Appendix – 9

Result of Soil Investigation

PS
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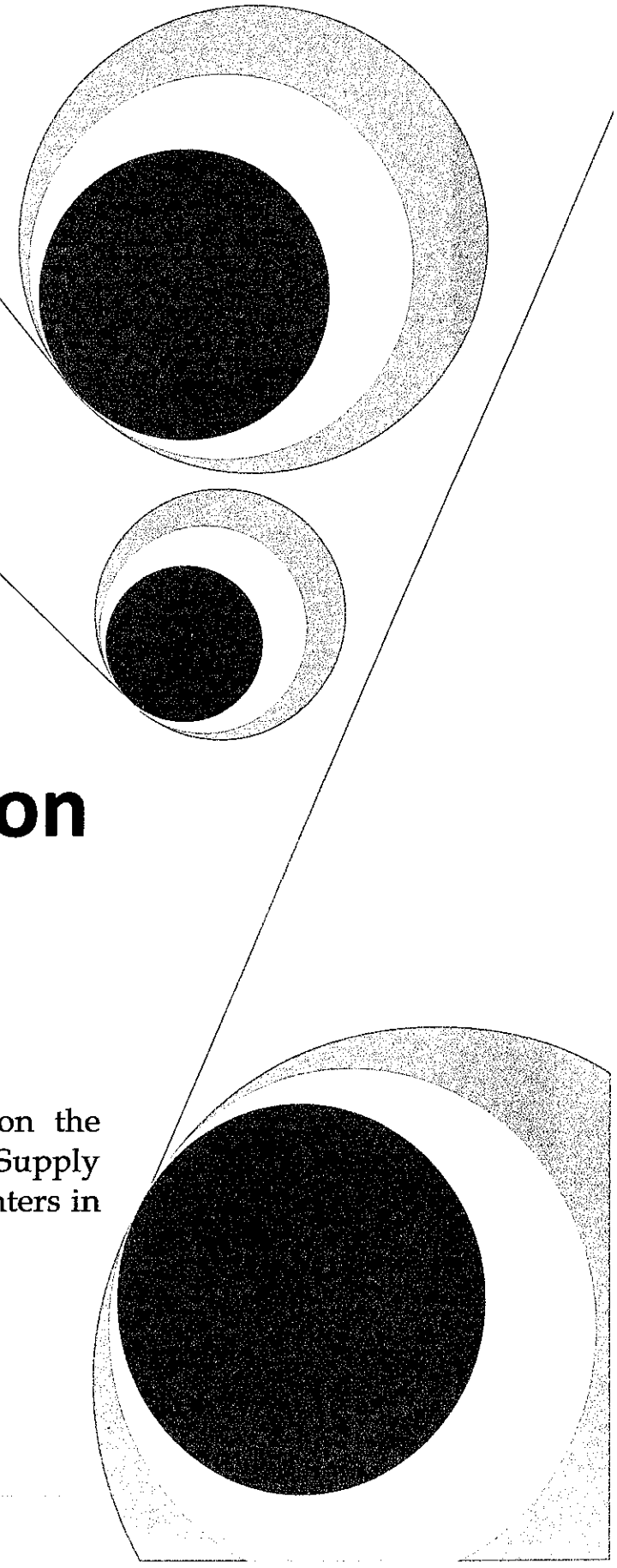
Pacific Strata Drilling Limited



Soil Investigation Survey Report

For the Basic Design Team Study on the Project for Improvement of Water Supply System in Honiara and Provincial Centers in the Solomon Islands

Kenneth Bulehite
April 2008

DOCUMENT INFORMATION

Project Title

The Project for Improvement of Water Supply System in Honiara and Provincial Centers in the Solomon Islands: Soil Investigation Survey

Client

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Distribution List

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Yachiyo Engineering	**May 2008**	**Mr.** Masatoshi SENO

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1 Introduction

Pacific Strata Drilling Limited has undertaken a soil investigation survey for the Basic Design Study on the Project for the improvement of Water Supply System in Honiara and Provincial Centers in the Solomon Islands.

The survey as detailed in this report, has reviewed the geology information on Honiara areas. The survey considered the detail information provided as part 2 Technical information of the contractual agreement.

The survey involves drilling of 8 boreholes of 10 meters in depth for Service Reservoirs and Water Treatment Facilities and Standard Penetration Tests (SPT) at every meter depth intervals at each borehole. However, due to unavailability of equipment in the country the undisturbed sample from cohesive strata at each borehole could not be obtained.

The report also contains laboratory analysis for each of the sample obtained from the boreholes. The laboratory test will cover the Soil Classification and Soil Strength Tests using British and Australian Standards appropriately.

The Plate Loading Test was also done for all the Service Reservoir s and Water Treatment Facility to determine the ultimate bearing capacity of soil at the bottom. Eight (8) plate loading test were done one at each of the five (5) Services Reservoirs and three (3) Water Treatment Facilities. The plate loading test was done according to ASTM D – 1194 using a diameter of 30 cm circular load plate to determine the ultimate bearing capacity of soil and allowable bearing capacity of soil. The loads of test was done according to step by step test with load of 5 ton/m^2, 10 ton/m^2, 15 ton/m^2, 20 ton/m^2, and 30 ton/m^2.

The expected allowable bearing capacity of soil at the bottom is 10 ton/m^2 and the ultimate bearing capacity of soil is at settlement is 30mm equal to the 10% of a diameter of loading plate.

The results of all the tests were analyzed and presented in a tabular and graph forms. The discussion was also made for each site. The general discussion on the results was also made in chapter 6 of this report.

2 Review of Existing Documentation and Data Collection

2.1 Review of Existing Document

The soil investigation survey in Solomon Islands has been primarily limited to the few large building project and restricted to the low coast region area of Honiara area. It is also limited to the town areas.

2.1.1 Geology of the Honiara Area

Hackman [1979] undertook the study of the Geology of Honiara area and produce a 1:50,000 scale geological sheet GU4 "Honiara". In the Honiara area, a Palaeogene igneous basement is overlain unconformably by not more than about 1400 m of Neogene to Quaternary sedimentary and volcanic rocks, including volcaniclastics and reef limestones. The basement comprises basaltic andesites intruded by predominantly dioritic complex of probable Oligocene age.

The succeeding Miocene to Pleistocene volcanic include the predominantly andesitic Gallego Lavas and the associated Tiaro Tuff-breccias, which provide the source materials for the Plio – Pleistocene Lungga Beds, a variable sequence of volcaniclastic wackes, arenites and rudites with carbonate admixture.

The Lungga Beds comprise a lithesome of three distinct facies: In the south the Plio-Pleistocene Mataniko Sandstones, Tp-Qplm, comprise about 400m of volcanic arenites and wackes with turbidite features. Around Honiara and Mount Austen, the Pleistocene Honiara Beds, Qplh, about 400m thick, form a sequence of calcareours volcanic arenite and rudites: these phase westwards into the Saghalu Conglomerates, Qpls, which form a mantle of volcaniclastic rudites derived from the Gallego Volcanics in the northwest. The Kombito Marls, Qpk, are a lagoonal back – reef facies of the Honiara Beds.

