

Rangitaiki River Stopbanks Assessment

Section 15

Left Bank 9300 to 9900m

Prepared for

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1 Introduction

The section of stopbank on the left bank of the Rangitaiki River from 9300m to about 9900m is the last section on the left bank to be investigated within the Edgumbe urban area. Investigations in Section 2, immediately downstream of Section 15, resulted in a length of pressure relief trench being installed on the inland side of the stopbank. Immediately upstream an overlay has been placed over what was a paddock at 63A College Road. (Hendy's) u/s of Edgumbe Domain.

Section 15 was not identified as an area with possible seepage problems in the 2005 study of the information available on the stopbanks (Reference 1). However it was discovered during the investigations that there had been some slumping along a particularly steep length of river bank as a result of the July 2004 flood. The investigations carried out for this report confirm that there should be no problems with seepage under the stopbank along this length but that there are areas with a low factor of safety against slope failure.

This report presents the following information:

- the results of insitu investigations,
- laboratory grading and permeability test results,
- the results of seepage analyses for the estimated 100 year return period flood,
- the results of stability analyses 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 left bank from 9300m to 9900m.

2 Site Description

Along this section of stopbank there is a wide variation in stopbank geometry. Over the first 100m the stopbank is about 1.8m above the surrounding land and there is a 5 to 10m wide berm 2 to 3m below the general ground level (Figure 1). (Meterages given are from the upstream end of the study section.)

At about 200m, where a stormwater outlet to the river passes under the stopbank, there is no river berm and the river bank is steep (nearly 40°). A concrete floodwall starts just downstream of the outlet. The exposed portion of the wall varies in height from 0.6 to 1.3m and the height of the stopbank on which it sits varies from about 0.3m to 1.1m. There is no river berm along the 140m length of the wall.

At the end of the floodwall (340m) the earth stopbank rises to 1.6m height. There is no river berm until about 430m. From 430m to the end of the study section the stopbank height is typically 1.4 to 1.7m and the river berm

increases in width until it is about 20m wide. The berm is 1.5 to 3.0m below the typical ground level as it has been used as a source of fill.

The crest of the stopbank is typically 3 to 4m wide, including that adjacent to the floodwall. The ground slopes gently away from the stopbank, falling 400 to 500mm across the properties to College Road.

It appears from the surveyed cross sections that the desired 600mm freeboard above the estimated peak of the 100 year return period flood has not been achieved along the whole study length.

Over most of the study length there are gardens and structures right up to the inland toe of the stopbank. There is access to the stopbank from the end of Tanekaha St and from a right of way above the stormwater outlet.

3 Subsurface Investigations

The subsurface investigations consisted of 26 hand augers and two boreholes carried out in thirteen cross sections at 60 to 70m intervals along the study length (Figure 1). The location of the tests was chosen on the basis of spacing, land owner permission and the presence of underground and overhead services. The hand augers were continued until the holes collapsed below ground water level, the holes squeezed in or over 4.0m depth was achieved. BH1 was drilled to 10.5m depth below the top of the stopbank and BH2 was drilled to 7.5m. Seven holes were augered on the river berm. The depth of these was largely determined by the height of the river berm above river level. Four holes were augered through the stopbank where there was no river berm and the remainder were on the inside of the stopbank. The hand auger and bore logs are included in Appendix A and Figures 3 to 10 show the estimated sub surface profiles of the cross sections analysed.

The near surface soils found along the study length are predominantly silts, clayey silts and silty fine sands. Some of the clayey silts contain organic material. The clayey layers form a good seal, reducing flows from the river under the stopbank. Medium to coarse grained sands were only found within the depth of the hand auger investigations at the upstream end of the study section near 63A College Road and at the downstream end of the study section, near the termination of the pressure relief trench in Section 2. Layers of pumice lapilli embedded in a silt matrix were found at about 5.5m below the natural ground surface in both boreholes. In general the predominant soils found along this study length have a lower permeability than those found in many other parts of Edgumbe.

The soil layers slope gently towards or away from the river. The change in slope direction could be a result of past braiding of the river. Some of the soils appear to be in lenses, such as the peat found in HA3 and BH1. This is probably also a result of braiding. Similar lenses of peat were found below 63A College Road.

The ground water level was found to be at 1.3 to 2.0m depth on the inland side of the stopbank when the augers were carried out in the winter of 2006.

4 Laboratory Test Results

Laboratory constant head permeability tests were carried out on three “undisturbed” tube samples of the surface brown silts taken from sites spread down the study length. These tests were carried out as the permeability of the surface silts largely determines the magnitude of the uplift pressures developed under the surface soil layers. The range of head used in the tests was 2 to 4m to simulate the head that could be applied when the river is in flood. The results are summarised in Table 1.

Table 1: Surface Silt Permeability Test Results

Sample	Location	permeability
HA2	back lawn	1.0×10^{-6} m/s
HA13	back lawn	3.0×10^{-6} m/s
HA24	cattle grazing area	6.1×10^{-7} m/s

The range of permeabilities given in Table 1 is a reflection of the use of the area from where the sample was taken. HA2 was in the well used back lawn of a family with children. HA13 was in the little used lawn of an elderly widow and the area of HA24 had been heavily trampled by cattle. As a low permeability of the surface silt results in increased uplift pressures it is considered conservative to estimate a permeability on the low side. Therefore a permeability of 6.0×10^{-7} m/s was assumed in the seepage analyses.

The average initial wet density of the silt permeability samples was 1.49t/m^3 and average final wet density 1.60t/m^3 .

Three laboratory permeability tests were carried out on deeper soils below the stopbank to provide information on the flow of water beneath it.

Table 2: Deep Permeability Test Results

sample	soil	permeability
BH1 3.0m	silty fine sand	2.8×10^{-5} m/s
BH2 4.5m	silt	4.5×10^{-8} m/s
BH2 6.0m	organic and sandy silt	2.0×10^{-7} m/s

The permeability of the BH1 sample is higher than would be expected for a silty fine sand. This could be due to difficulties in achieving saturation in the laboratory. Only 52% saturation was recorded for this sample.

Hydrometer particle grading tests were carried out on nine samples of subsurface soils to provide comparison between the soils on which permeability tests had been carried out and other soils. Permeabilities were also estimated using the Hazen formula:

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

The grading test results are summarised in Table 3.

Table 3: Particle Grading Results

Sample	Description	D ₁₀ (mm)	D ₆₀ (mm)	permeability
HA2 1.2m	grey sandy silt/silty fine sand	0.005	0.075	2.5×10^{-7} m/s
HA13 2.5m	light grey sandy silt	0.002	0.028	4.0×10^{-8} m/s
HA14 1.8m	grey silt with clay	<0.001	0.018	clay
HA24 1.9m	grey sandy silt	0.0015	0.025	2.3×10^{-8} m/s
BH1 3.7m	sandy silt/silty fine sand	0.005	0.09	2.5×10^{-7} m/s
BH1 5.2m	coarse sand	0.06	1.0	3.6×10^{-5} m/s
BH1 7.5m	sandy silt with gravel	0.005	0.05	2.5×10^{-7} m/s
BH2 5.1m	silt	0.002	0.02	4.0×10^{-8} m/s
BH2 6.7m	silty med-coarse sand	0.015	0.425	2.3×10^{-6} m/s

The results of all 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. The logs 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 identified. In this urban area it is possible that there are undetected buried pipes below the stopbank, rubbish pits or buried rotten tree stumps along the stopbank.

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 lateral changes in the soil profile or the presence of an impermeable surface of given width, 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). The aim of the remedial measures is to achieve a minimum factor of safety against heave of 1.1 to 1.2. In reality, due to the conservative assumptions made in the permeability of the soil layers and the weight of the upper soils, the factor of safety should be higher than that estimated. Over most of the study length the use of an overlay is impractical due to the built up nature of the properties adjacent to the stopbank.

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. Pressure relief trenches can be used to reduce both the risk of piping and 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 surface layer with a lower permeability than those underlying it. Seepage from the ground surface inside the stopbank has been modelled right along the study length as most of the houses are of an older style and are built on short timber piles which will allow ground seepage under them. The driveways and paths are relatively narrow.

5.2 Flood Hydrograph

EBoP has provided a 100 year return period flood flow hydrograph for the Rangitaiki River at their benchmark number 23 (Figure 2). This is an eight day hydrograph which rises to a peak of RL5.94 on the third day of the flood. The top of the stopbank along Section 15 is at RL6.1 to 6.6. Allowing for some change in the peak river level upstream and downstream of the benchmark, it appears that the design freeboard for an urban area (600mm) has not been met and that around BM23 there may be less than 300mm freeboard.

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 the substation, therefore this flood was not a true test of the stopbanks.

5.3 Soil Model

The soil layers found in the in situ investigations were simplified in the models used for the seepage analyses (Figures 3 to 10). The grading test results

were compared to the field descriptions of the soils to confirm the soil categories. Below the surface layer of brown silt the layers were divided into grey silt, silty fine sand, fine to medium sand, clayey silt, medium to coarse sand, banded silts and silty sands and pumice in a silt matrix. The permeabilities assumed were conservatively based on the permeability tests and the grading test results for this site and near-by sites previously investigated. 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 4 summarises the saturated soil permeabilities assumed. In the cross sections where there was no deep sub surface information it was conservatively assumed that there is a thick layer of coarse sand below the depth of investigations.

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 4: Assumed Soil Permeabilities

soil	k_h (m/s)
stopbank fill	2×10^{-6} $k_v=1 \times 10^{-6}$
brown silt	6×10^{-7}
grey silt / sandy silt	8×10^{-7}
silty fine sand	4×10^{-6}
fine to medium sand	5×10^{-5}
medium to coarse sand	4×10^{-5}
clayey silt	5×10^{-8}
banded silty sands and silt	4×10^{-6} $k_v=6 \times 10^{-7}$
pumice in silt matrix	3×10^{-7}

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 and the banded silty sands. 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 14 or 15 kN/m³, depending on its location. 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 sandy silts are quite light.

The stopbank cross section was modelled to at least 30m away from the inland side of the stopbank. Infinite elements were then used to model flow from a great distance towards the river. An initial steady state condition with water flowing towards the river is required at the start of the transient flood analysis. This was modelled by specifying a head at the infinite elements and another in the river. The inland head was based on those measured on site and the river head was set at the starting level of the 100 year flood flow hydrograph.

A sensitivity analysis was carried out varying the boundary condition at the infinite elements during the transient analysis to find which was most conservative in terms of uplift pressures. It was found that removing the head boundary condition specified in the steady state analysis produced the greatest pressures. In reality the ground water level away from the river is likely to be rising at some stage during the flood due to rainfall. Peak ground water levels due to rainfall infiltration could be before or after the peak river flow. Rainfall has not been modelled.

5.4 Floodwall

Figure 11 shows a cross section of the floodwall. The original floodwall consisted of a 600mm high upstand on a strip footing and just provided the freeboard above the flood level. After the 1987 earthquake the height of the upstand was raised about 700mm and the key was added to the foundation on the river side.

The stability of the highest section of exposed floodwall has been assessed and found to be acceptable under flood conditions. Seepage beneath the floodwall has also been assessed and it was found that the factor of safety against piping beneath the wall is close to 1.0 at the toe of the wall. The hydraulic exit gradient can be reduced to an acceptable level by installing a 200mm wide by 400mm deep, or a 400mm wide by 200mm deep filter drain along the inland toe of the foundation as shown on Figure 11. This drain should be extended until less than 1100mm of the wall is exposed.

5.5 Cross Section 1

At Cross Section 1 the stopbank is 1.8m higher than the land on the inland side and there is a 10m wide river berm about 2m below the general ground level (Figure 3). This cross section is about 50m downstream of 63A College Road where an overlay has been placed across the ground surface.

Medium to coarse sand was found 1.4m below the ground surface at HA1 on the river berm. Above this level there are layers of silt and silty fine sand. BH1 was drilled through the stopbank to determine the thickness of this sand layer as it has a considerable effect on the seepage pressures on the inside of the stopbank. It was found there is only a 200mm thick layer of coarse sand below the stopbank and there are thin layers of silty sand, fine sand and peat below it. For the purposes of the seepage analysis the basement layer consists of a low permeability layer of pumice lapilli in a silt matrix.

An initial static seepage analysis was carried out assuming a ground water level of RL3.0 on the inland side of the stopbank model and a river level of RL2.0. 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 carried out assuming the permeabilities given in Table 4 showed that there should not be any seepage or uplift problems with this section of stopbank. As the laboratory test on the silty sand layer showed a permeability of about 3.0×10^{-5} m/s another analysis was carried out assuming this permeability in case the laboratory result was not due to testing problems. It was found that the factors of safety were still acceptable for this permeability. Another analysis was carried out increasing the permeability of the coarse sand to 1×10^{-4} m/s in case the permeability estimated using the Hazen formula is an under-estimate. This analysis also resulted in acceptable factors of safety.

5.6 Cross Section 2

The geometry of the stopbank at Cross Section 2 is similar to that at Cross Section 1 (Figure 4). On the inland side of the stopbank there is a layer of grey silt below the surface brown ashes extending to 1.1m depth. Below this there is silty fine sand. Silty fine sands and sandy silts were found below the river berm in HA4. A 500mm thick layer of peat was found at RL-0.6 and no coarse sands were found above RL-1.4. It was assumed in the analyses that there is silty fine sand extending to RL-4.5 and then the layer of pumice lapilli in a silt matrix found in BH1. This layer was found at RL-0.6 in both BH1 and BH2, and at RL0.0 in a borehole through the stopbank near 35 College Road.

A transient flood flow analysis was carried out as for Cross Section 1. It was found that there should be no seepage problems with this section of stopbank with the assumed soil properties and profile. As for Cross Section 1 a sensitivity analysis was carried out assuming a permeability of 3×10^{-5} m/s for the silty fine sand. A factor of safety against heave of 1.3 was found for this analysis. Only a small reduction in FOS was found when this analysis was repeated with a 1m thick layer of coarse sand just below the depth of HA3.

The slope stability of this section of stopbank was assessed under rapid drawdown conditions when the water level within the stopbank is higher than the river. The soil strength parameters assumed are given in Table 5. A factor of safety against slope failure close to 1.6 was obtained. This is considered acceptable. As Cross Section 1 has a similar geometry it has been assumed that this cross section also has adequate stability.

Table 5: Assumed Soil Parameters

soil	density (kN/m³)	effective cohesion (kPa)	friction angle (degrees)
stopbank fill	16	2	33
brown silt	15.5	5	27
grey silt	15	2	27
silty fine sand	15	2	33
fine to medium sand	14	0	35
medium to coarse sand	14	0	35
clayey silt	15.5	5	24
pumice lapilli in silt	14	5	35

5.7 Cross Sections 3, 4, 5 and 6

The soils found at cross sections 3, 4, 5 and 6 consist of complex layers of silts, clayey silts and silty fine sands. The flood wall is up to 1.3m high at cross sections 4, 5 and 6 and there is no wall at Cross Section 3. However as the river bank has a similar geometry at all four cross sections it was decided to analyse Cross Section 4 only because it has the thickest layers of silty fine sands and clayey silts at the greatest depth of the four cross sections. Cross Section 4 also has the highest floodwall and hence the narrowest stopbank. The results from the analysis of Cross Section 4 should therefore be conservative when applied to the other cross sections.

