  
 Contractor :  
 Sample ID : HA19 Depth: 0.80 metres  
 Sampled by : M. O'Halloran  
 Date received : 26/05/06  
 Sampling method : Auger  
 Sample condition : As received  
 Sample description : Brownish grey sandy SILT  
 Solid Particle Density ( $t/m^3$ ): 2.60 Assumed  
 Water Content (as received): 56.6 %

Project No: 2-68229.82  
 Lab Ref No: 06/229/004  
 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	0.0468	71	0.0074	19
37.5	--	2.36	100	0.212	98	0.0345	62	0.0052	16
19.0	--	1.18	100	0.150	97	0.0257	50	0.0037	11
13.2	--	0.600	99	0.075	86	0.0188	41	0.0015	6
9.5	100	0.425	99	0.063	79	0.0142	32	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0103	25		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: 30/05/06

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: 1/06/06

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician  
 Date : 1/06/06



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

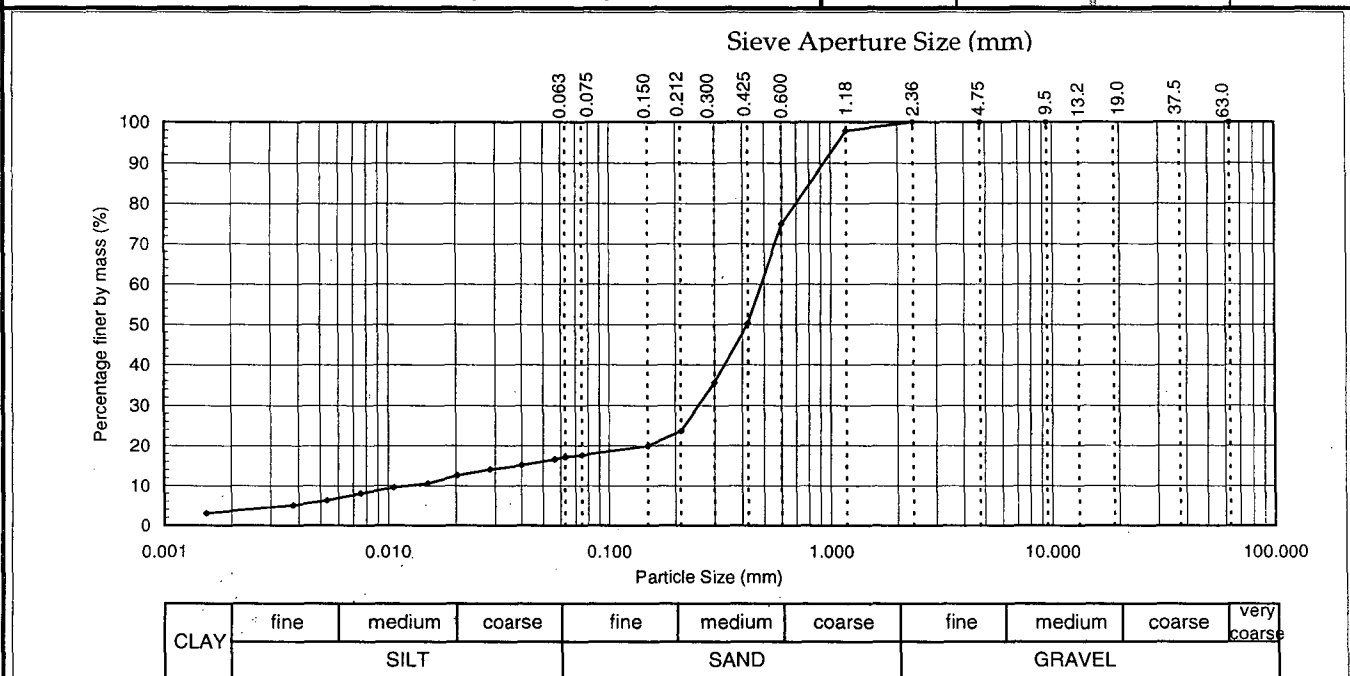
# PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT



Project : **Rangitaiki Stopbanks Section 4**  
 Location : **Rangitaiki**  
 Client : **Ice Geo & Civil Ltd, Papamoa**  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: **HA20**      Depth: **1.50 metres**  
 Sampled by : **M. O'Halloran**  
 Date received : **26/05/06**  
 Sampling method : **Auger**  
 Sample condition : **As received**  
 Sample description : **Brownis grey silty SAND**  
 Solid Particle Density ( $t/m^3$ ): **2.60**      Assumed  
 Water Content (as received): **43.5** %

Project No: **2-68229.82**  
 Lab Ref No: **06/229/004**  
 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	36	0.0564	17	0.0075	8
37.5	--	2.36	100	0.212	24	0.0402	15	0.0054	6
19.0	--	1.18	98	0.150	20	0.0285	14	0.0038	5
13.2	--	0.600	75	0.075	18	0.0203	13	0.0015	3
9.5	100	0.425	50	0.063	17	0.0150	11	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0106	10		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: 31/05/06