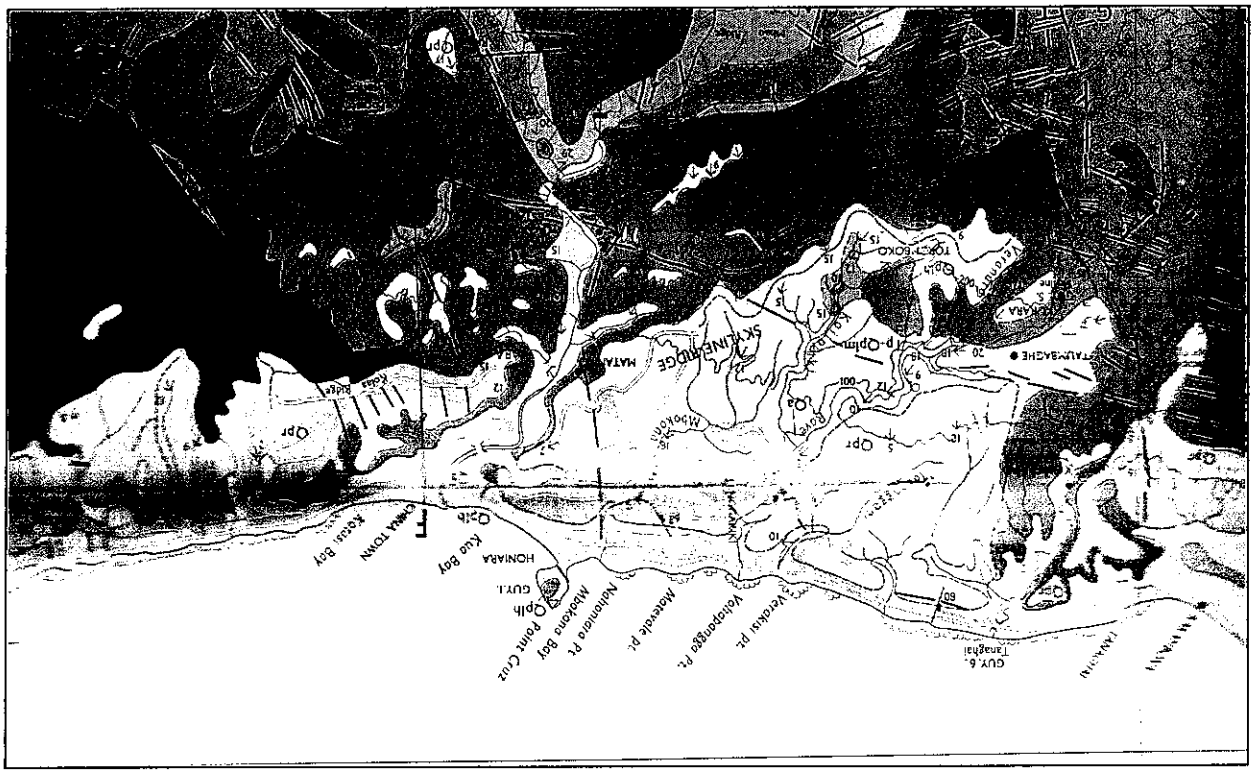


Figure 1: Geology Map of Immediate Honiara

2.1.2 Geology of Immediate Honiara Area

The Honiara Beds are capped by a 60 m of coralgal biolithite and derived debris, the Honiara Reef Limestones (Qpr), which are associated with a magnificent complex sequence of terraces with a height ranging from 700m above to 100m below the sea level.

Most of the coastal are fringed with dead corals (Qr), which is being swamped by alluvium, Qa, derived from the major rivers. Extensive alluvial valleys occur along the courses of the Lungga, Poha and Umasani River.

The structural geology is controlled essentially by faulting. Faults trending NNW – SSE are the

most persistent along their strikes, e.g. the Saghalu Fault, which forms the western "hinge" to the main outcrop of the Poha Diorite: many of these fractures are high-angle reverse fault which have contributed to composite horsting of the pre-Pliocene basement. Figure1 shows the geology map of the immediate Honiara area.

2.1.3 Earthquake

Solomon Islands experience earthquake of magnitude 4.5 and above on average 12 times every month. In recent years, Solomon Islands experience some of the most devastating earth quake in magnitude 7 & 8 in the Richter scale. The latest major earthquake occurs in 2 April 2007 with magnitude 8.1. The Gizo earthquake kills 52 people and cause 15,000 homeless

2.2 Data Collection

Data sampling for the laboratory and in situ testing especially Standard Penetration Test was done using drilling rig with rotary bit.

Plate 1: Drilling Rig G 210B

2.2.1 Drilling Rig

The description of the soil was done through the identification of soil characteristics using the borehole log. The disturbed sample is collected for the soil classification and identification test. Undisturbed sample is not possible due to non availability of sampling tube in the country. The Standard Penetration Test (SPT) shall be done using the drilling rig with a hammer of 63 kg. The SPT is done according to AS 1289

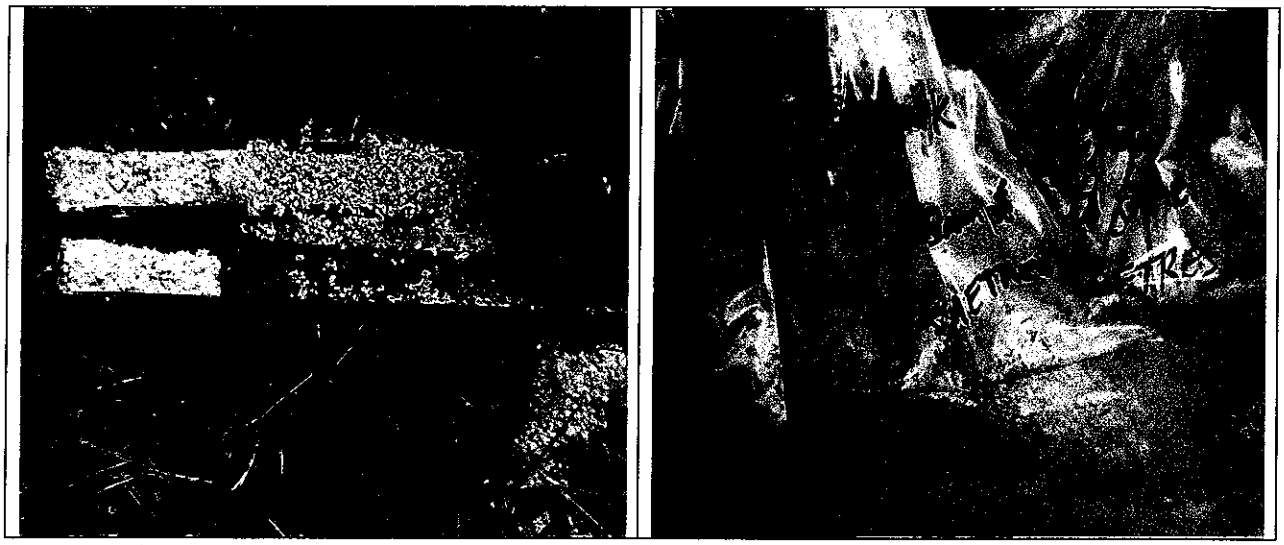


Plate 2: Core sample from SPT Rods & Sample Bag

2.2.2 Laboratory

The laboratory test is done by the Material Laboratory of the Ministry of Infrastructure Development using the British Standards (BS) and Australian Standards (AS) 1289.

2.2.3 Plate Loading

The plate loading test is done according to the ASTM D 1194 using 30 cm diameter plate and hydraulic jack to apply the required step by step reactive loads. The standard had been withdrawn due to its limitation. The geology and soil situation in Honiara, especially in the terraces area is consist of the Honiara Reef Limestone, which is generally uniform thus meet the minimum requirement for the plate loading test for the determination the ultimate bearing capacity and expected bearing capacity.

Plate3: Plate Loading Test and Slab used additional weight

The equipment used as weight for the counter load is:

- Mitchubisu Truck 4 tonne
- 17 Concrete slabs, Size 1200mm x 540 mm x 125 mm
- Hydraulic Jack with gauge in kg/cm^2

3 Survey Works

The survey works covers the following:

- Borehole drilling
- Sampling and In situ Testing
- Laboratory Testing
- Plate Loading Testing

3.1 Timeframe

The survey work was done within two weeks, the mobilization activities take a week and the last week was used to prepare the report.