The transient seepage analysis was carried out using the permeabilities given in Table 4, assuming silty fine sands from the depth of the investigations to RL-2.0 and pumice lapilli in a silt matrix below (Figure 5). No seepage problems were identified in the analysis (apart from at the flood wall as discussed in Section 5.4 above). If the permeability of the silty sand is increased to 3×10^{-5} m/s there is a slight possibility of uplift of the 200mm brown ash layer on the inside of the stopbank. Further analysis suggested that although this could result in seepage flows of the order of $5\text{m}^3/\text{m}$ length of stopbank over the eight day flood, the hydraulic exit gradients should not be sufficient to cause a piping failure of the stopbank. The upper brown silt layer is much thicker at cross sections 3, 5 and 6 and the risk of heave less than at Cross Section 4. The neighbour downstream of Cross Section 4 reported the formation of a sinkhole in the back lawn. This may have been the result of localised heave of the surface silt layer or may be associated with high hydraulic exit gradients behind the floodwall.

A failure of the river bank adjacent to the flood wall was observed in 2004. This may have been due to scour at the toe or very rapid drawdown when the stopbank burst upstream. A stability analysis showed that when the river is high this section of stopbank should have adequate stability, but when the river drops to RL 2.0 the factor of safety against slope failure drops to 1.15. This factor of safety is considered to be unacceptably low for static conditions.

The placement of a 5m wide berm against the river bank up to RL 2.0 should improve the factor of safety against slope failure to more than 1.5 for all conditions in the river.

5.8 Cross Sections 7 and 8

At cross sections 7 and 8 the stopbank is about 1.9m high and there is no river berm. The investigations showed a layer of silty fine sand below a thin layer of brown silt at Cross Section 7 (Figure 6). Below this sand are layers of silt, sandy silt and clayey silt. A 100mm thick layer of fine to medium sand was found at RL 1.1 in HA14 but there did not appear to be a corresponding layer in HA14 closer to the river. Only a thin silty sand layer was found at 2.0m depth in HA15 on Cross Section 8. Therefore the results from the analysis of Cross Section 7 would be conservative when applied to Cross Section 8.

It was assumed in the soil model used in the transient analysis that there was a 1.3m thick layer of sands with a permeability of 1×10^{-4} m/s below the depth of the hand augers and then a layer of pumice lapilli in a silt matrix as found in BH2 down stream. The only seepage problem identified in the analysis was the slight possibility of the heave of the upper brown silt layer. An analysis was carried out assuming a hole in this layer and it was found that the hydraulic exit gradient not high enough to encourage piping of the silty sand below.

The stability analyses of this cross section indicated a factor of safety against slope failure of about 1.2 for both rapid drawdown and low river level conditions. Some stabilising work is therefore required here as for cross sections 3 to 6.

5.9 Cross Section 9

At Cross Section 9 the stopbank is about 1.8m high and there is a narrow river berm (Figure 7). The river bank is lined with rock at this location. The hand augers showed layers of silts, sandy silts and silty fine sands. A clayey silt layer was found at 3.4m depth below the river berm. Initial seepage analyses carried out assuming sands below the depth of the hand augers did not produce conclusive results. BH2 was therefore drilled through the stopbank to confirm the soil types below the depth of the hand augers. It was found that the silty fine sands and silts extend to RL 0.3 and are underlain by about 1m of banded fine to medium sands and then pumice lapilli in a silt matrix.

The transient seepage analysis carried out assuming a simplified soil profile from the three tests along the cross section showed that there should be no seepage problems with this section of stopbank.

The factors of safety against slope failure of the stopbank are acceptable for all river levels and drawdown conditions due to the presence of the small river berm at this cross section.

The neighbour at this site commented on an area of seepage in the riverbank just upstream from the cross section. This may be due to an old pipe. It is suggested that when the river berm is being constructed some investigations are carried out.

5.10 Cross Section 10

The stopbank at Cross Section 10 is 1.4m high and there is about a 10m wide river berm (Figure 8). The hand augers at this location showed layers of silts, sandy silts and silty fine sands. A medium to coarse sand layer was found at RL0.4 below the river berm. This is consistent with the depth of the sand layer found in BH2 just upstream. It was therefore assumed in the soil model that there was a 1m thick layer of medium to coarse sand between the silty fine sands and pumice lapilli in a silt matrix.

The transient seepage analysis using the permeabilities in Table 4 showed there should be no seepage problems at this cross section. A sensitivity analysis was carried out increasing the permeability of the sand to 1×10^{-4} m/s. Although the uplift pressures under the surface silt layers increased they should still not be sufficient to cause heave problems.

5.11 Cross Sections 11 and 12

Cross sections 11 and 12 have a similar geometry with a low wide river berm (Figure 9). No clean sands were found within the depth of the hand augers and there are no silty fine sands within 2.5m of the ground surface.

A transient seepage analysis of Cross Section 11 with a 2m thick layer of sand below the depth of the hand augers showed that there should be no seepage problems along this section of stopbank.

5.12 Cross Section 13

Cross Section 13 slightly over-laps the upstream end of the previously investigated Section 2. The shallowest silty fine sand layer was found at 1.8m below the ground surface (Figure 10). Banded silty fine sands and silts were found below the river berm. The only high permeability layer found is a medium to coarse sand at 1.6m depth below the river berm.

The permeabilities shown in Table 4 were used in the transient seepage analysis. The vertical permeability of the banded sand/silt layer was assumed to be that of a silt and the horizontal that of a silty fine sand. A 3m thick layer of medium to coarse sand with a permeability of 5×10^{-4} m/s was assumed below the depth of the investigations. The lowest factor of safety found against uplift of the surface low permeability layers was greater than 1.2. Therefore it is considered that no work is required at this cross section; which confirms the findings of the Section 2 investigations.

6 Conclusions

1. The level of freeboard along this length of stopbank needs to be checked.
2. A filter drain should be installed behind the floodwall where ever more than 1100mm of the wall is exposed.
3. The construction of a berm along the river bank at least up to RL2.0 is required from Cross Section 3 to Cross Section 8 to improve the bank stability to an acceptable level.
4. The area of seepage near Cross Section 9 should be investigated.



M. O'Halloran

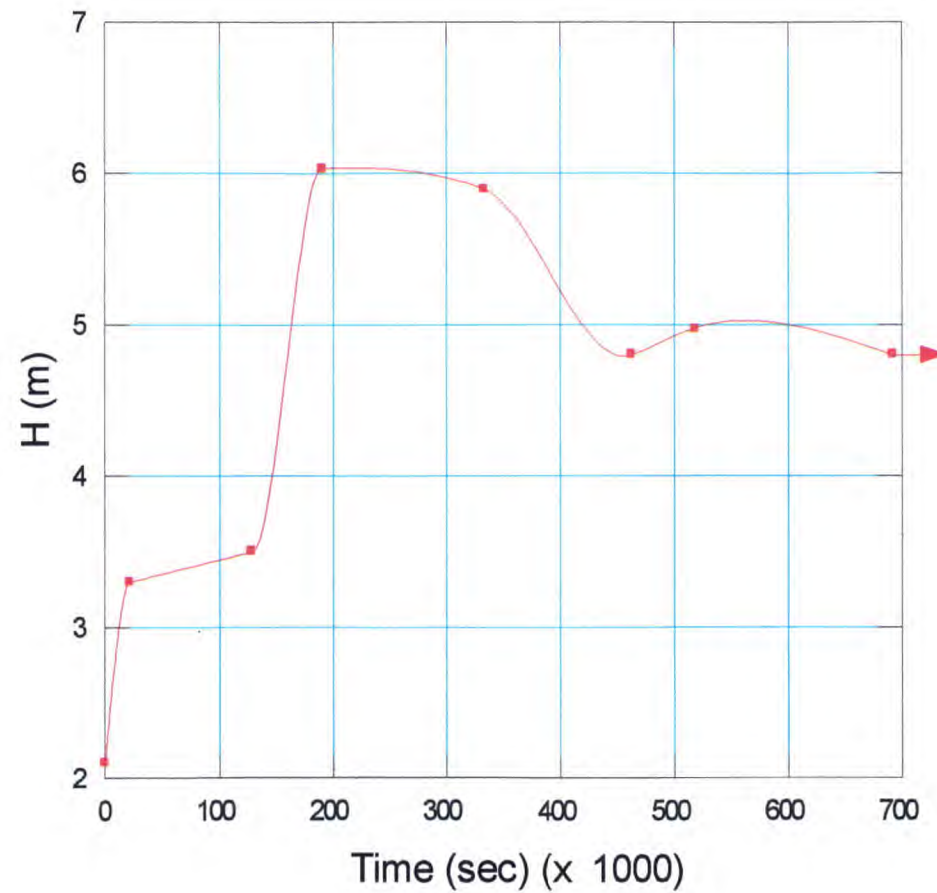
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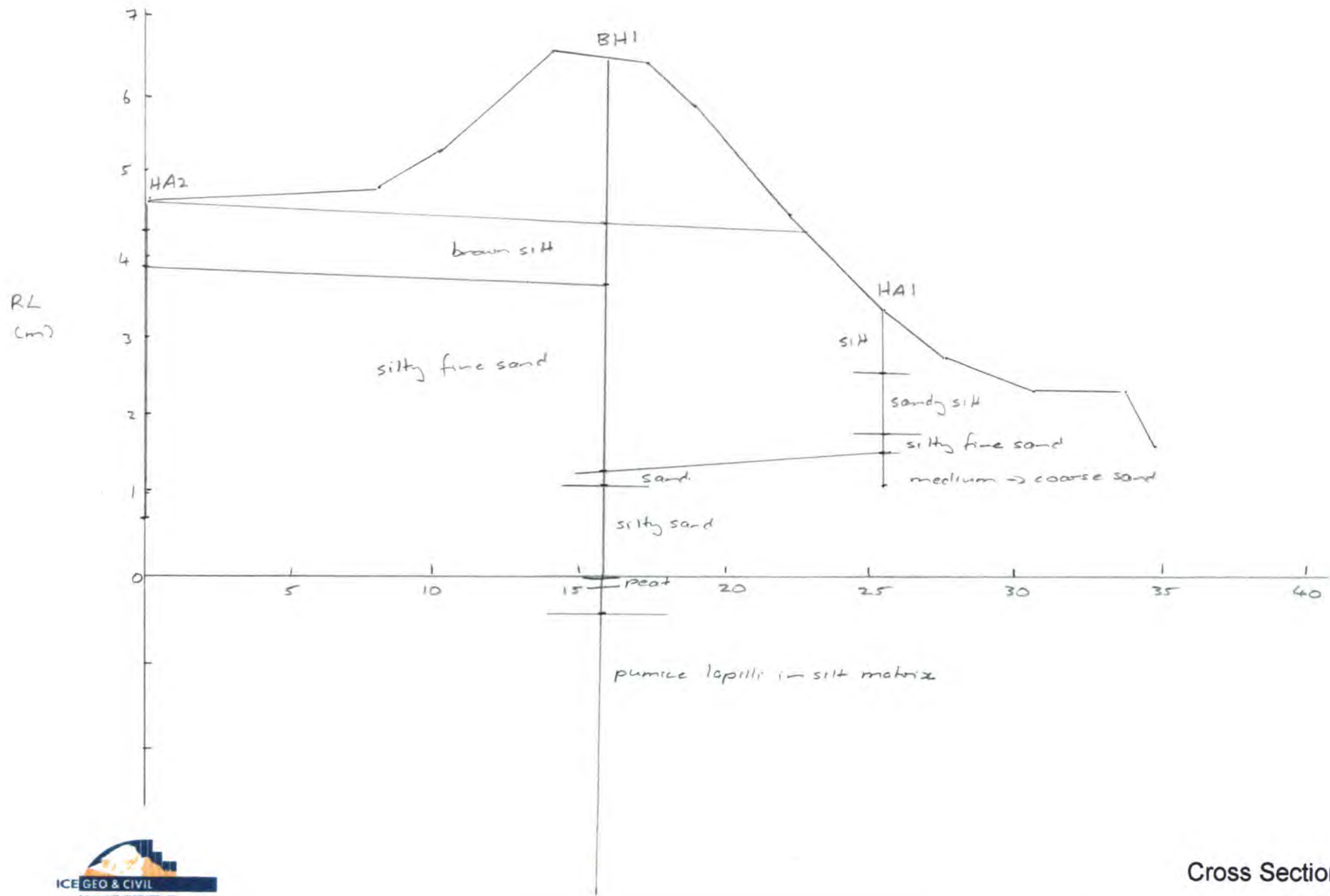
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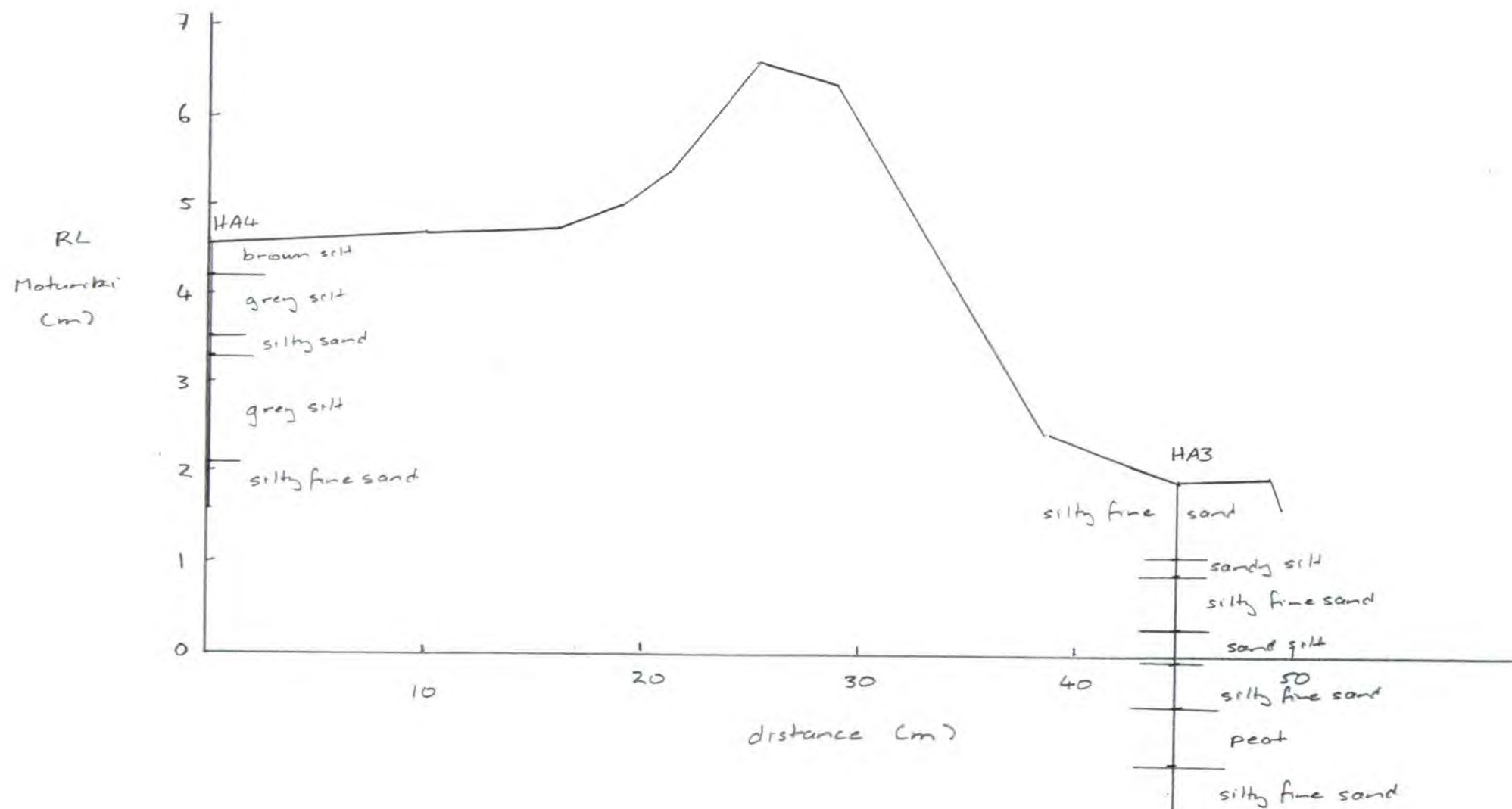