Sampling is not covered by IANZ Accreditation  
 This report may only be reproduced in full

Date Reported: 1/06/06

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*  
 Date : 1/06/06



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



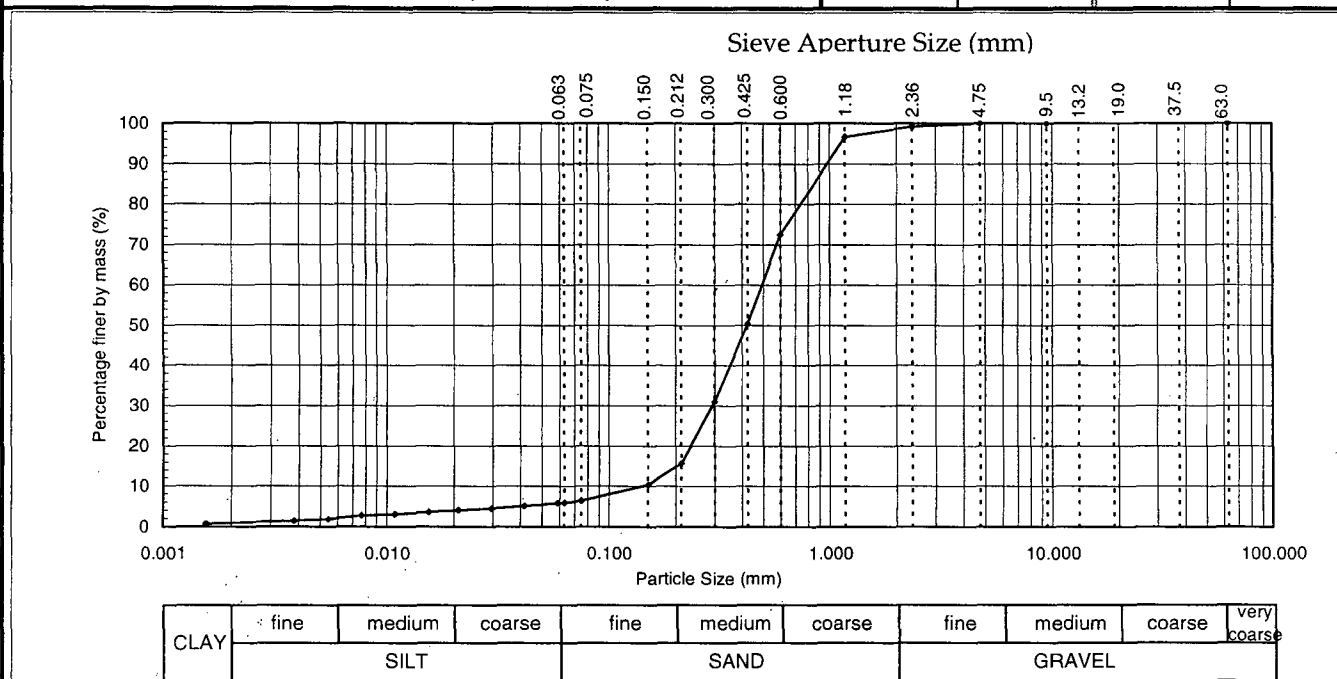
**PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)  
TEST REPORT**

Project : **Rangitaiki Stopbanks Section 4**  
 Location : **Rangitaiki**  
 Client : **Ice Geo & Civil Ltd, Papamoa**  
 Client/Sample Ref :  
 Contractor :  
 Sample ID: **HA28**      Depth: **3.50 metres**  
 Sampled by : **M. O'Halloran**  
 Date received : **26/05/06**  
 Sampling method : **Auger**  
 Sample condition : **As received**  
 Sample description : **Grey medium SAND**  
 Solid Particle Density ( $t/m^3$ ): **2.60**      Assumed  
 Water Content (as received): **32.9** %



Project No: **2-68229.82**  
 Lab Ref No: **06/229/004**  
 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	31	0.0587	6	0.0077	3
37.5	--	2.36	99	0.212	16	0.0417	5	0.0054	2
19.0	--	1.18	97	0.150	10	0.0296	5	0.0038	1
13.2	--	0.600	73	0.075	6	0.0210	4	0.0016	1
9.5	100	0.425	50	0.063	6	0.0154	4	--	--
<b>Note:</b> "--" denotes sieve not used and/or hydrometer analysis not tested						0.0109	3		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Hydrometer Method)	pH of suspension : 8.0      Whatmans Full Range pH indicator paper

Date Tested: 30/05/06

Sampling is not covered by IANZ Accreditation

This report may only be reproduced in full

Date Reported: 1/06/06

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician

Date : 1/06/06



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