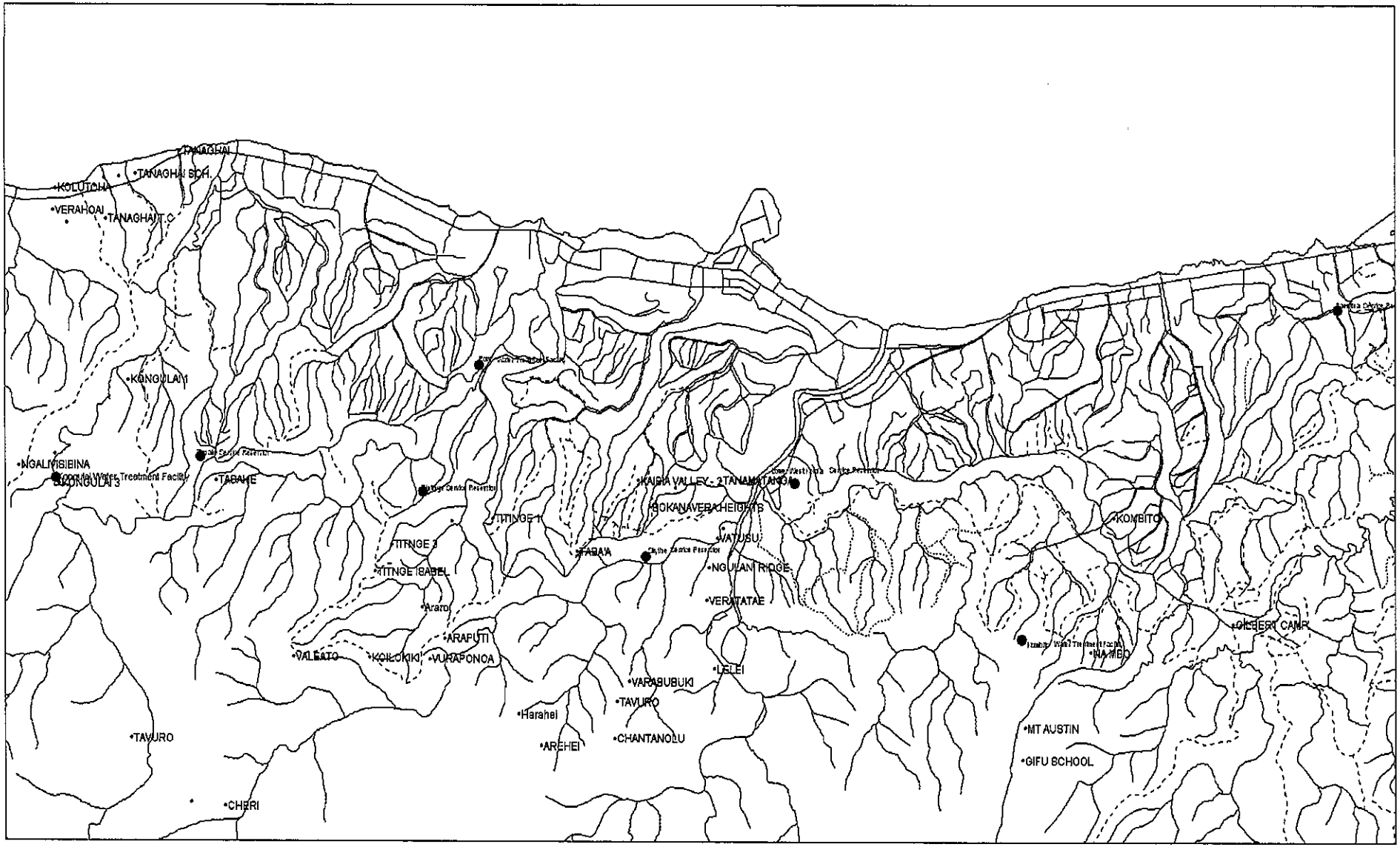


Figure 2: Location of Site Investigation

Soil Investigation Survey

No:	Activities	Number of Days																													T
	Number of Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
		April																		May											
	Date	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	
1.0	Signing of Contract Agreement	#																													
2.0	Mobilization									#																					
3.0	Site Visit and Inspection								#																						
4.0	Drilling of Borehole																														
4.1	Tasahe Reservior																														
4.2	Tintinge Reservior																														
4.3	Skyline Reservior																														
4.4	Lower West Kolaa Reservior																														
4.5	Panatina Reservoir																														
4.6	Kongulai Water Treatment																														
4.7	Rove Water Treatment																														
4.8	Kombito Water Treatment																														
5.0	Sampling and In situ Testing																				#										
6.0	Laboratory Testing																														
7.0	Plate Loading Test																						#								
8.0	Report Writing																														
8.1	Review of documents									#																					
8.2	Draft Report completed																										#				
8.3	Review Report																											#			
8.4	Final Report																												#		
9.0	Report Completion																													##	

Key # **Milestones**

Project completion

A9-11

4 Service Reservoir & Water Treatment Facility Site

4.1 Panatina Service Reservoir

Panatina Service Reservoir is situated on the eastern part of Honiara. The site is easily accessible by road. Currently it has an existing reservoir tank of 600 m^3, a disinfection house and existing foundation of an old reservoir tank. The project proposed a 2000 m^3 capacity reservoir tank.

4.1.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The borehole log for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

Plate 4.1: Drilling rig and Operator at Test Site

4.1.2 Sampling and In situ Testing

Borehole log below provides details of the sampling and the in situ testing done

4.1.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.1.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the

number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log Annex 1 below.

4.1.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.1.3.1 Soil Classification Tests

Moisture Content

Sample	1- 4 m depth	6 m depth
Moisture Content %	14	14.9

Plasticity Test

Sample	1 –4 m depth	6 m depth
	%	%
Liquid Limit %	43	41
Plastic limit %	27	18
Plasticity Index %	16	23
Linear Shrinkage %	6.4	7.9

From the Plasticity Chart for Soil Classification, the soil sample at Panatina Service Reservoir is medium compressible inorganic clay.

Specific Gravity

Sample	1	2	3
Specific Gravity (G_s)	2.62	2.59	2.63

The average Particle Specific Gravity is 2.61

Grain size distribution analysis

The results of the Particle Size Distribution is tabulated in Table 4.4 and presented in Graph 4.4

Sample	1-4 m depth	6 m depth
D_{10}	0.075	0.075
D_{60}	2.7	5.8
C_u	36	77
	Well graded	Well graded
D_{30}	0.72	1
C_e	3.6	2.3
	Uniform	Medium Graded

4.1.4 Plate Loading Testing

Panatina Service Reservoir was done on the western part, outside of the existing fence. The depth of the trench is about 0.7 m depth. The test was done twice for confirmation of the initial test. The results are clearly detailed below.

4.1.4.1 Soil Condition

The soil condition at Panatina Services Reservoir is brown clayey soil. The soil appears to firm and cohesive. The plate below shows the settlement of the 30 cm diameter plate.

Plate 4.1: Hydraulic Jack and the settlement of the Plate Loading Test

4.1.4.2 Data

The data of the plate loading test results of the two gauges for the reading are tabulated below.