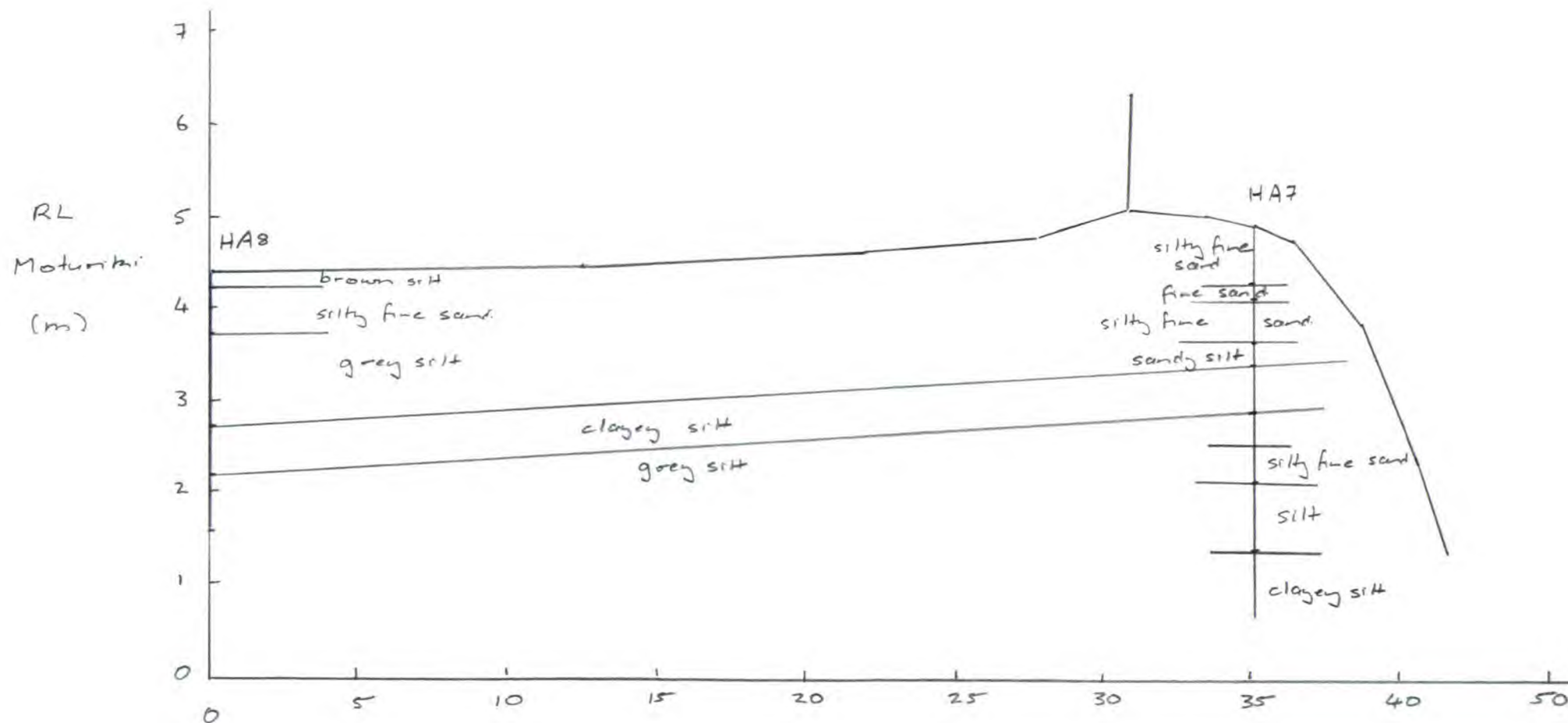
100 year flood flow hydrograph



Cross Section 1

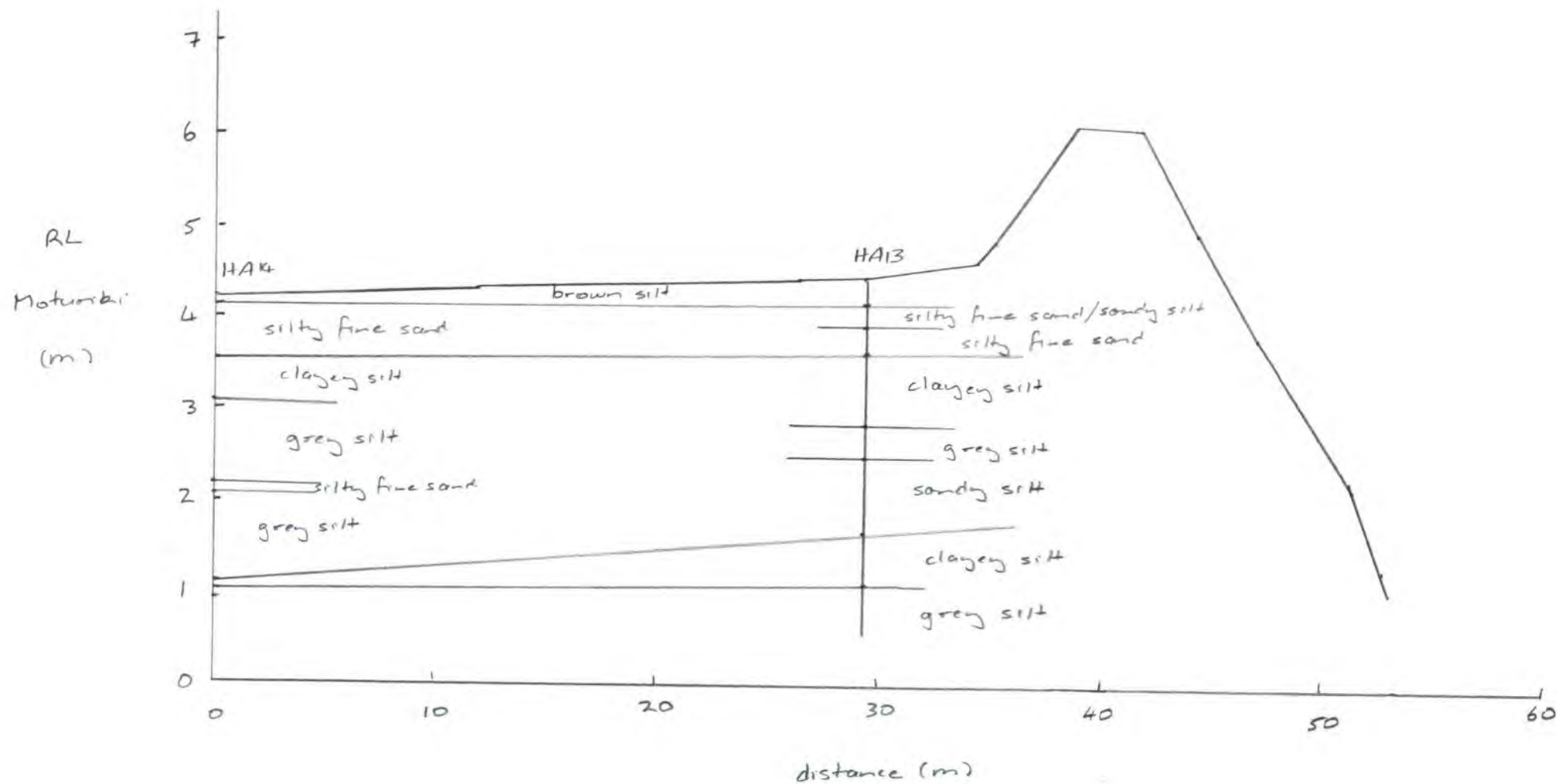


Cross Section 2



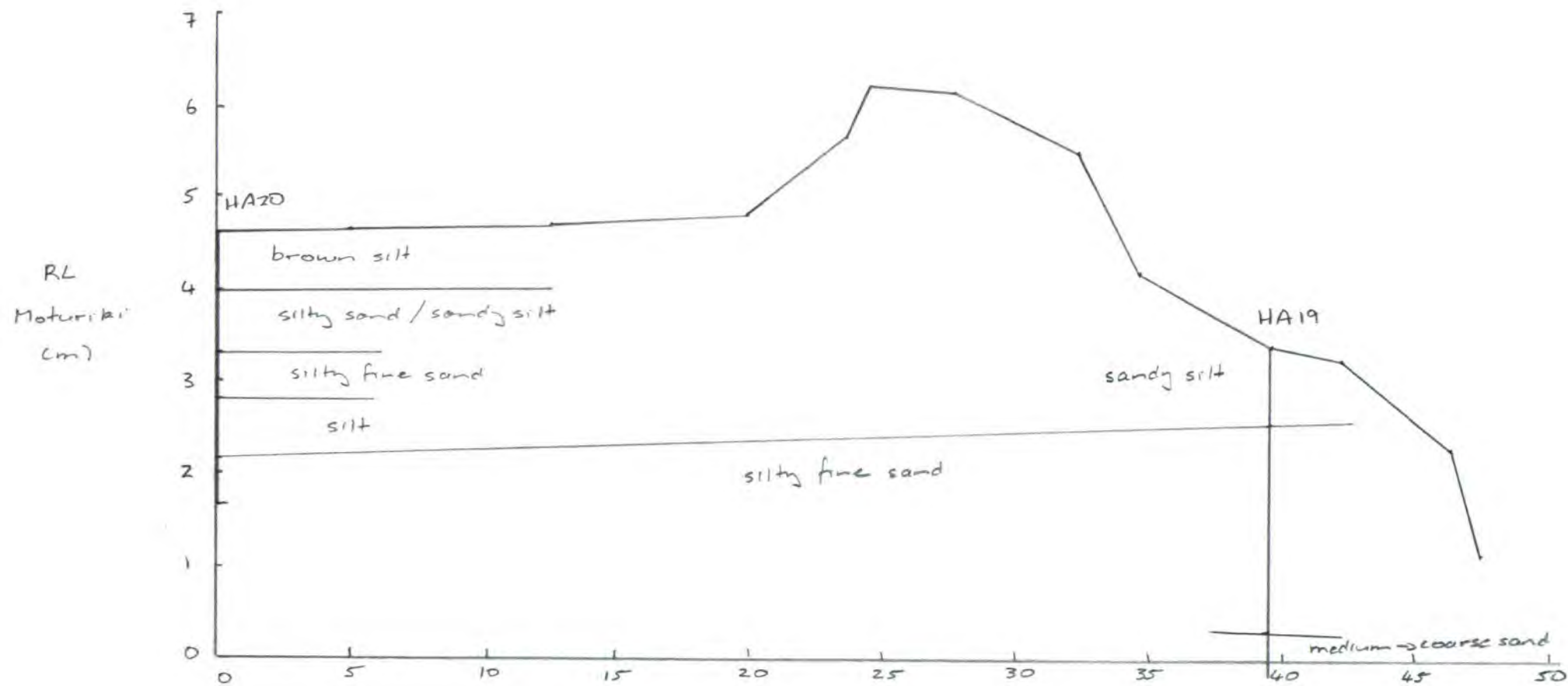
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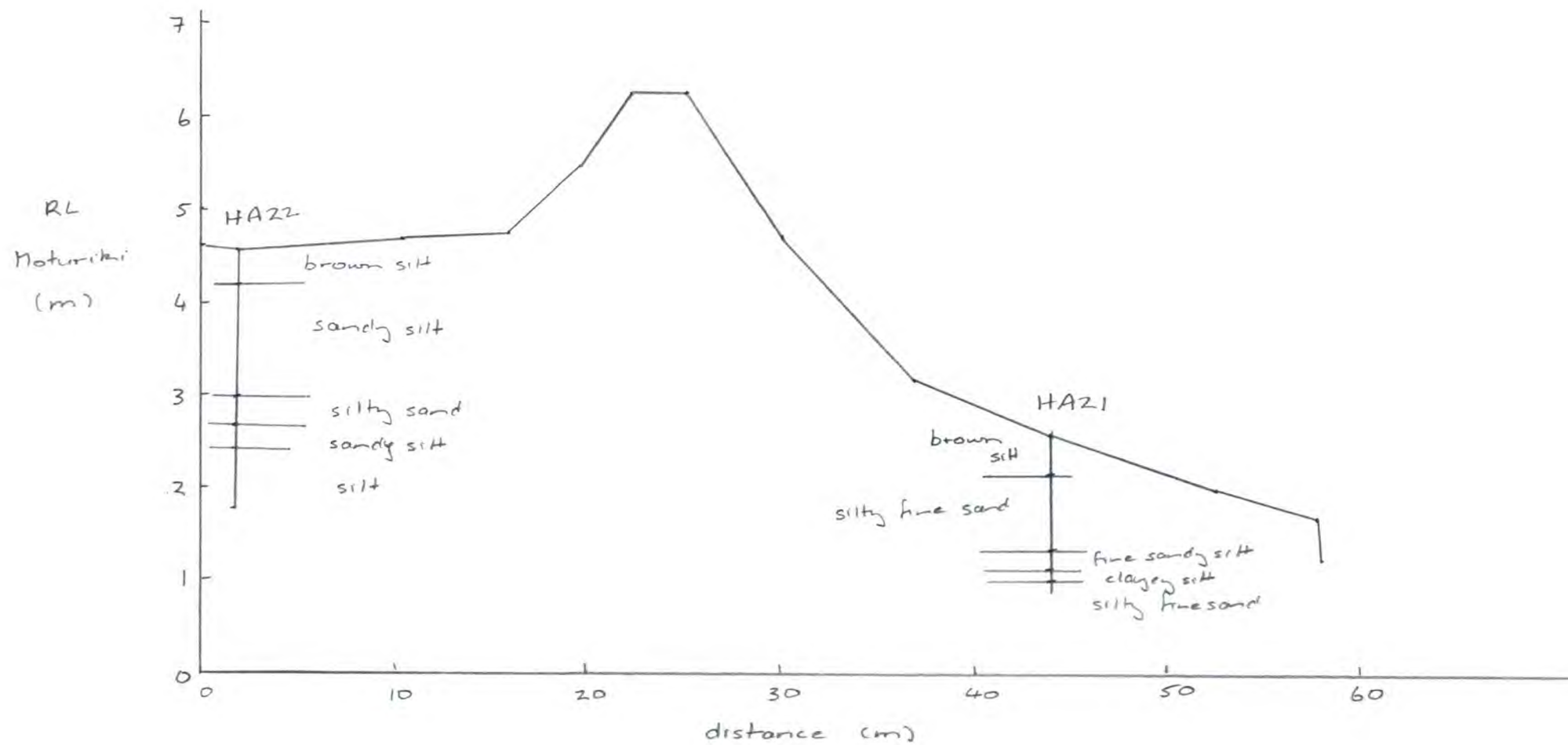
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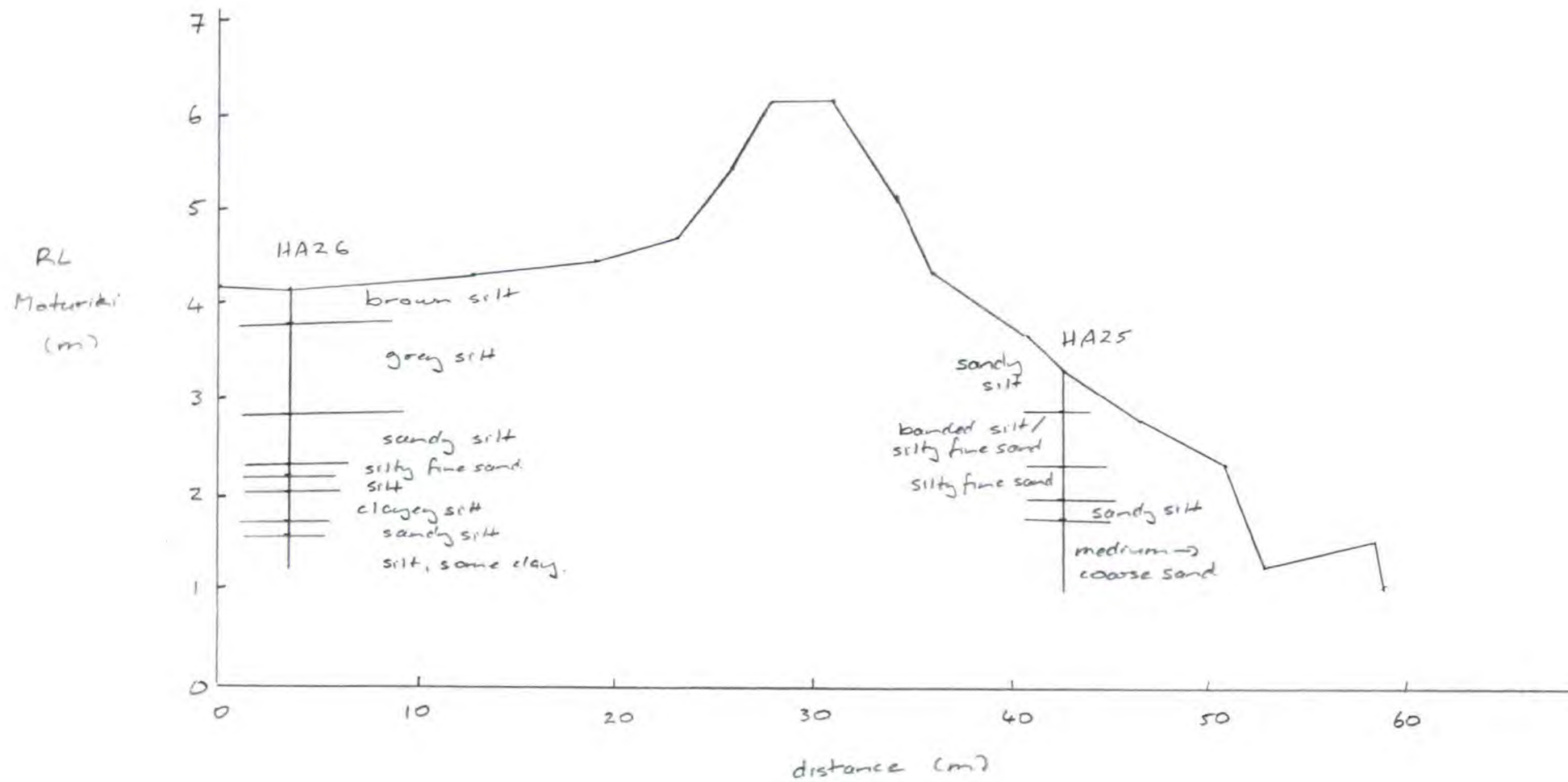
Cross Section 7