Table 4.1: Tabulated Results

Test Load 1

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.00	0.00
1.00	2.05	2.53
1.50	3.08	1.36
2.00	2.02	2.12
3.00	7.80	7.70

Test load 2

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0	0.00
0.50	1.03	0.72
1.00	2.45	0.75
1.50	1.91	1.74
2.00	2.30	2.08
2.50	5.70	4.85

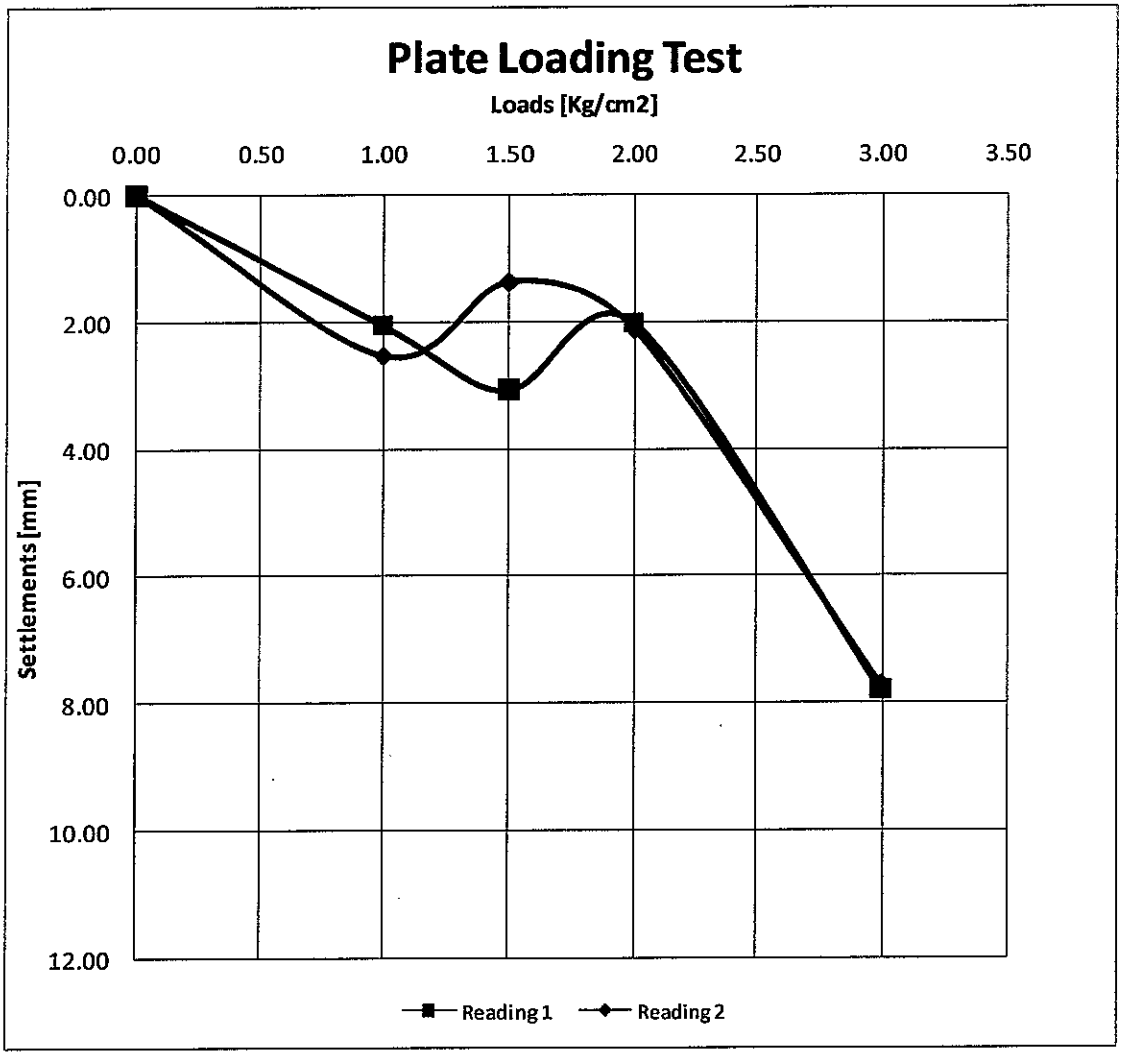


Figure: 4.1a: Plate loading Test for Panatina Service Reservoir

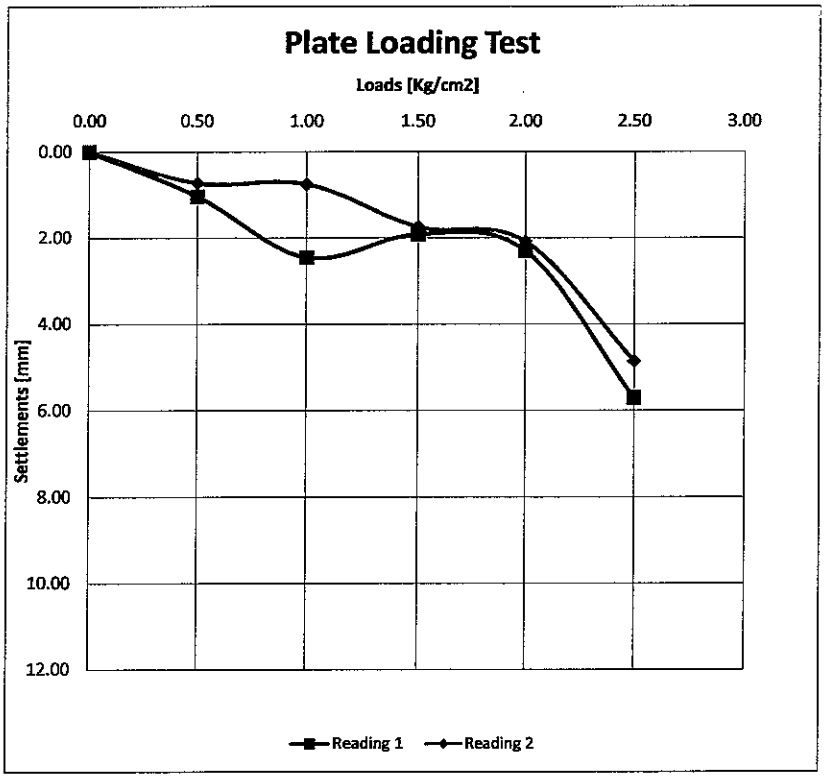


Figure: 4.1b: Plate loading Test for Panatina Service Reservoir

4.1.4.3 Results

The ultimate bearing loading for the soil condition in Panatina is 2.0 kg / cm^2 or 20 ton / m^2. The soil at the test level is mostly clay soil. The tests done shows that soil was moist following the rainfall the day before, which also indicate cohesion type soil.

4.2 Tasahe Service Reservoir

Tasahe is situated in the western end of Honiara City area along the Galloping Horse / Skyline terrace. Currently in the area is a chlorination injection chamber and service reservoir of 12.0m x 21.6m x 4.0m. The proposed service reservoir will be two 8m x 23m x 4.5 m. The existing chlorination house will be removed including existing pipeline system.

4.2.1 Borehole Drilling

The borehole drilling was done using boring rig equipment GEMCO 210B. The borehole log in Annex 1 below shows the descriptive strata of the soil at the interested area.

4.2.2 Sampling and In situ Testing

4.2.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.2.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in Annex 2 below.

4.2.3 Laboratory Testing

The laboratory test was done according to British Standard (BS)

4.2.3.1 Soil Classification Tests

Moisture Content

Sample	1- 5 m depth	6 – 10 m depth
Moisture Content %	14.3	15.4

Plasticity Test

Sample	2 – 6 m depth	8 m depth	10 m depth
	%	%	%
Liquid Limit %	40	32	35
Plastic limit %	18	19	21
Plasticity Index %	22	13	14
Linear Shrinkage %	8.6	6.3	7.3

From the Plasticity Chart for Soil Classification, the sample for 2 – 6 m depth the soil is medium compressible inorganic clay. The soil sample for 8m depth and 10m depth is low compressible inorganic clay soil.

Specific Gravity

Sample	1	2	3
Specific Gravity (G_s)	2.57	2.52	2.58

The average specific gravity is 2.56

Grain size distribution analysis
The results of the Particle Size Distribution is tabulated in Table 4.1 and presented in Graph 4.1

Sample	1-5 m depth	6 – 10 m depth
D_{10}	0.075	0.075
D_{60}	2.5	3.6
C_u	33	48
	Well graded	Well graded
D_{30}	0.2	0.4
C_e	1	1.48
	Medium Graded	Medium Graded

From the Particle Size Distribution Graph 4.2 the samples of depth 1- 5 m and 6 -10 m are Gravel with Sandy Clay Soils.

4.2.4 Plate Loading Testing

The soil condition at Tasahe is firmly dark brown graded coral gravel and rock. The test had to be done twice due to suspicious of abnormality on the results. Plate 4.2 shows the gravel with clay and coral soil at Tasahe Service Reservoir. The plate loading test was done on the 24 April 2008. Plate 4.1 shows the soil condition of the area.

Plate 4.2: Firmly graded Coral Gravel with Clay at Tasahe Site

4.2.4.1 Results

The result of the plate loading test were tabulated in Table 4.2 and graphed in Figure 4.2. The recommended maximum required load of 30 ton / m^2 applied the soil does not appear to be failed. The ultimate bearing loading for the soil condition in Tasahe is more than 3.5 kg / cm^2 or 35 ton / m^2.

Table 4.1: Tabulated results of two dial gauge for the plate loading test

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	0.30	0.10
1.00	0.50	1.15
1.50	0.55	0.30
2.00	1.55	0.60
2.50	0.50	0.90
3.00	0.70	1.10
3.50	0.90	0.21

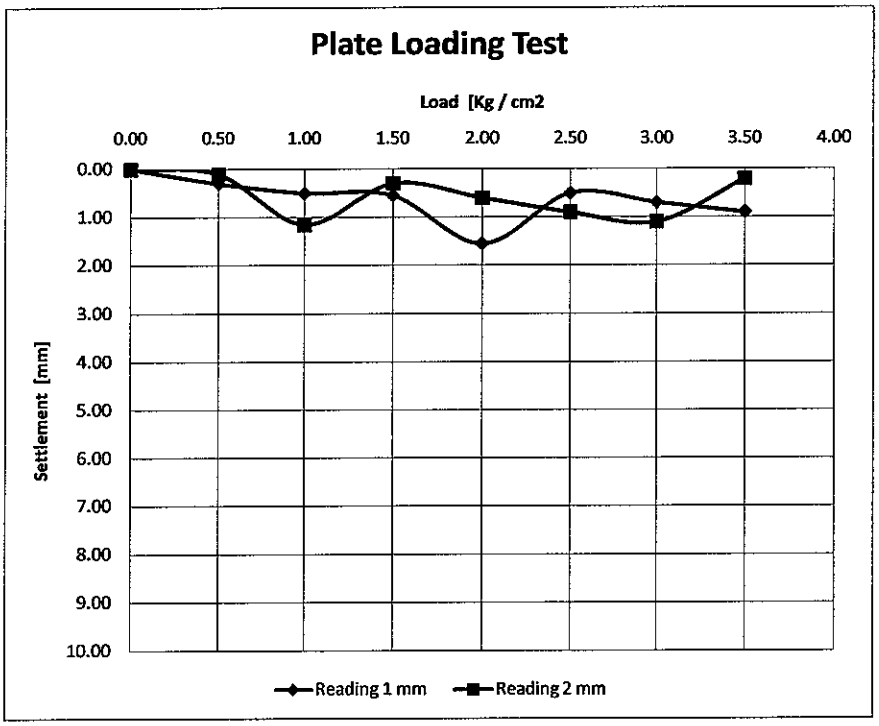


Figure 4.1: Plate loading Test for Tasahe Service Reservoir

4.2.4.2 Discussion

From the result on plate loading test, the recommended load of 30 ton /m^2 is applied and yet there is no indication of settlement occurring above 2 mm. The acceptable allowable capacity of 10 ton / m^2 is within the strength of the soil tested, which is about 50 cm below the ground level.

4.3 Kongulai Purification facility

Kongulai is situated in the western part Honiara. It is the situation of the main water supply system of Honiara, supplying about 50% of Honiara Water Supply. Currently, there is an existing pumping station and a chlorination injection system at Kogulai.

4.3.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The drilling rig was towed to the site using backhoe due to road condition. The borehole log for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

4.3.2 Sampling and In situ Testing

4.3.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.3.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in Annex 3 below.

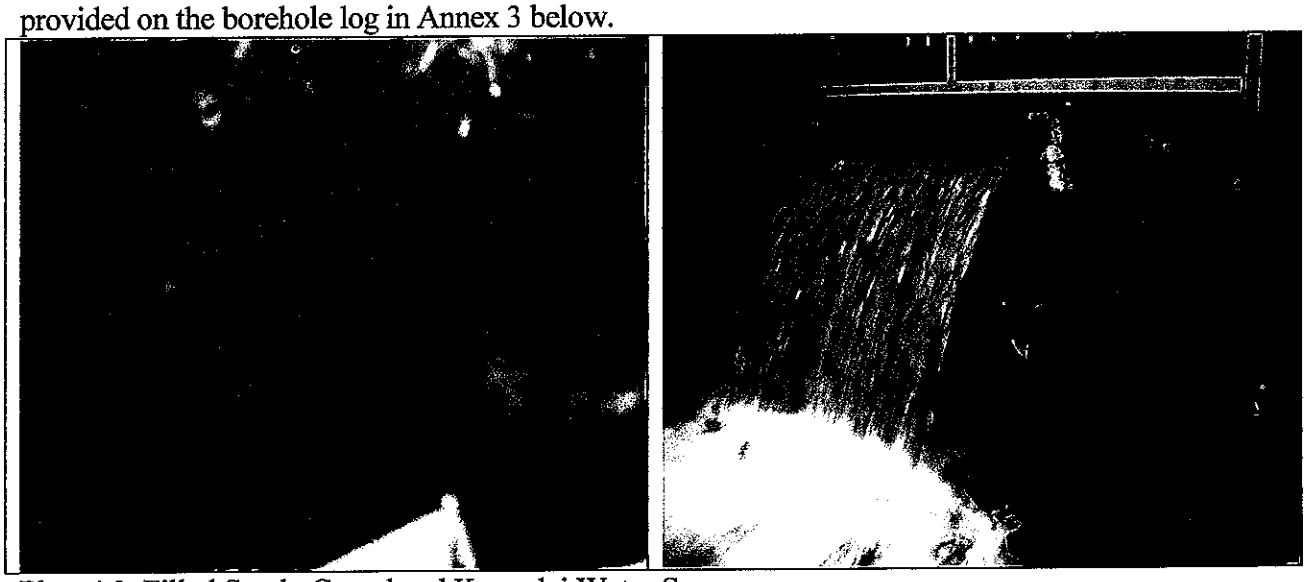


Plate 4.3: Filled Sandy Gravel and Kongulai Water Source

4.3.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.3.3.1 Soil Classification Tests

The following were the results of the laboratory classification test.