Figure 6



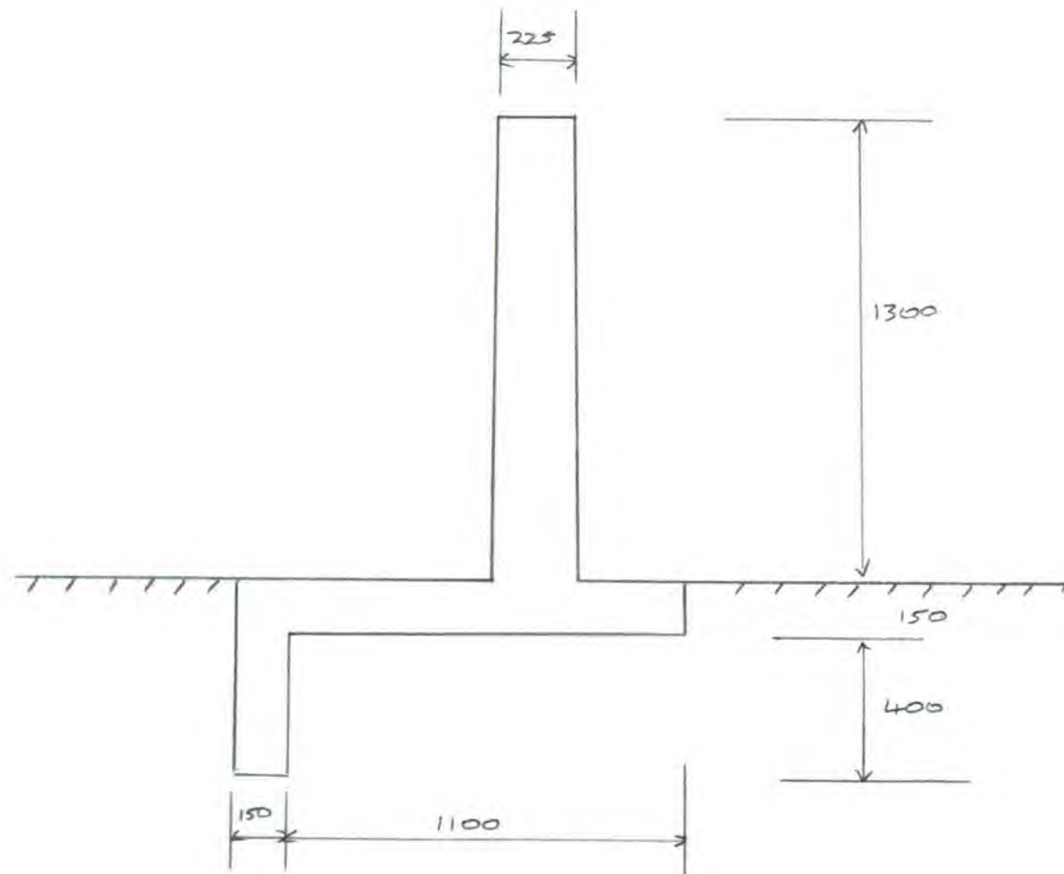


Cross Section 11



Cross Section 13

Figure 10



Appendix A

Hand Auger and Bore Hole Logs

Hand Auger Log

Test Number: HA1

Job Name: Rangitiki Stopbanks
Section 15

Date: 22/9/06

Tested by: M.O.H

m	Blows/50mm													C _u (kPa)	soil description	
	0	2	4	6	8	10	12									
0.2														X	X	brown SILT
														X	X	
0.4														X	X	
														X	X	
0.6														X	X	0.8 brown fine. sandy SILT
														X	X	
0.8														X	X	
														X	X	- 1.2 moist
1.0														X	X	
														X	X	
1.2														X	X	1.7 orange stained grey silty fine-medium SAND
														X	X	
1.4														X	X	
														X	X	1.9 grey medium-coarse SAND wet
1.6														X	X	
														X	X	
1.8														X	X	2.2 EOB collapse
														X	X	
2.0														X	X	
														X	X	
2.2														X	X	
														X	X	
2.4														X	X	
														X	X	
2.6														X	X	
														X	X	
2.8														X	X	
														X	X	
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	

Hand Auger Log

Test Number: 14A2

Job Name: Rangitiki Stopbanks
Section 15

Date: 16/8/06

Tested by: M.OH

Blows/50mm																
m	0	2	4	6	8	10	12	C _u (kPa)					soil description			
0.2													X	X	brown SILT	
													X	X		tube
0.4														X		0.4
													X	X	brown fine sandy SILT	
0.6													X	X		
													X	X		
0.8													X	X		0.8
													X	X	orange stained grey	
1.0													X	X	silty fine SAND	
													X	X		
1.2													X	X		1.2
													X	X		
1.4													X	X		
													X	X		
1.6													X	X		
													X	X		
1.8													X	X		
													X	X		
2.0													X	X		
													X	X		
2.2													X	X		
													X	X		
2.4													X	X		
													X	X		
2.6													X	X		
													X	X		
2.8													X	X		
													X	X		
3.0													X	X		
													X	X		
3.2													X	X	3.2	
													X	X		
3.4													X	X		
													X	X		
3.6													X	X		
													X	X		
3.8													X	X		
													X	X		
4.0													X	X	4.0	EOB
													X	X		

Hand Auger Log

Test Number: H A 3

Job Name: Rangitahiri Stopbanks
Section 15

Date: 22/9/06

Tested by: N.O.H

Blows/50mm													Cu(kPa)	soil description
m	0	2	4	6	8	10	12							
0.2													X	grey silty fine SAND
													X	
0.4													X	
0.6													X	0.8 grey fine sandy SILT, moist
													X	
0.8													X	
1.0													X	1.0 grey fine silty SAND some fine organic content
													X	
1.2													X	
1.4													X	1.6 grey fine sandy SILT
													X	
1.6													X	
1.8													X	2.0 grey silty fine SAND
													X	
2.0													X	
2.2													X	2.5 fibrous organic material roots etc.
													X	
2.4													X	
2.6													X	3.0 grey silty fine SAND
													X	
2.8													X	
3.0													X	3.3 EOB
													X	
3.2													X	
3.4													X	
3.6														
3.8														
4.0														

Cu (kPa)

020406080100120

Hand Auger Log

Test Number: HA4

Job Name: Rangitahi Stopbands
Section 15

Date: 16/8/06

Tested by: M.O.H

Blows/50mm													C _u (kPa)	soil description
m	0	2	4	6	8	10	12							
0.2													X	brown SILT
													X	
0.4													X	
0.6													X	0.4 dark grey SILT
													X	
0.8													X	
1.0													X	1.1 orange stained grey silty fine SAND/sandy SILT, wet
													X	
1.2													X	
1.4													X	1.3 orange stained grey SILT, wet
													X	
1.6													X	
1.8													X	2.75 light grey fine pum. silty SAND
													X	
2.0													X	
2.2													X	3.0 EOB squeezing
													X	
2.4													X	
2.6													X	2.75 light grey fine pum. silty SAND
													X	
2.8													X	
3.0													X	3.0 EOB squeezing
													X	
3.2													X	
3.4													X	2.75 light grey fine pum. silty SAND
													X	
3.6													X	
3.8													X	3.0 EOB squeezing
													X	
4.0													X	
													X	2.75 light grey fine pum. silty SAND
0													X	
20													X	
40													X	3.0 EOB squeezing
60													X	
80													X	
100													X	2.75 light grey fine pum. silty SAND
120													X	
													X	

Hand Auger Log

Test Number: HA 6

Job Name: Rangitikei Stopbanks
Section 15

Date: 22 / 9 / 06

Tested by: N.O.H

Blows/50mm															soil description	
m	0	2	4	6	8	10	12	C _u (kPa)								
0.2													X			brown fine sandy SILT, fill
0.4													X			
0.6													X			0.5 brown fine sandy SILT, in situ
0.8													X			0.6 orange mottled grey silty fine SAND
1.0													X			0.8 brown fine sandy SILT
1.2													X			1.1 orange mottled grey SILT, damp
1.4													X			
1.6													X			
1.8													X			1.7 orange mottled grey clayey SILT
2.0													X			1.9 orange mottled grey SILT
2.2													X			2.2 heavy iron staining
2.4													X			2.4 grey clayey SILT
2.6													X			
2.8													X			
3.0													X			3.0 some organic content
3.2													X			
3.4													X			3.4 EOB
3.6													X			
3.8													X			
4.0													X			

Hand Auger Log

Test Number: HA7

Job Name: Rangitiki Stopbanks
Section 15

Date: 22/9/06

Tested by: N.O.H

Blows/50mm													C _u (kPa)	soil description
m	0	2	4	6	8	10	12							
0.2													X	brown sandy SILT/silty fine SAND
													X	
0.4													X	
													X	
0.6													X	0.6 grey fine SAND, some silt
													X	
0.8													X	0.7 brown sandy SILT/silty fine SAND
													X	
1.0													X	
													X	
1.2													X	1.2 orange mottled dark grey fine sandy SILT
													X	
1.4													X	1.5 orange mottled dark grey clayey SILT
													X	
1.6													X	2.0 light grey SILT
													X	
1.8													X	
													X	
2.0													X	2.4 light grey silty fine SAND
													X	
2.2													X	2.7 light purple grey SILT some clay
													X	
2.4													X	3.0 grey silty fine SAND, wet
													X	
2.6													X	3.15 light purple grey SILT, some clay
													X	
2.8													X	3.5 grey clayey SILT some organic material
													X	
3.0													X	4.2 EOB
													X	
3.2													X	
													X	
3.4													X	
													X	
3.6													X	
													X	
3.8													X	
													X	
4.0													X	
													X	
C _u (kPa)													X	

Hand Auger Log

Test Number: H A 8

Job Name: Rangitahi Stopbanks
Section 15

Date: 15/8/06

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				0.2	
									x				light brown silty fine	
0.4										x			SAND	
0.6									x					
													0.7	orange stained grey SILT
0.8									x	x				
									x				0.9	dark grey SILT, organic
1.0									x				smell	
										x				
1.2									x					
										x				
1.4									x					
													1.5	
1.6														
										x				
1.8										x			1.7	orange mottled grey
													clayey SILT	
2.0										x				
										x				
2.2													2.2	orange mottled grey SILT
										x				
2.4										x				
2.6										x				
										x				
2.8										x			2.8	EOB squeezing.
3.0														
3.2														
3.4														
3.6														
3.8														
4.0														
	0	20	40	60	80	100	120							
	Cu (kPa)													

D/S neighbour ϕ 300mm
s-holes in back lawn?