Moisture Content

Sample	3 - 7 m depth	6 m depth	8 -10 m depth
Moisture Content %	64.1	56.7	20.7

Plasticity Test

Sample	8 - 10 m depth
	%
Liquid Limit %	31
Plastic limit %	23
Plasticity Index %	8
Linear Shrinkage %	5.0

The soil sample is low compressible inorganic clay soil

Specific Gravity

Sample	1	2	3
Specific Gravity (G_s)	2.56	2.51	2.53

Grain size distribution analysis

The results of the Particle Size Distribution is tabulated in Annex 2.1 and presented in Annex 2.2

Sample	3-7 m depth	6 m depth	8 – 10 m depth
D_{10}	0.075	0.075	0.075
D_{60}	0.075	0.26	1.7
C_u	1	3.5	23.3
	Uniform	Uniform	Well graded
D_{30}	0.075	0.084	0.075
C_e	13.3	4.3	0.5
	Uniform	Uniform	Well Graded

From the Particle Size Distribution graph present in Graph 5.1, the sample of depth between 3 -7 indicated high presents of clay (Cu) and sample for 6m depth shows sandy clay (Su) and sample 8 – 10 shows sandy gravel clay (Gc).

4.3.4 Plate Loading Testing

The soil condition at Kongulai proposed water treatment site appears to be filled sandy gravel; it is likely to fill done for the construction of the pumping station. The access to the site was difficult due to road condition.

4.3.4.1 Results

The result of the plate loading test were tabulated in Table 4.3 and graphed in Figure 4.3. The ultimate bearing loading for the soil condition is 3.0 kg / cm^2 or 30 ton / m^2.

4.3.4.2 Discussion

From the test the ultimate bearing capacity is 30 ton / m^2, which the recommended maximum loads applied.

Table 4.3: Tabulated Results of Two Gauge

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	0.21	0.17
1.00	0.39	1.22
1.50	0.57	0.27
2.00	1.21	0.87
2.50	1.47	0.97
3.00	3.05	2.20
3.50	5.25	6.90

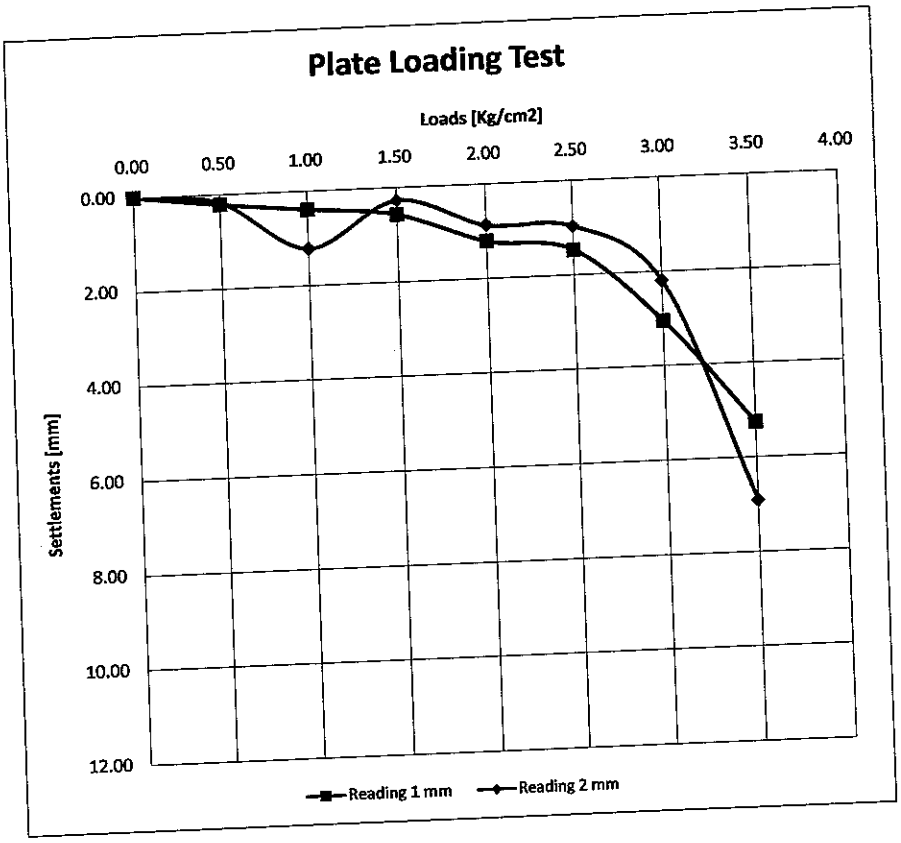


Figure 4.3: Plate loading Test for Kongulai Service Reservoir

4.4 Kombito Purification facility

Kombito is situated south east of Honiara. Currently, there is an existing pumping station at Kombito Borehole. The proposed plan was to develop a water treatment facility, which shall consist of two settling tank

4.4.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The borehole log annex 4 for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

4.4.2 Sampling and In situ Testing

4.4.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.4.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in Annex 4 below.

4.4.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.4.3.1 Soil Classification Tests

Moisture Content

Sample	1- 4 m depth	2- 10 m depth
Moisture Content %	24	16

Plasticity Test

Sample	1 –4 m depth	5-10 m depth
	%	%
Liquid Limit %	45	43
Plastic limit %	30	25
Plasticity Index %	15	18
Linear Shrinkage %	9.3	9.2

From the Plasticity Chart for Soil Classification, the soil sample at Kombito Water Treatment Facility Service Reservoir is medium compressible inorganic clay.

Specific Gravity

Sample	1 – 4 m	5 – 10 m
Specific Gravity (G_s)	2.55	2.60

Grain size distribution analysis

The results of the Particle Size Distribution is tabulated in annex 4.1 and presented in Annex 4.2

Sample	1-5 m depth	6 - 10 m depth
D_{10}	0.075	0.075
D_{60}	2.5	3.5
C_u	33	47
	Well graded	Well graded
D_{30}	0.075	0.3
C_e	1	4
	Uniform	Uniform Graded

From the Graph the soil is 30 % of gravel, 30 % sand and 30 % clay , therefore the soil can be termed as well graded gravelly sandy clay.

4.4.4 Plate Loading Testing

The plate loading test was done approximately 40m from the existing pumping station. The soil condition is coral gravel. The depth of the test hole is 0.40 m.

4.4.4.1 Results

The results of the plate loading test are presented in table 4.4 and figure 4.4 below. There is no indication of any failure or any major settlements occur when the required maximum load is applied. However, 3.5 kg/cm^2 load is applied. Therefore, there should be no problem, if the ultimate bearing capacity of 30 ton/m^2 is used.

Table 4.4: Tabulated Results of Two Gauge

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	0.18	0.30
1.00	0.19	1.46
1.50	0.15	0.37
2.00	0.14	0.34
2.50	0.13	0.27
3.00	0.25	0.47
3.50	0.42	0.83

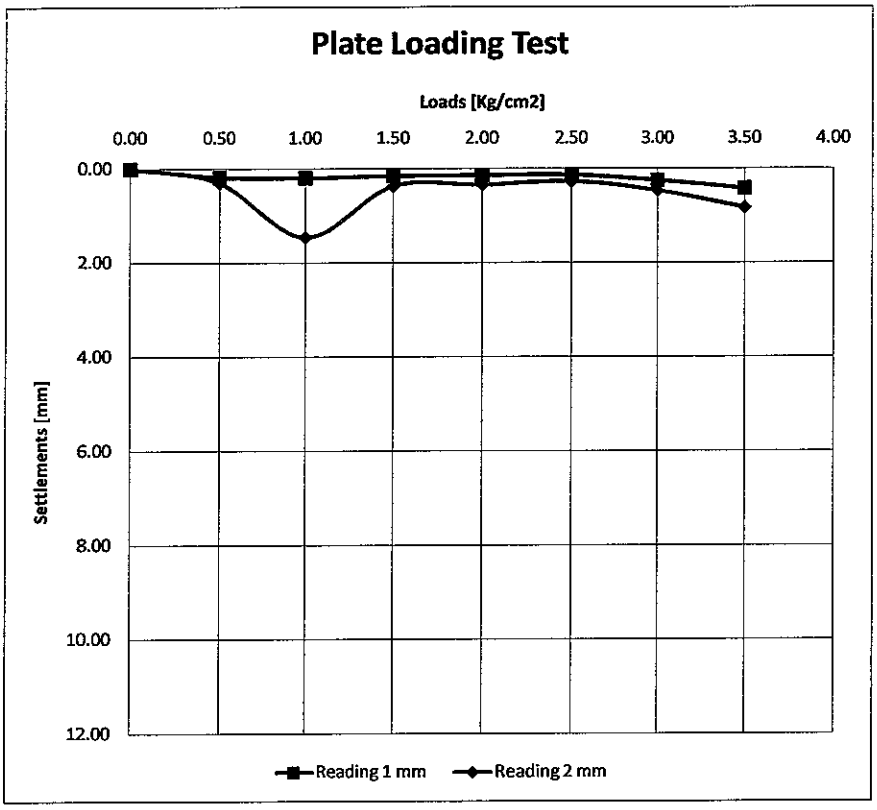


Figure 4.4: Plate loading Test for Kombito Water Treatment Facility

4.4.4.2 Discussion

As mentioned above, there should be no problem with using the ultimate bearing capacity of 30 ton/m^2 and allowable capacity of 10 ton/m^2. Plate 4.4 shows the coral gravel that is presented at Kombito. The soil strength is capable of taking the load for the treatment.

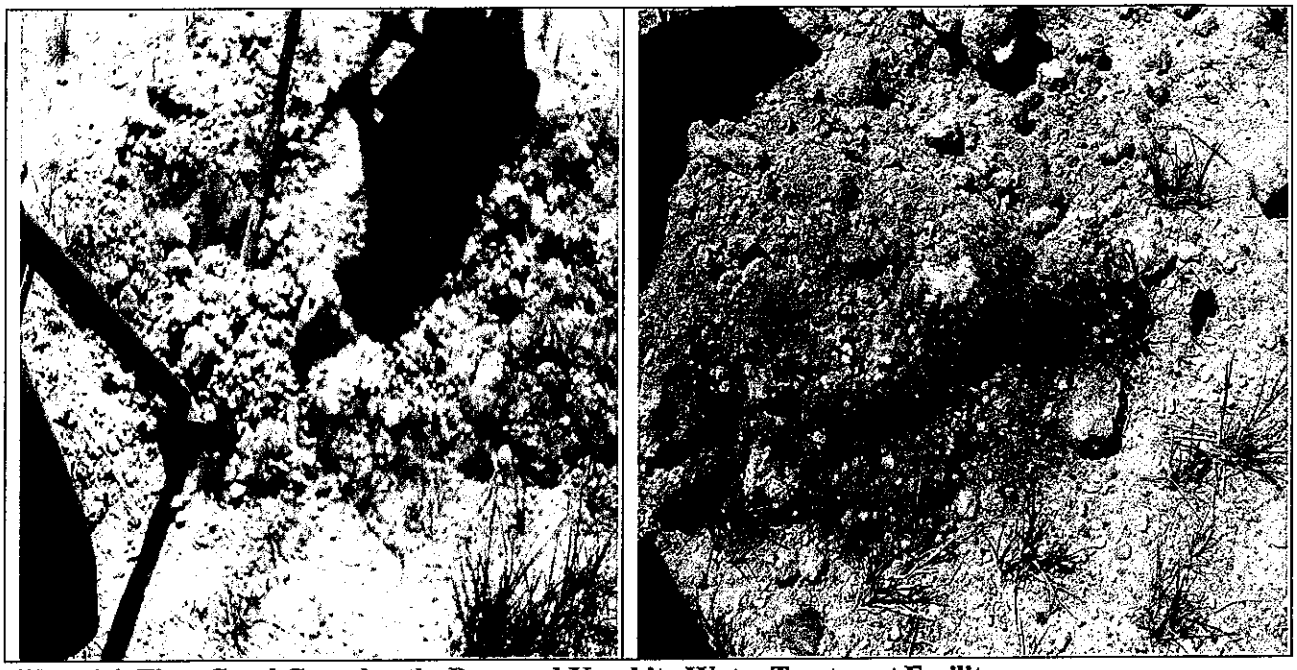


Plate 4.4: Firm Coral Gravel at the Proposed Kombito Water Treatment Facility

4.5 Lower West Kola' a Service Reservoir

Lower west Kola'a Service Reservoir is situated at the central part of Honiara, overlooking Mataniko River. The geology of the lower Kola'a Site is Mataniko Siltsones. The most typical rock occurrence is a dark grey tuffaceous mudstone, with well marked bedding and with abundant crystals of augite and feldspar which appear fresh and unworn. Irregularly interspersed with the typical mass are bands of coarse or finer materials, the latter almost silty.

Currently there are two existing tanks at the site. The proposed site for the new reservoir is situated on the other side of the access road. However due to restriction on the access the test and drilling were done on the access road site of the reservoir. The proposed Service Reservoir is 10m x 12m x 3.8m

4.5.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The borehole log for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

4.5.2 Sampling and In situ Testing

4.5.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.5.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in Annex 5 below.

4.5.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.5.3.1 Soil Classification Tests

Moisture Content

Sample	1 - 2 m depth	3 - 10 m depth
Moisture Content %	10.5	25.4

Plasticity Test

Sample	1 –4 m depth	6 m depth
	%	%
Liquid Limit %	34	50
Plastic limit %	23	36
Plasticity Index %	11	14
Linear Shrinkage %	5.6	6.1

From the Plasticity Chart for Soil Classification, the soil sample at Panatina Service Reservoir is medium compressible inorganic clay.

Specific Gravity

Sample	1 – 2 m depth	3 – 10 m depth
Specific Gravity (G_s)	2.63	2.52

Grain size distribution analysis

The results of the Particle Size Distribution is tabulated in Annex 5.1 and Graphed in Annex 5.2

Sample	1-2 m depth	3 – 10 m depth
D_{10}	0.075	0.075
D_{60}	15	0.4
C_u	200	5
	Well graded	Uniformly graded
D_{30}	1.3	0.075
C_e	17	1

From the distribution graph, the soil for depth 1 – 2m is 60 % gravel and 20 % sand and the remaining 20 % is clay. Soil in depth 3 – 10 m is 20 % gravel, 45 % sand and the remaining 35 % clay. Therefore the soil can be described as clayey sandy gravel (GW – C) and gravelly clay sand (GS) respectively

4.5.4 Plate Loading Testing

The plate loading test for Lower West Kola'a done on the upper part of the existing tank due to the problem of access of the road Results. The depth of the excavation area is 0.5 m. The soil condition was a mixture of coral gravel, sandstone and top soil possibly from the access road.

4.5.4.1 Results

The result of the plate loading test were tabulated in Table 4.5 and graphed in Figure 4.5. The ultimate bearing loading for the soil condition is 2.0 kg / cm^2 or 20 ton / m^2. However, this was done on the soil that could be transported by water during heavy rainfall. The result is showing us the results of soil but the soil strength at the actual area for the proposed Service Reservoir would be higher than the results of the load test.