Hand Auger Log

Test Number: HA9

Job Name: Rangitaihi Stopbanks
Section 15

Date: 22/9/06

Tested by: N.O.H

Blows/50mm									soil description	
m	0	2	4	6	8	10	12	C _u (kPa)		
0.2									X	brown fine sandy SILT/ silty fine SAND, fill
									X	
0.4									X	
									X	
0.6									X	
									X	
0.8									X	
									X	
1.0									X	
									X	1.1 grey brown SILT
1.2									X	
									X	
1.4									X	
									X	
1.6									X	
									X	
1.8									X	1.8 orange mottled grey sandy SILT
									X	
2.0									X	1.9 orange mottled SILT, some clay
									X	
2.2									X	
									X	
2.4									X	
									X	2.5 orange mottled grey fine sandy SILT, moist
2.6									X	
									X	
2.8									X	
									X	
3.0									X	
									X	3.1 orange mottled grey SILT
3.2									X	
									X	
3.4									X	3.3 purplish grey clayey SILT
									X	3.4 light grey silty fine SAND
3.6									X	3.4.5 purplish grey clayey SILT
									X	
3.8									X	3.7 grey clayey SILT, some organics
									X	
4.0									X	4.0 grey SILT
									X	4.2 EOB

Hand Auger Log

Test Number: HA10

Job Name: Rangitaihi Stopbanks
Section 15

Date: 16/8/06

Tested by: N.O'H

Blows/50mm											soil description
m	0	2	4	6	8	10	12	C _u (kPa)			
											brown SILT
0.2											
											0.6 dark grey SILT
0.4											
											0.8 dark grey clayey SILT, organic smell
0.6											
											1.1 orange mottled grey clayey SILT
0.8											
											1.3
1.0											
											1.8 orange mottled grey SILT
1.2											
											2.6 blue grey clayey SILT, trace organics
1.4											
											2.8 EOB , squeezing
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_u (kPa)

m	0	2	4	6	8	10	12	C _u (kPa)		soil description
0.2								X X		brown sandy SILT/ silty fine SAND, fill
0.4								X X		
0.6								X X		0.5 brown coarse SAND, some silt, fill
0.8								X X		0.7 brown silty fine SAND
1.0								X X		0.8 brown fine sandy SILT, in situ?
1.2								X X		
1.4								X X		1.3 brown silty fine SAND
1.6								X X		
1.8								X X		1.6 orange mottled grey fine sandy SILT
2.0								X X		
2.2								X -		2.0 orange mottled grey SILT, some clay
2.4								-X		
2.6								X		
2.8								X		
3.0								-X		2.9 orange mottled grey fine sandy SILT
3.2								X X		
3.4								X X		
3.6								X		3.5 orange mottled grey SILT
3.8								X X		
4.0								X		
								X		4.1 grey clayey SILT, some organic material
								X		
								X		
								X		
								X		blank forms/scala log
								X		4.4 EOB

Hand Auger Log

Test Number: H A 12

Job Name: Rangitikei Stopbanks
Section 15

Date: 16/08/06

Tested by: N.O.H

Blows/50mm													soil description	
m	0	2	4	6	8	10	12	C _u (kPa)						
0.2									X	X			brown SILT	
									X					
0.4									X	X				
									X					
0.6									X				0.6 grey fine sandy SILT	
									X	X				
0.8									X				0.8 dark grey clayey SILT, trace organics, sparsely	
									X	X				
1.0									X				1.0 orange stained grey fine sandy SILT / silty SAND	
									X	X				
1.2									X				1.5 orange mottled grey clayey SILT, trace organics.	
									X					
1.4									X	X				
									X					
1.6								1.5	X				1.8 orange mottled grey SILT	
									X					
1.8									X	X				
									X					
2.0									X	X			2.7 orange mottled blue grey silty CLAY	
									X					
2.2									X					
									X					
2.4									X				2.9 EOB squeezing	
									X					
2.6									X					
									X					
2.8									X				300mm deep hole behind old shed with water pipes	
									X					
3.0									X					
									X					
3.2														
3.4														
3.6														
3.8														
4.0														
	0	20	40	60	80	100	120							



Hand Auger Log

Test Number: HA 14

Job Name: Rangitaihi Stopbanks
Section 15

Date: 27/7/06

Tested by: M.O.H

Blows/50mm													soil description	
m	0	2	4	6	8	10	12	C _u (kPa)						
0.2									X	X			0.05	brown fine sandy SILT
0.4									X					brown silty fine SAND
0.6									X					
0.8									X				0.6	some mixed Tararua Ash
1.0									X				0.7	orange stained grey clayey SILT, moist
1.2									X					
1.4									X	X			1.2	orange stained grey fine sandy SILT
1.6									X				1.5	orange stained grey SILT, some clay
1.8								1.8	X					
2.0									X	X			2.0	orange stained grey silty fine SAND
2.2									X					
2.4									X	X			2.2	orange stained grey pumiceous SILT, some dark mottles
2.6									X					
2.8									X					
3.0									X	X			3.0	dark grey clayey SILT
3.2									X	X			3.2	grey fine to med pum. SAND some silt
3.4									X				3.3	dark grey SILT some organics / timber fragments
3.6									X					
3.8									X	X				
4.0									X	X			4.0	EOB
	0	20	40	60	80	100	120	C _u (kPa)						

Hand Auger Log

Test Number: HA 15

Job Name: Ransitairi Stopbanks
Section 15

Date: 16/8/06

Tested by: N.O.H

Blows/50mm										C _u (kPa)	soil description
m	0	2	4	6	8	10	12				
0.2										X X	brown SILT
										X X	
0.4										X X	
										X X	
0.6										X X	0.6 orange stained grey sandy SILT, spongy
										X X	
0.8										X X	
										X X	
1.0										X X	1.3
										X X	
1.2										X X	
										X X	
1.4										X X	1.7 orange stained grey SILT, spongy
										X X	
1.6										X X	
										X X	
1.8										X X	1.8 orange stained grey clayey SILT
										X X	
2.0										X X	1.95 orange stained grey fine silty SAND
										X X	
2.2										X X	2.1 grey SILT
										X X	
2.4										X X	2.5 blue grey fine sandy SILT, trace organics, organic smell
										X X	
2.6										X X	2.8 EOB
										X X	
2.8										X X	
3.0											
3.2											
3.4											
3.6											
3.8											
4.0											

Hand Auger Log

Job Name: Rangitiki Stopbanks
Section 15

Test Number: HA16

Date: 16/08/06

Tested by: N.O.H

Blows/50mm													soil description	
m	0	2	4	6	8	10	12	Cu(kPa)						
0.2									X	X			brown SILT	
									X	X				
0.4									X	X				
									X	X				
0.6									X	X				
									X	X			0.7 orange mottled grey SILT	
0.8									X	X				
									X	X				
1.0									X	X				
									X	X				
1.2									X	X			1.4 orange mottled grey fine sandy SILT	
									X	X				
1.4								1.4	X	X				
									X	X				
1.6									X	X				
									X	X			2.1 orange mottled grey clayey SILT	
1.8									X	X				
									X	X				
2.0									X	X				
									X	X				
2.2									X	X			2.3 orange mottled grey SILT	
									X	X				
2.4									X	X			2.4 orange mottled grey clayey SILT	
									X	X				
2.6									X	X			2.5 blue grey clayey SILT, trace organics, organic smell, spongy	
									X	X				
2.8									X	X				
									X	X			2.8 EOB squeezing.	
3.0														
3.2														
3.4														
3.6														
3.8														
4.0														
	0	20	40	60	80	100	120							

Cu (kPa)

Hand Auger Log

Test Number: HA17

Job Name: Rangitikei Stopbanks
Section 15

Date: 22/09/06

Tested by: M.O.H

Blows/50mm											C _u (kPa)	soil description
m	0	2	4	6	8	10	12					
0.2											X X	brown fine sandy SILT, d11
0.4											X X	0.4 brown silty fine SAND, d11
0.6											X X	0.5 brown fine sandy SILT
0.8											X X	0.6 brown silty fine SAND
1.0											X X	0.7 brown SILT
1.2											X X	1.0 orange stained grey fine sandy SILT
1.4											X X	1.1 orange stained grey fine silty SAND
1.6											X X	1.3 orange stained grey fine sandy SILT
1.8											X X	2.0 orange stained grey silty fine SAND
2.0											X X	2.4 orange stained grey fine sandy SILT, moist
2.2											X X	2.6 orange stained grey silty fine SAND
2.4											X X	2.7 orange stained grey SILT
2.6											X X	3.0 grey silty fine SAND, wet
2.8											X X	3.4 grey clayey SILT, some organics
3.0											X X	3.6 EOB squeezing.
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: HA18

Job Name: Rangitaikei Stopbanks
Section 15

Date: 16/08/06

Tested by: M. O'H

Blows/50mm											soil description	
m	0	2	4	6	8	10	12	C _u (kPa)				
0.2											X	brown SILT
											X	
0.4											X	0.4
											X	
0.6											X	orange mottled grey SILT,
											X	sparsy.
0.8											X	
											X	
1.0											X	
											X	
1.2											X	1.2 orange mottled grey silty
											X	fine SAND
1.4								1.4			X	1.4
											X	orange mottled grey SILT
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	2.8 EOB squeezing
3.0												
3.2												
3.4												
3.6												
3.8												
4.0												

Hand Auger Log

Job Name: Rangitiki Stopbanks
Section 15

Test Number: HA 19

Date: 16/08/06

Tested by: N.O.H

Blows/50mm										soil description
m	0	2	4	6	8	10	12	C _u (kPa)		
0.2									X X	0.2 brown fine sandy SILT orange stained grey fine sandy SILT
0.4									X X	
0.6									X X	
0.8									X	
1.0									X	0.8 orange stained grey silty fine SAND
1.2									X	
1.4									X	
1.6									X	
1.8									X	
2.0									X	
2.2									X	
2.4									X	
2.6									X	3.0 brown medium → coarse SAND, some pumice gravel → 4mm
2.8									X	
3.0									X	
3.2									X	
3.4								33	X	3.5 EOB
3.6									X	
3.8									X	
4.0									X	
	0	20	40	60	80	100	120	C _u (kPa)		

Hand Auger Log

Test Number: HAZO

Job Name: Rangitiki Stopbanks
Section 15

Date: 16/08/06

Tested by: M.O.H

		Blows/50mm										C _u (kPa)		soil description
m		0	2	4	6	8	10	12						
0.2												X	brown SILT	
												X		
0.4												X		
												X		
0.6												X	0.6	grey silty fine SAND/ sandy SILT
												X		
0.8												X		
												X		
1.0												X		
												X		
1.2												X		
												X		
1.4											1.4	X	1.3	grey silty fine SAND
												X		
1.6												X		
												X		
1.8												X	1.8	grey SILT
												X		
2.0												X		
												X		
2.2												X		
												X		
2.4												X		
												X		
2.6												X	2.5	grey silty fine SAND
												X		
2.8												X		
												X		
3.0												X	3.0	EOB
												X		
3.2												X		
												X		
3.4												X		
												X		
3.6												X		
												X		
3.8												X		
												X		
4.0												X		

Hand Auger Log

Job Name: Rangitangi Stopbanks
Section 15

Tested by: N.O.H

Test Number: HAZ1

Date: 22/09/06

Blows/50mm											soil description	
m	0	2	4	6	8	10	12	Cu(kPa)				
0.2											X	brown SILT
											X	
0.4											X	
											X	
0.6											X	0.5
											X	orange stained grey silty
0.8											X	fine SAND
											X	
1.0											X	
											X	
1.2											X	
											X	
1.4											X	1.3 dark grey fine sandy SILT
											X	
1.6								1.6			X	1.5 dark grey clayey SILT, some
											X	fibrous organic material
1.8											X	1.7 dark grey silty fine SAND
											X	1.8 EOB collapse
2.0												
2.2												
2.4												
2.6												
2.8												
3.0												
3.2												
3.4												
3.6												
3.8												
4.0												
	0	20	40	60	80	100	120	Cu (kPa)				

Hand Auger Log

Test Number: **HA22**

Job Name: **Rangitahi Stopbanks
Section 15**

Date: **25/09/06**

Tested by: **N.O.H**

Blows/50mm		C _u (kPa)												soil description	
m	0	2	4	6	8	10	12						C _u (kPa)		
0.2														X	brown SILT
														X	
0.4														X	0.4
														X	
0.6														X	orange mottled grey fine sandy SILT
														X	
0.8														X	
														X	
1.0														X	
														X	
1.2														X	
														X	
1.4														X	
														X	
1.6														X	1.6 orange mottled grey fine silty SAND, moist
														X	
1.8														X	
														X	
2.0														X	1.9 orange mottled grey fine sandy SILT
														X	
2.2														X	2.1
														X	
2.4														X	grey SILT, wet
														X	
2.6														X	
														X	
2.8														X	2.8 EOB - log
														X	
3.0															
3.2															
3.4															
3.6															
3.8															
4.0															

C_u (kPa)

Hand Auger Log

Test Number: HA23

Job Name: Rangitaihi Stopbanks
Section 15

Date: 22/09/06

Tested by: M.O.H

Blows/50mm		soil description	
m	Cu(kPa)		
0.2		X	brown fine sandy SILT
		X	
0.4		X	0.4
		X	
0.6		X	brown silty fine SAND
		X	
0.8		X	
		X	
1.0		X	
		X	
1.2		X	
		X	
1.4		X	
		X	
1.6	1.5	X	1.5 some fibrous material
1.8		X	1.8 EOB, collapse
		X	
2.0			
2.2			
2.4			
2.6			
2.8			
3.0			
3.2			
3.4			
3.6			
3.8			
4.0			

Cu (kPa)

Hand Auger Log

Job Name: Rangitikei Stopbanks
Section 15

Test Number: HA 24

Date: 27/07/06

Tested by: N.O.H

Blows/50mm												soil description	
m	0	2	4	6	8	10	12	Cu(kPa)					
0.2												X	brown SILT
0.4												X	
0.6												X	
0.8												X	0.7 orange stained grey SILT
1.0												X	
1.2												X	1.2
1.4												X	orange stained grey fine
1.6												X	sandy SILT
1.8												X	
2.0												X	2.0 orange stained grey
2.2								2.2				X	SILT
2.4												X	
2.6												X	2.5 orange stained grey
2.8												X	clayey SILT
3.0												X	
3.2												X	3.1 grey SILT
3.4												X	
3.6												X	
3.8												X	3.7 some timber/roots
4.0												X	3.9 EOB

Hand Auger Log

Test Number: HAZ5

Job Name: Rangitaihi Stopbanks
Section 15

Date: 25/09/06

Tested by: N.O'H

		Blows/50mm							C _u (kPa)	soil description
m		0	2	4	6	8	10	12		
0.2									X X	brown fine sandy SILT
									X	
0.4									X X	0.3 grey brown silty fine SAND
									X	
0.6									X X	banded with fine sandy SILT
									X	
0.8									X X	± 100mm bands
									X X	
1.0									X	0.9 grey brown silty fine SAND
									X	
1.2									X	1.2 moist
									X	
1.4									X X	1.4 grey fine sandy SILT
									X	
1.6									X	1.6 grey medium to coarse gritty SAND
									X	
1.8									X X	1.7 timber over
									X	
2.0									X	grey medium to coarse SAND
									X	
2.2									2.1 X	
									S	
2.4									X	2.3 EOB collapse
									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: HA26

Job Name: Ransitaihi Stopbanks
Section 15

Date: 25/09/06

Tested by: N.O.H

Blows/50mm												soil description	
m	0	2	4	6	8	10	12	C _u (kPa)					
0.2												X X	brown SILT
												X	
0.4												X	0.4 orange stained grey SILT
												X	
0.6												X X	
												X	
0.8												X	
												X	
1.0												X X	
												X	
1.2												X	
												X	
1.4												X X	1.3 orange stained light grey fine sandy SILT
												X	
1.6												X	1.5 moist
												X	
1.8												X	1.8 light grey silty fine SAND
												X	
2.0												X X	1.9 light grey SILT
												X	
2.2												X -	2.1 light grey clayey SILT
												X	
2.4												X -	2.5 grey fine sandy SILT
												X	
2.6												X X	2.6 organic material over grey SILT, some clay, organic smell.
												X X	
2.8												X X	3.0 EOB squeezing.
												-	
3.0												X X	
3.2													
3.4													
3.6													
3.8													
4.0													
	0	20	40	60	80	100	120						









Record of Borehole					Sheet 1 of 3		BH 1			
Job Name: Pungitahi Stopbanks Section 15				Location: Cross Section 1						
Client: EBP				Coordinates:		Datum				
				Elevation:						
depth (m)	logged	symbol	% recovery	Strata	sample		field tests			lab test
				description	depth (m)	type	SPT	vane	other	
0.5		xxx		dk brown fine sandy SILT with organics, topsoil						
		x x		0.03 grey with orange mottles fine						
		x		sand, SILT / silty SAND, fill						
		x x								
		x								
1.0		x x	100							
		x								
		x		1.2 mixed brown SILT & grey						
		x x		silty fine SAND, some coarse pum.						
		x		SAND, fill						
1.5		x x		1.6 dark brown fine sandy SILT						
		x x								
		x								
		x x		1.95 5mm layer black med. SAND						
		x x		2.1 dark brown clayey SILT - old topsoil						
2.0		-x		2.2 brown SILT, some fine sand.						
		x x	100							
		x								
		x x								
		x x								
2.5		x x								
		x								
		x x								
		x x								
		x x								
3.0		x x		2.95 grey silty fine SAND	3.0	tube				
		x		some orange staining.						
		x		some banding						
		x								
		x								
3.5		x								
		x								
		x								
		x								
		x								
4.0		x	100		3.7	x				
		x								
		x								
		x								
		x								
4.5		x								
		x								

Observations	Samples * small disturbed b large bag tube sample	Field Tests SPT blows/150mm, N blows/300mm C direct shear vane reading Cr remoulded shear vane Cc corrected shear vane
Pilcon Vane		
Date started: 27/8/07	core dia: 68mm	Rig: Kubota
Date finished: 27/8/07	logged by: N.O.H	Contractor: Penn

Record of Borehole					Sheet 2 of 3		BH 1			
Job Name: Rangitiki Stopbanks Section 15					Location: Cross Section 1					
Client: EBOF					Coordinates:					
					Elevation: Datum					
depth (m)	logged	symbol	% recovery	Strata	sample		field tests			lab test
				description	depth (m)	type	SPT	vane	other	
5.0		X		5.2 black coarse SAND, Tararua Ash?	5.2	*				
5.5		X	100	5.4 grey silty fine SAND						
6.0		X		5.8 orange stained grey fine → coarse SAND						
6.5		X		5.85 grey silty fine → med. SAND, some coarse sand, rare pum. gravel → 10mm						
7.0		X	100	6.6 orange stained grey fine → med. SAND						
7.5		X		6.65 black fibrous homog. PEAT, some timber						
8.0		X		6.8 as 6.6m						
8.5		X		6.9 grey fine SAND, some silt						
9.0		X		7.1 brownish grey pumice → 5mm in silt matrix, stiff → hard, rare charcoal → 20mm = 30% pumice, 70% silt, low permeability						
9.5		X		7.55 grey pum. SILT	7.5	*				
10.0		X		7.6 brown / grey ≈ 90% pumice → 5mm, 10% silt, rare charcoal → 3mm, hard						
10.5		X		8.2 grey pum. SILT						
11.0		X		8.3 grey fine → med. SAND						
11.5		X		8.35 ≈ 50mm bands SILT + pumice / SILT mix						
12.0		X		8.7 grey pumice SILT, some bands containing pumice gravel → 5mm						

Observations piezometer 5.5 → 7.5m.	Samples * small disturbed b large bag tube sample	Field Tests SPT blows/150mm, N blows/300mm C direct shear vane reading Cr remoulded shear vane Cc corrected shear vane
Pilson Vane		
Date started: 27/8/07	core dia: 68 mm	Rig: Kubota
Date finished: 27/8/07	logged by: N.O.H	Contractor: Perry, Mark

Ice Geo & Civil Ltd

Record of Borehole					Sheet 3 of 3		BH 1			
Job Name: Rangitahi stopbanks Section 15				Location: Cross Section 1						
Client: EBRP				Coordinates:						
				Elevation: Datum						
depth (m)	logged	symbol	% recovery	Strata	sample		field tests			lab test
				description	depth (m)	type	SPT	vane	other	
9.5		   		9.3 grey with brown varved bands SILT, stiff 9.7 brown/grey SILT						
10.0		 								
10.5		 								

Observations

Samples

* small disturbed
b large bag
tube sample

Field Tests

SPT blows/150mm, N blows/300mm
C direct shear vane reading
Cr remoulded shear vane
Cc corrected shear vane

Pilcon Vane

Date started: 27/8/07

core dia: 68mm

Rig: Kubota

Date finished: 27/8/07

logged by: M.O.H

Contractor: Perry, North

Record of Borehole						Sheet 1 of 2		BH 2			
Job Name: Rangitakei stopbanks Section 15				Location: Cross Section 2							
Client: E B O P				Coordinates:							
				Elevation:			Datum				
depth (m)	logged	symbol	% recovery	Strata		sample		field tests			lab test
				description		depth (m)	type	SPT	vane	other	
0.5		x x x x x	100	brown / grey silty fine SAND/ sandy SILT, firm							
1.0		x x x x x									
1.5		x x x x x									
2.0		x x x x x	100	21 mixed brown SILT & silty fine SAND/sandy SILT - topsoil							
2.5		x x x x x		24 orange stained grey fine sandy SILT, firm							
3.0		x x x x x									
3.5		x x x x x									
4.0		x x x x x	100	36 orange mottled grey SILT, sensitive, becoming darker grey with depth							

Observations

Samples

* small disturbed
b large bag
tube sample

Field Tests

SPT blows/150mm, N blows/300mm
C direct shear vane reading
Cr remoulded shear vane
Cc corrected shear vane

Pilcon Vane

Date started: 28/8/07

core dia: 68mm

Rig: Kubota

Date finished: 28/8/07

logged by: N.O.H

Contractor: Perry

Ice Geo & Civil Ltd

Mark

Record of Borehole							Sheet 2 of 2		BH 2		
Job Name: Rangitikei stopbanks Section 15						Location: Cross Section 2					
Client: EBRP						Coordinates:					
						Elevation:			Datum		
depth (m)	logged	symbol	% recovery	Strata		sample		field tests			lab test
				description		depth (m)	type	SPT	vane	other	
45		x				45	t				
		x									
		x									
50		x				51	x				
		x									
		x	100								
		x									
55		x		- 5.5 grey silty fine SAND							
		x									
		x									
		x									
60		.		- 5.9 grey fine → med. SAND, some silty bands		60	t				
		. x .									
		. x .									
65		. x .									
		. x .									
		.	100			67	x				
		OxO		- 6.8 brown grey pumice → 30mm im silt matrix ≈ 50/50 s.H.							
		OxO									
70		OxO		- 7.0 grey pum. SILT , some pumice							
		OxO									
		OxO		- 7.2 as 6.8m.							
		OxO									
75		OxO									

Observations <i>pneumatometer 5.5 – 7.5 m.</i>	Samples * small disturbed b large bag tube sample	Field Tests SPT blows/150mm, N blows/300mm C direct shear vane reading Cr remoulded shear vane Cc corrected shear vane
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Pilcon Vane
Date started: <i>28/8/09</i> core dia: <i>68 mm</i> Rig: <i>Kubota</i>
Date finished: <i>28/8/09</i> logged by: <i>N.O.H</i> Contractor: <i>Perry Clark</i>

Ice Geo & Civil Ltd

Appendix B

Laboratory Tests

CONSTANT HEAD PERMEABILITY TEST REPORT

Project: **Rangitaiki Stopbank**
 Location: **Rangitaiki**
 Client: **ICE Geo & Civil Ltd**
 Source: **Section 15**
 Sampled by: **Client**
 Sampling method: **Pushtube**

Date: **Unknown**



Comments:

Project No: **2-68229.82**
 Lab Ref No: **06/229/007**
 Client No:

SOIL PROPERTIES								
Sample ID:	S15		S15		S15			
Position:	HA2		HA13		HA24			
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Specimen length (mm)	119.49	117.98	141.87	140.69	127.69	125.90		
Specimen diameter (mm)	72.54	71.35	72.76	71.83	71.97	70.88		
Specimen mass (g)	738.01	752.66	870.25	906.08	778.73	797.26		
As rec'd Water Content (%)	42.0	-	39.4	-	39.6	-		
Water content (%)	42.0	44.8	39.4	45.2	39.6	43.0		
Wet density (t/m³)	1.49	1.60	1.48	1.59	1.50	1.60		
Dry density (t/m³)	1.05	1.10	1.06	1.09	1.07	1.12		
Saturat ⁿ by calculation (%)	73	84	69	84	72	84		
Saturation calculations uses the ASSUMED Solid Density (t/m³)=	2.65		2.65		2.65			
	Head (kPa)	Permeability (m/s)	Head (kPa)	Permeability (m/s)	Head (kPa)	Permeability (m/s)	Head (kPa)	Permeability (m/s)
	20	1.0E-06	20	2.8E-06	20	6.1E-07		
	30	9.8E-07	30	3.2E-06	30	6.0E-07		
	40	9.2E-07	40	3.1E-06	40	6.2E-07		
	95		90		95			
Saturation by pore pressure response (B value) (%) =								
Notes: 1. 1kPa Head = 0.10m H ₂ O								
2. (m/s) = metres per second								
3. X.YE-0Z = X.Y x 10 ^{-0Z} m/s								
Sample Test Conditions								
Cell Pressure (kPa)=	550							
Saturation Backpressure (kPa)=	500							
Effective Confining Pressure (kPa)=	50							
Permeant Liquid Used for Test :					Deaired Tap Water			
Temperature during Test (°C):					20.0			
Test Methods					Notes			
Permeability Test :	ASTM D5084-00:Method A-Constant Head Method				1.The sample was tested using the ELE test apparatus to enable back pressure saturation.			
Water Content :	NZS 4402 : 1986 Test 2.1							

Date tested : 31/07/06

Testing is covered by IANZ Accreditation

Date reported : 8/08/06

IANZ Approved Signatory

Designation: Senior Civil Engineering Technician

Date : 8/08/06



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

CONSTANT HEAD PERMEABILITY TEST REPORT

Project: Rangitaiki Stopbanks Section 15
 Location: Unknown
 Client: ICE Geo & Civil Ltd
 Source: -
 Sampled by: M. O'Halloran
 Sampling Method: Pushtube Sample

Date: 28/08/07



Project No: 2-68229.82
 Lab Ref No: 07/229/006
 Client No:

SOIL PROPERTIES									
Sample ID:		BH1		BH2		BH2			
Depth:		3.0m		4.5m		6.0m			
Sample description		Grey brown silty fine SAND		Brownish grey SILT.		Dk grey brown organic SILT and pumiceous sandy SILT.			
Specimen Status		Initial	Final	Initial	Final	Initial	Final	Initial	Final
Specimen length (mm)		119.87		120.01	118.36	119.70	118.73		
Specimen diameter (mm)		60.10		59.47	59.09	59.85	59.82		
Specimen mass (g)		450.84	510.94	526.65	515.61	475.94	466.48		
As rec'd Water Content (%)		31.9	-	64.4	-	91.1	-		
Water content of test sample (%)		31.9	49.5	64.4	60.9	91.1	87.3		
Wet density (t/m³)		1.33		1.58	1.59	1.41	1.40		
Dry density (t/m³)		1.00		0.96	0.99	0.74	0.75		
Saturation by calculation (%)		52		98	97	99	96		
Saturation calculations uses the Assumed/Tested Solid Density= (t/m³)=		2.60 (Assumed)		2.60 (Assumed)		2.30 (Assumed)			
		Head (kPa)	Permeability (m/s)	Head (kPa)	Permeability (m/s)	Head (kPa)	Permeability (m/s)	Head (kPa)	Permeability (m/s)
		3	3.0E-05	35	4.2E-08	35	2.0E-07		
		6	3.1E-05	50	4.6E-08	50	2.1E-07		
		13	2.8E-05						
		0.76		0.96		0.96			
Saturation by pore pressure response (B value) =									
Notes: 1. 1kPa Head = 0.10m H ₂ O 2. (m/s) = metres per second 3. X.YE-0Z = X.Y x 10 ^{-0Z} m/s									
Permeant Liquid Used: Deaired Tap Water									
Sample Test Conditions									
Sample ID:		BH1: 3.0m	BH2: 4.5m	BH2: 6.0m					
Cell Pressure (kPa) =		550	570	590					
Saturation Backpressure (kPa) =		500	500	500					
Effective Confining Pressure (kPa) =		50	70	90					
Temperature during Test (°C) =		20	20	20					
Test Methods					Notes				
Permeability Test :		ASTM D5084-03:Method A-Constant Head Method			1.The sample was tested using the ELE test apparatus to enable back pressure saturation.				
Water Content :		NZS 4402 : 1986 Test 2.1							

Date tested: 5/09/07

Testing is covered by IANZ Accreditation

Date reported: 11/09/07

IANZ Approved Signatory

Designation: Senior Civil Engineering Technician

Date: 11/09/07



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

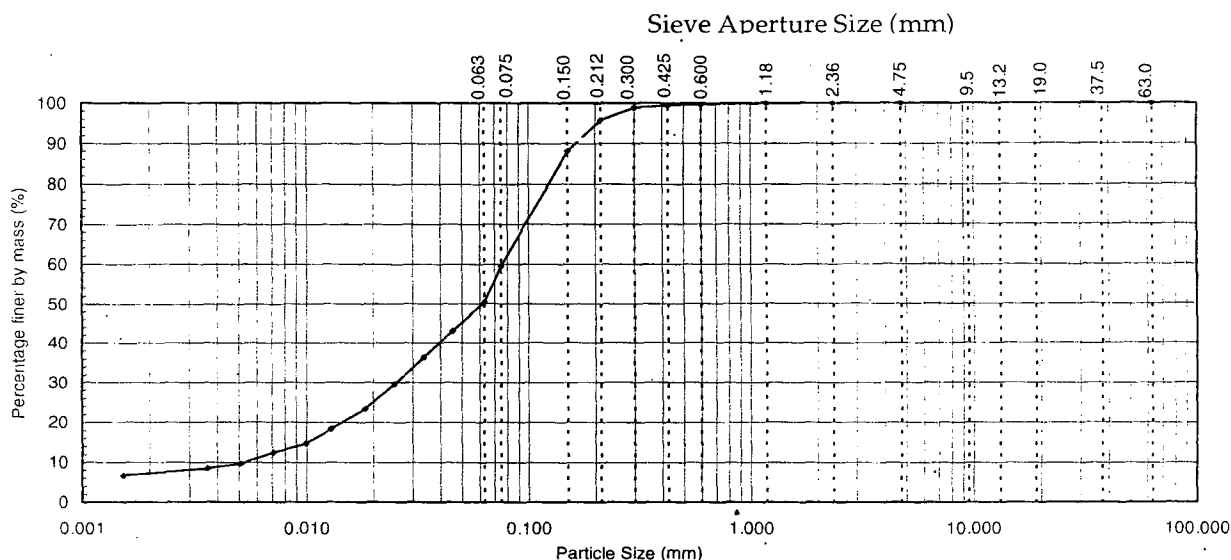
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT



Project : Rangitaiki Stopbanks
 Location : Rangitaiki
 Client : ICE Geo & Civil Ltd
 Client/Sample Ref : Section 15
 Contractor :
 Test Pit No: HA2 Depth: 1.20 metres
 Sampled by : Client
 Date received : 28/07/06
 Sampling method : Hand Auger
 Sample condition : As received
 Sample description : Grey sandy SILT / silty SAND
 Solid Particle Density (t/m^3): 2.65 Assumed
 Water Content (as received): 35.7 %

Project No: 2-68229.82
 Lab Ref No: 06/229/007
 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	0.0454	43	0.0071	12
37.5	--	2.36	100	0.212	96	0.0337	36	0.0051	10
19.0	--	1.18	100	0.150	88	0.0249	30	0.0036	8
13.2	--	0.600	100	0.075	60	0.0183	23	0.0015	7
9.5	--	0.425	99	0.063	50	0.0129	18	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0099	15		



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: 31/07/06

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Date Reported: 8/08/06

IANZ Approved Signatory

Designation : Senior Civil Engineering Technician
 Date : 8/08/06



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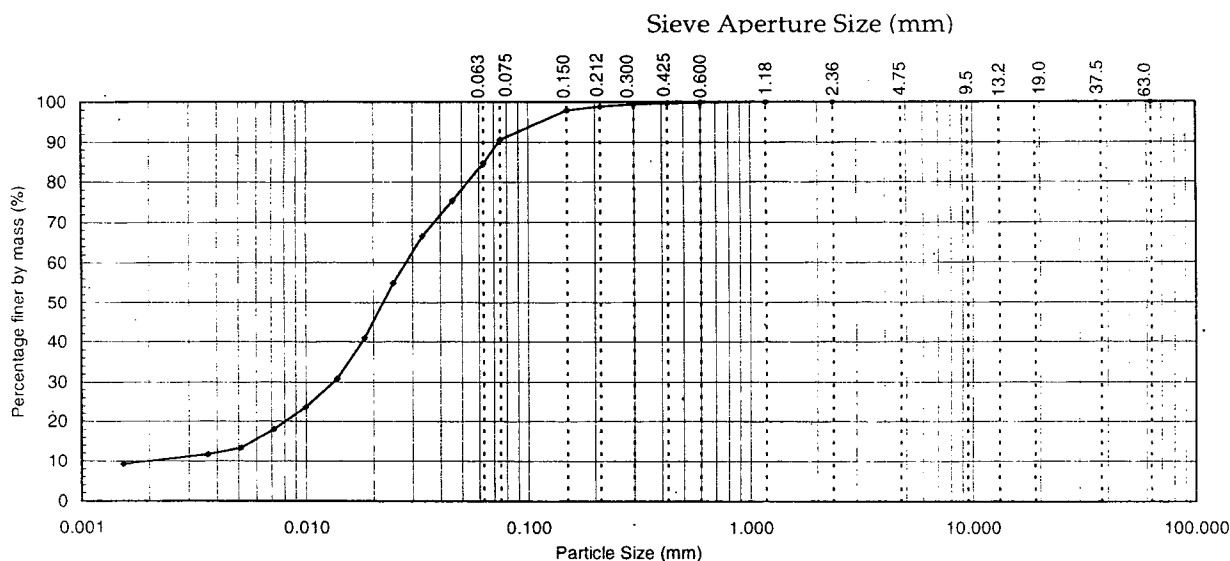
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project : **Rangitaiki Stopbanks**
 Location : **Rangitaiki**
 Client : **ICE Geo & Civil Ltd**
 Client/Sample Ref : **Section 15**
 Contractor :
 Test Pit No: **HA13** Depth: **2.50 metres**
 Sampled by : **Client**
 Date received : **28/07/06**
 Sampling method : **Hand Auger**
 Sample condition : **As received**
 Sample description : **Lt grey silty SAND sandy SILT, minor clay**
 Solid Particle Density (t/m^3): **2.65** Assumed
 Water Content (as received): **57.3** %



Project No: **2-68229.82**
 Lab Ref No: **06/229/007**
 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	0.0454	75	0.0072	18
37.5	--	2.36	100	0.212	99	0.0333	67	0.0051	13
19.0	--	1.18	100	0.150	98	0.0246	55	0.0036	12
13.2	--	0.600	100	0.075	91	0.0183	41	0.0015	9
9.5	--	0.425	100	0.063	85	0.0138	31	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0100	24		



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: **31/07/06**

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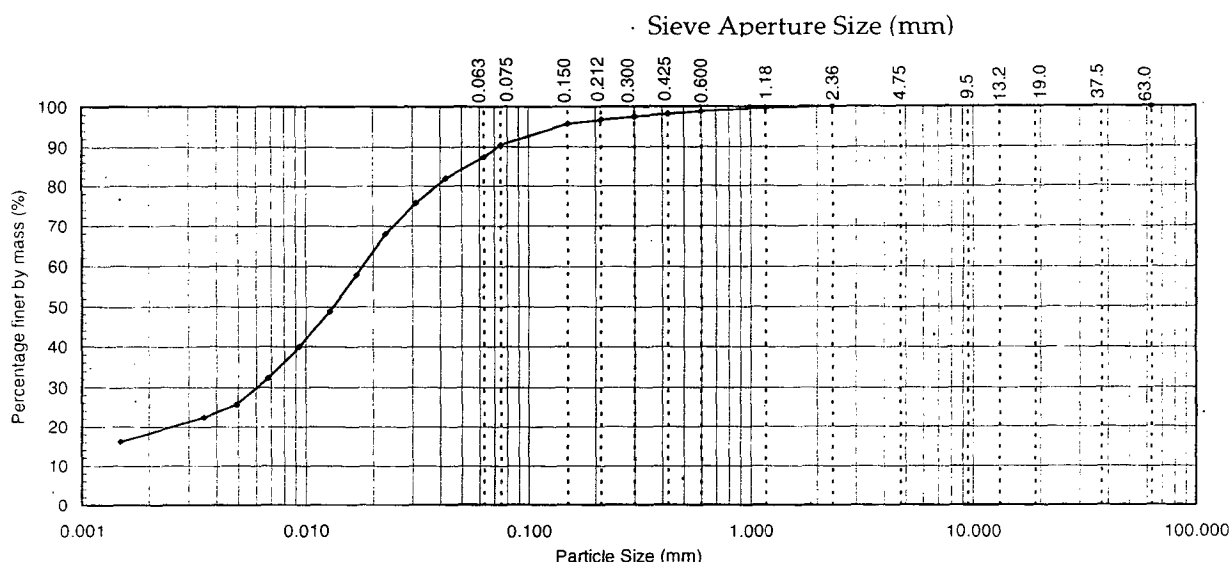
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT



Project : Rangitaiki Stopbanks
 Location : Rangitaiki
 Client : ICE Geo & Civil Ltd
 Client/Sample Ref : Section 15
 Contractor :
 Test Pit No: HA14 Depth: 1.80 metres
 Sampled by : Client
 Date received : 28/07/06
 Sampling method : Hand Auger
 Sample condition : As received
 Sample description : Brownish grey SILT *w.n. clay*
 Solid Particle Density (t/m³): 2.65 Assumed
 Water Content (as received): 47.2 %

Project No: 2-68229.82
 Lab Ref No: 06/229/007
 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	97	0.0425	82	0.0068	32
37.5	--	2.36	100	0.212	97	0.0311	76	0.0049	26
19.0	--	1.18	100	0.150	96	0.0228	68	0.0035	22
13.2	--	0.600	99	0.075	91	0.0169	58	0.0015	16
9.5	--	0.425	98	0.063	87	0.0128	49	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0093	40		



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: 31/07/06

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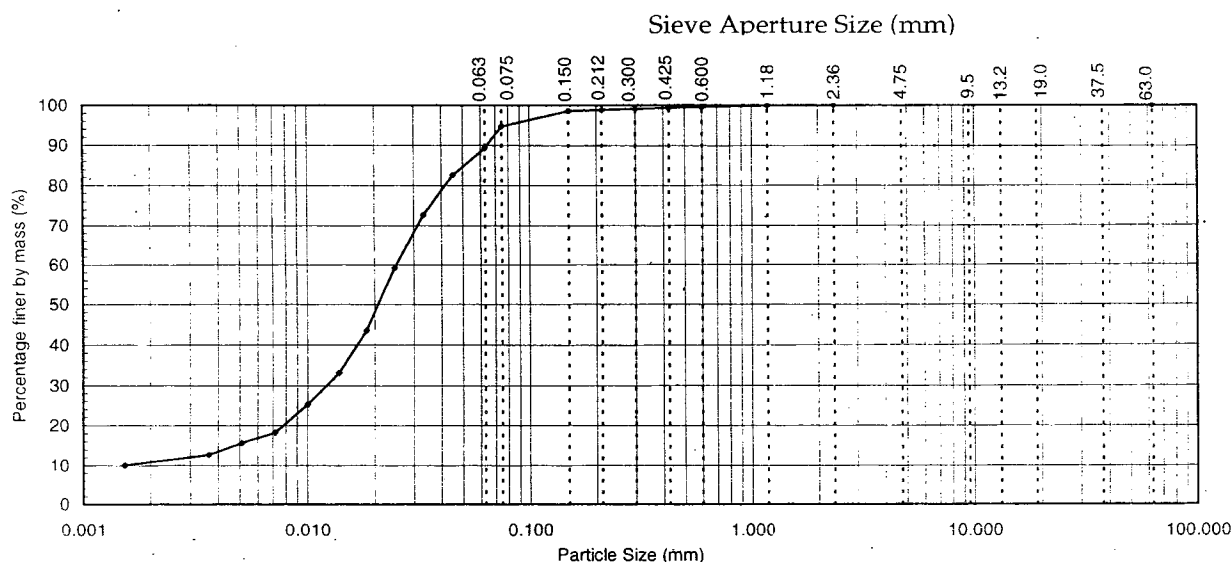
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project : Rangitaiki Stopbanks
 Location : Rangitaiki
 Client : ICE Geo & Civil Ltd
 Client/Sample Ref : Section 15
 Contractor :
 Test Pit No: HA24 Depth: 1.90 metres
 Sampled by : Client
 Date received : 28/07/06
 Sampling method : Hand Auger
 Sample condition : As received
 Sample description : Grey silty-SAND SILT, with some sand, clay
 Solid Particle Density (t/m^3): 2.65 Assumed
 Water Content (as received): 59.7 %



Project No: 2-68229.82
 Lab Ref No: 06/229/007
 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	0.0452	83	0.0072	18
37.5	--	2.36	100	0.212	99	0.0332	73	0.0051	16
19.0	--	1.18	100	0.150	99	0.0246	59	0.0036	13
13.2	--	0.600	100	0.075	95	0.0183	44	0.0015	10
9.5	--	0.425	99	0.063	89	0.0138	33	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0100	25		



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: 31/07/06

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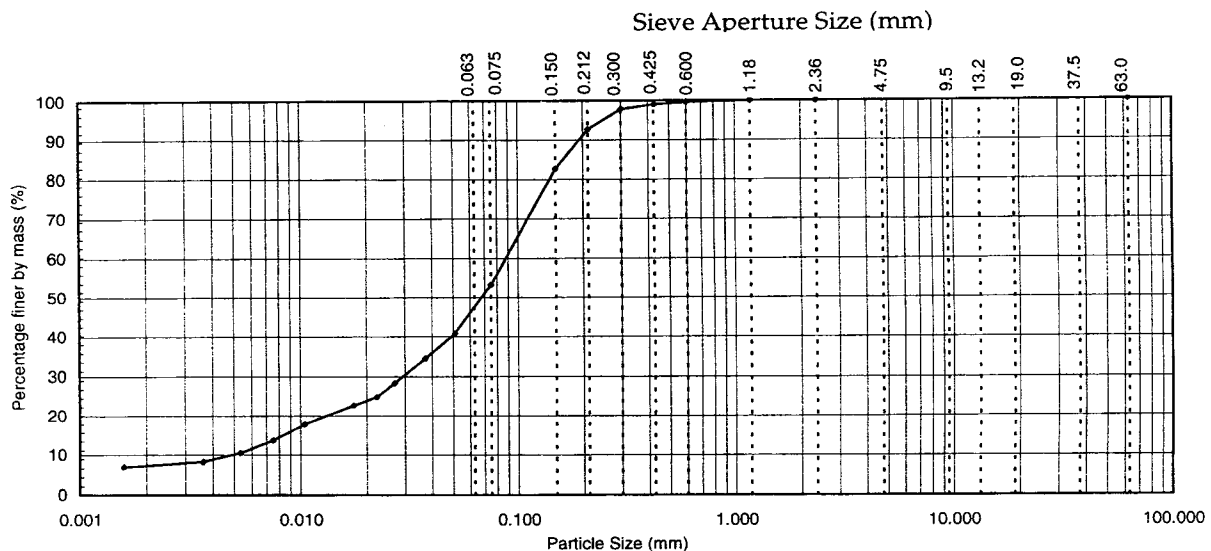
**PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT**



Project : **Rangitaiki Stopbanks Section 15**
 Location : **Unknown**
 Client : **Ice Geo & Civil Ltd**
 Client/Sample Ref : **-**
 Contractor : **-**
 Borehole No: **BH1** Depth: **3.70 metres**
 Sampled by : **M. O'Halloran (28/08/07)**
 Date received : **5/09/07**
 Sampling method : **Borehole**
 Sample condition : **As received**
 Sample description : **Sandy SILT / silty SAND**
 Solid Particle Density (t/m³): **2.60 Assumed**
 Water Content (as received): **46.9 %**

Project No: **2-68229.82**
 Lab Ref No: **07/229/006**
 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	98	0.0512	41	0.0075	14
37.5	--	2.36	100	0.212	93	0.0372	34	0.0053	11
19.0	--	1.18	100	0.150	83	0.0270	28	0.0036	8
13.2	--	0.600	100	0.075	53	0.0223	25	0.0016	7
9.5	--	0.425	99	0.063	--	0.0174	23	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0105	18		



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: 9/09/07

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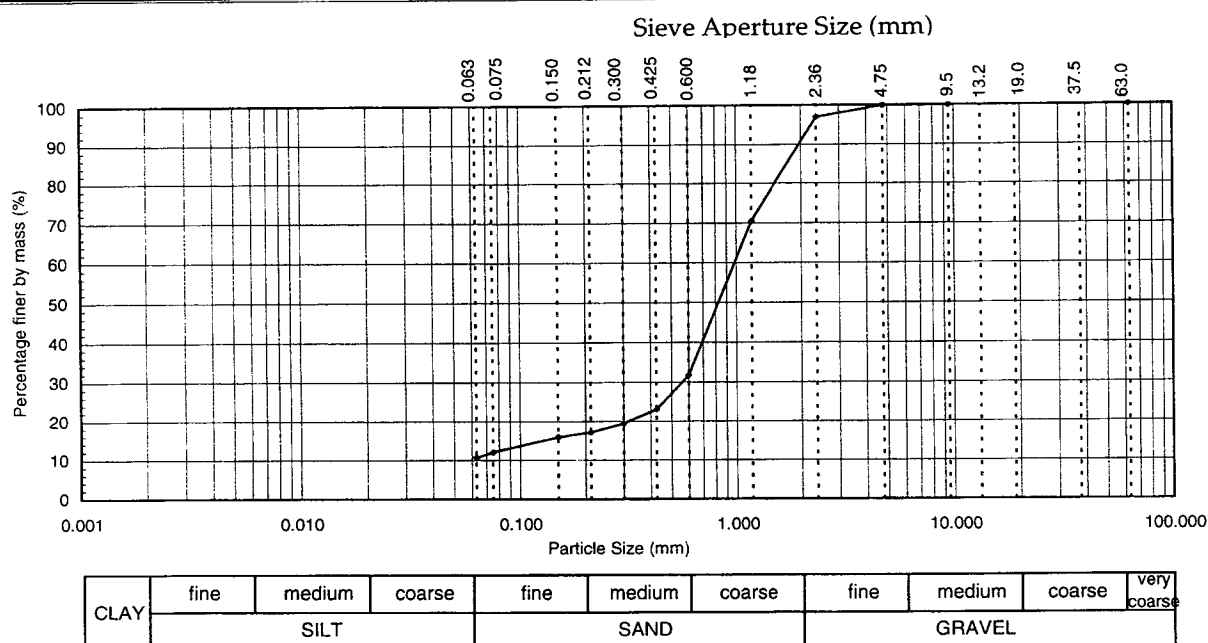
PARTICLE SIZE ANALYSIS (WET SIEVE METHOD) TEST REPORT



Project : Rangitaiki Stopbanks Section 15
 Location : Unknown
 Client : Ice Geo & Civil Ltd
 Client/Sample Ref : -
 Contractor : -
 Borehole No: BH1 Depth: 5.20 metres
 Sampled by : M. O'Halloran (28/08/07)
 Date received : 5/09/07
 Sampling method : Borehole
 Sample condition : As received
 Sample description : Coarse SAND
 Solid Particle Density (t/m³): N/A
 Water Content (as received): 40.1 %

Project No: 2-68229.82
 Lab Ref No: 07/229/006
 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	19	--	--	--	--
37.5	--	2.36	97	0.212	17	--	--	--	--
19.0	--	1.18	70	0.150	16	--	--	--	--
13.2	--	0.600	32	0.075	12	--	--	--	--
9.5	100	0.425	23	0.063	11	--	--	--	--
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 Method)	

Date Tested: 7/09/07

Sampling is not covered by IANZ Accreditation

Date Reported: 11/09/07

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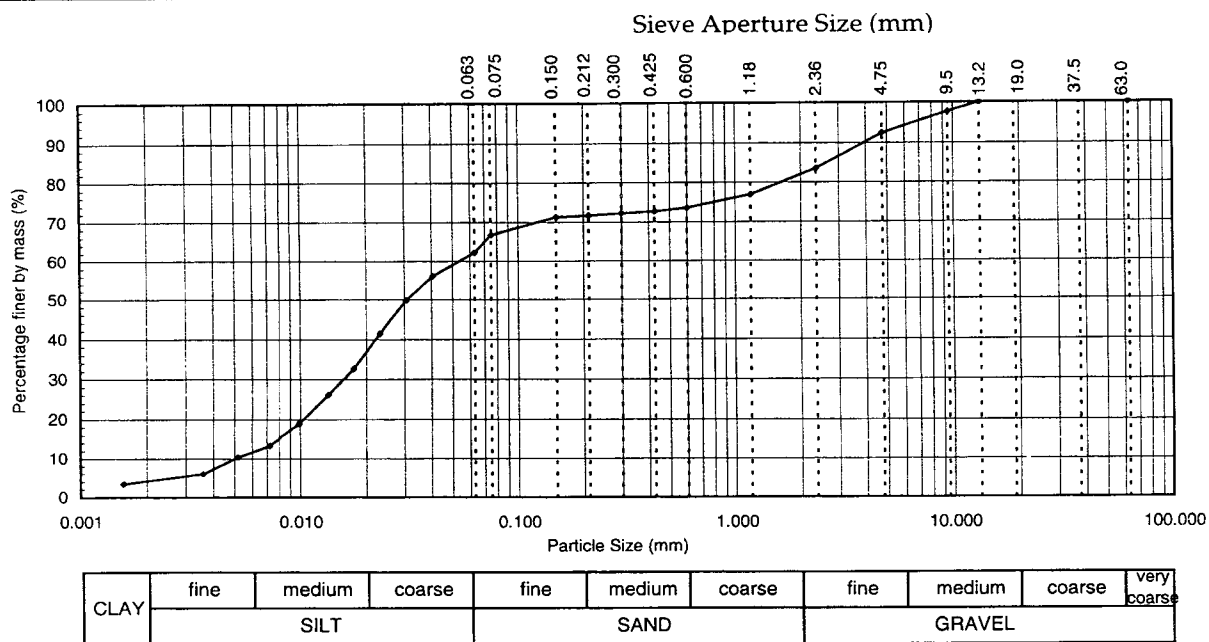
**PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT**



Project : **Rangitaiki Stopbanks Section 15**
 Location : **Unknown**
 Client : **Ice Geo & Civil Ltd**
 Client/Sample Ref : **-**
 Contractor : **-**
 Borehole No: **BH1** Depth: **7.50 metres**
 Sampled by : **M. O'Halloran (28/08/07)**
 Date received : **5/09/07**
 Sampling method : **Borehole**
 Sample condition : **As received**
 Sample description : **Sandy SILT** *with gravel*
 Solid Particle Density (t/m³): **2.65** **Assumed**
 Water Content (as received): **105.5** %

Project No: **2-68229.82**
 Lab Ref No: **07/229/006**
 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	92	0.300	72	0.0405	56	0.0072	13
37.5	--	2.36	84	0.212	72	0.0306	50	0.0052	10
19.0	--	1.18	77	0.150	71	0.0232	41	0.0036	6
13.2	100	0.600	74	0.075	67	0.0176	33	0.0016	3
9.5	98	0.425	73	0.063	62	0.0134	26	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0099	19		



Test Methods

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

Notes

pH of suspension : 8.0 Whatmans Full Range pH indicator paper

Date Tested: 9/09/07

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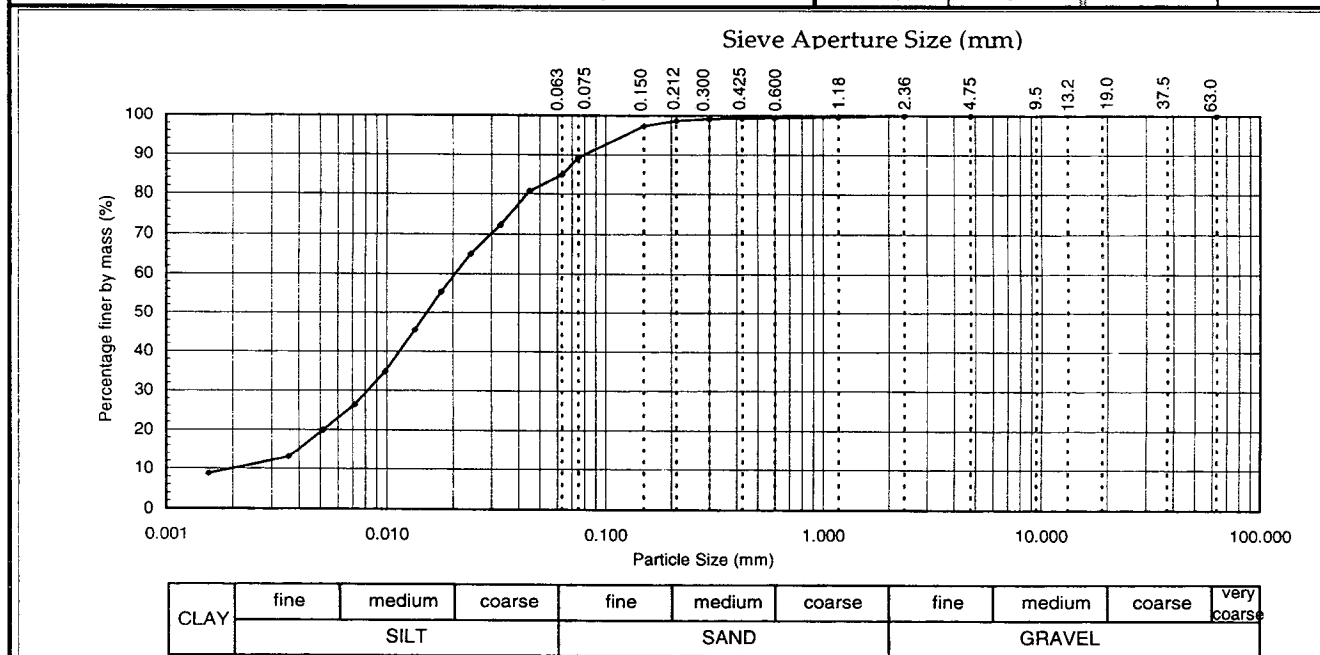
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

Project : Rangitaiki Stopbanks Section 15
 Location : Unknown
 Client : Ice Geo & Civil Ltd
 Client/Sample Ref : -
 Contractor : -
 Borehole No: BH2 Depth: 5.10 metres
 Sampled by : M. O'Halloran (28/08/07)
 Date received : 5/09/07
 Sampling method : Borehole
 Sample condition : As received
 Sample description : SILT
 Solid Particle Density (t/m³): 2.65 Assumed
 Water Content (as received): 54.3 %



Project No: 2-68229.82
 Lab Ref No: 07/229/006
 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	0.0449	81	0.0072	26
37.5	--	2.36	100	0.212	99	0.0330	72	0.0051	20
19.0	--	1.18	100	0.150	97	0.0241	65	0.0036	13
13.2	--	0.600	99	0.075	89	0.0177	55	0.0016	9
9.5	--	0.425	99	0.063	85	0.0134	46	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0099	35		



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: 9/09/07

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PARTICLE SIZE ANALYSIS (HYDROMETER METHOD) TEST REPORT

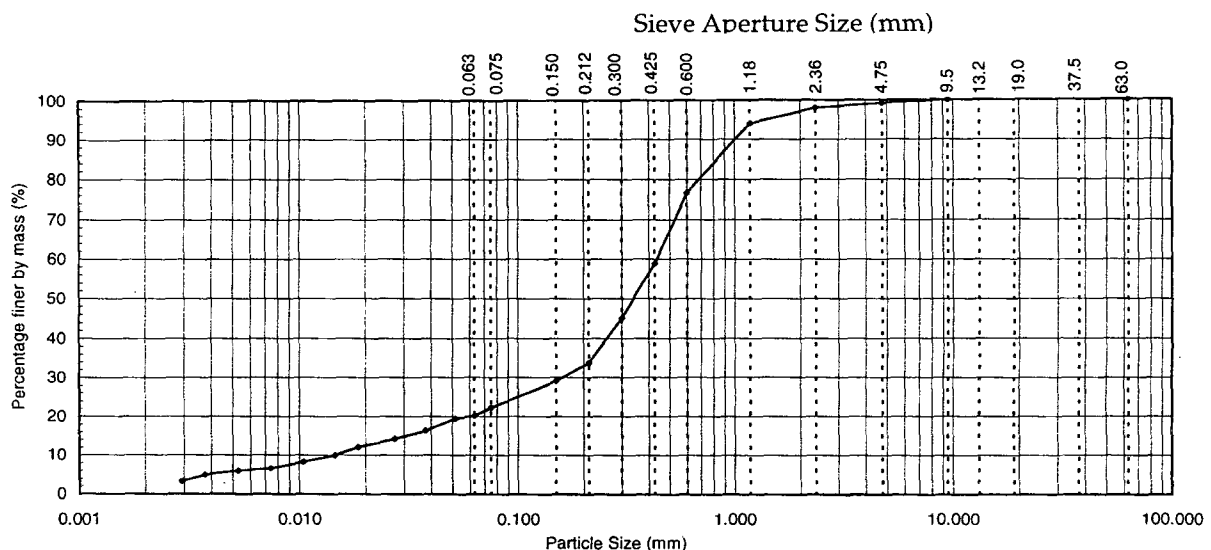


Project : **Rangitaiki Stopbanks Section 15**
 Location : **Unknown**
 Client : **Ice Geo & Civil Ltd**
 Client/Sample Ref : **-**
 Contractor : **-**
 Borehole No: **BH2** Depth: **6.70 metres**
 Sampled by : **M. O'Halloran (28/08/07)**
 Date received : **5/09/07**
 Sampling method : **Borehole**
 Sample condition : **As received**
 Sample description : **Silty med - coarse SAND**
 Solid Particle Density (t/m^3): **2.60** Assumed
 Water Content (as received): **29.6** %

Project No: **2-68229.82**
 Lab Ref No: **07/229/006**
 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	45	0.0516	19	0.0074	7
37.5	--	2.36	98	0.212	34	0.0376	16	0.0053	6
19.0	--	1.18	94	0.150	29	0.0271	14	0.0038	5
13.2	--	0.600	77	0.075	22	0.0185	12	0.0029	3
9.5	100	0.425	59	0.063	20	0.0145	10	--	--
						0.0104	8		

Note: "--" denotes sieve not used and/or hydrometer analysis not tested



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: 9/09/07

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