Table 4.5: Tabulated Results of Test at Lower West Kola'a

Loads	Settlement 1	Settlement 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	1.70	1.28
1.00	2.92	1.51
1.50	1.36	1.92
2.00	6.44	4.57
3.00	13.2	11.40

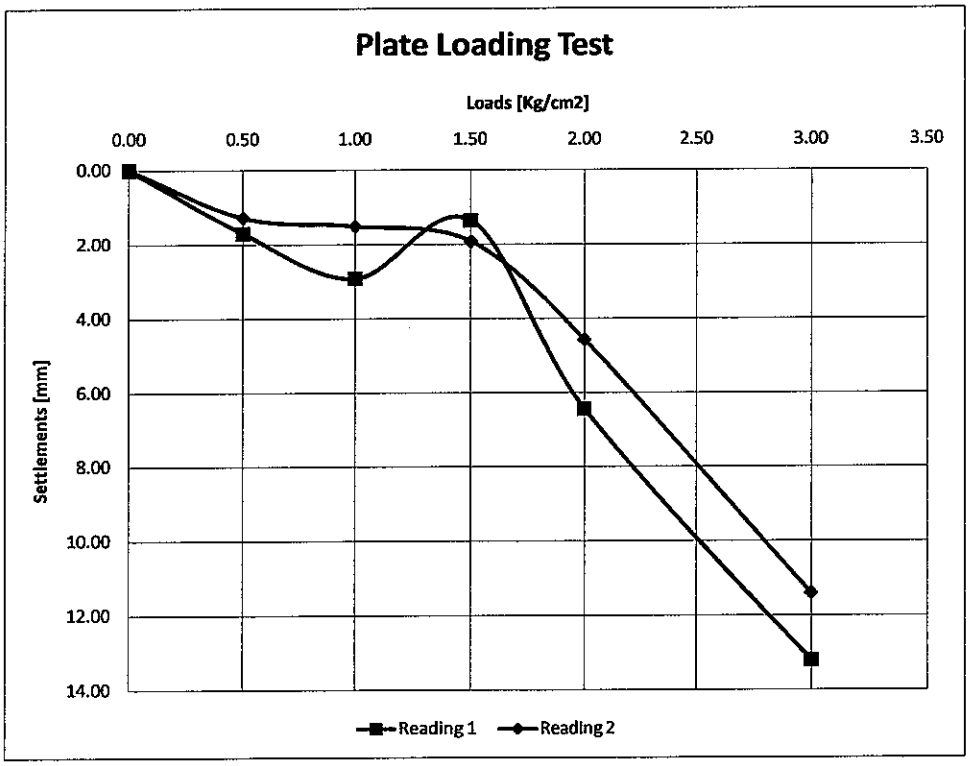


Figure 4.5.: Plate loading Test for Lower West Kola'a Service Reservoir

4.5.4.2 Discussion

The ultimate bearing loading for the soil condition in Lower West Kola'a is 2.0 kg / cm^2 or 20 ton / $m^{2.}$. Anyhow, the ultimate bearing loading of 30 ton / m^2 should be acceptable. The soil strength below, which is sandstone should acceptable.

4.6 Skyline Service Reservoir

Skyline Services Reservoir is situated at the central Honiara. Currently there is two existing tank 12.2 m x 11.0 m x 3.6 m and 15.97 m diameter x 2.4m height. The proposed tank is 20 m x 25 m x 4 m. The geology is coral gravel with clay.

4.6.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The borehole log for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

4.6.2 Sampling and In situ Testing

4.6.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.6.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in Annex 6 below.

4.6.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.6.3.1 Soil Classification Tests

Moisture Content

Sample	1 - 5 m depth	6 – 10 m depth
Moisture Content %	13.3	13.4

Plasticity Test

Sample	0 – 2 m depth	4 – 10 m depth
	%	%
Liquid Limit %	38	37
Plastic limit %	18	17
Plasticity Index %	20	20
Linear Shrinkage %	11.6	10.7

From the Plasticity Chart for Soil Classification, the soil sample at Panatina Service Reservoir is medium compressible inorganic clay.

Specific Gravity

Sample	1	2
Specific Gravity (G_s)	2.58	2.58

The average Particle Specific Gravity is 2.61

Grain size distribution analysis

The results of the Particle Size Distribution is tabulated in Annex 6.1 and presented in Annex 6.2

Sample	1-5 m depth	6 - 10 m depth
D_{10}	0.075	0.075
D_{60}	6	3
C_u	80	40
	Well graded	Well graded
D_{30}	0.35	0.35
C_e	4.7	4.7
	Uniform	Medium Graded

From the graph the soil for 1-5 m depth is 50% gravel, 25 % sand and for 6 -10 m depth is 30 % gravel and 45% sand and the remaining is mostly clay. Therefore the soil can be term as clay sandy gravel and clay gravelly sand respectively

4.6.4 Plate Loading Testing

The plate loading test for Skyline Service Reservoir was done twice due to the present of clay soil with moist. When the load applied the plate penetrated through the soil easily. There seems to be present of water or moist. The soil condition shows that there is very high presence of clay on the soil. Therefore, in spite of presence of coral gravel, the plate just sinks in. The test was stopped after the sink and the wider plate above the 30 cm diameter plate is also touching the ground. Plate 4.6 shows the soil characteristic and the plate sinks in the soil.

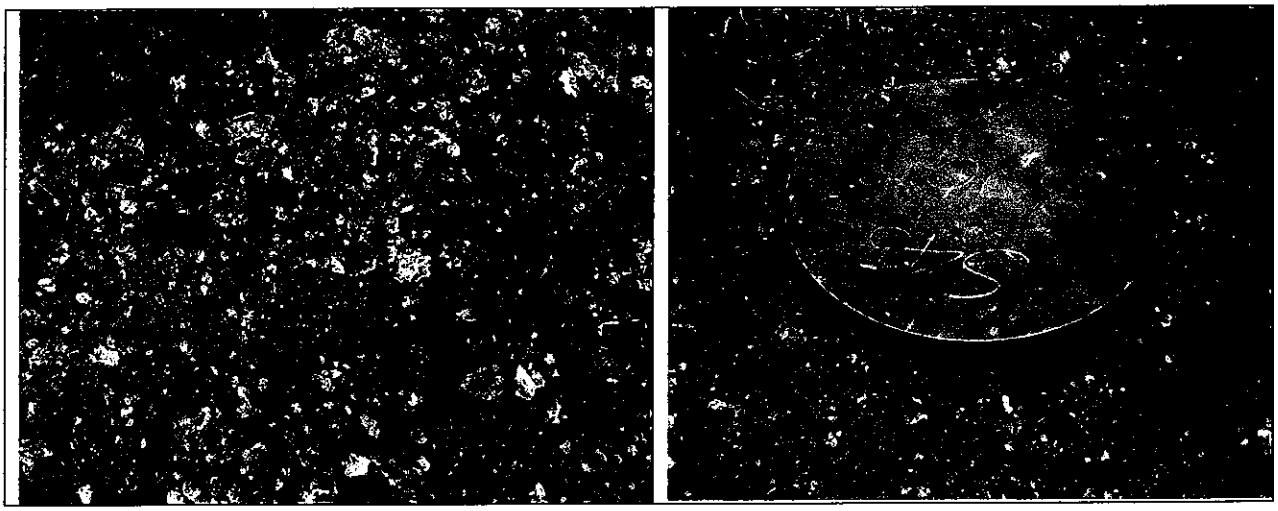


Plate 4.6: Coral gravel soil and Plate in the soil

4.6.4.1 Results

The results of the two plate loading test done at Skyline Service Reservoir were tabulated in Table 4.6a and table 4.6b and graphed in Figure 4.6a and 4.6b. The result consistently shows that the ultimate bearing capacity for the Skyline Service Reservoir is only 1.5 kg / cm^2 or 15 ton / m^2. Therefore, a compaction of sub-base soils needs to be done to improve the soil strength that will be able to take the weight bearing of the proposed Service Reservoir of 20^m x 25^m x 4^m.

Table 4.6a: Tabulated Results of Plate Test in Skyline Service Reservior

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.09	0.00
1.00	0.86	0.79
1.50	2.83	4.57
2.00	10.23	15.46

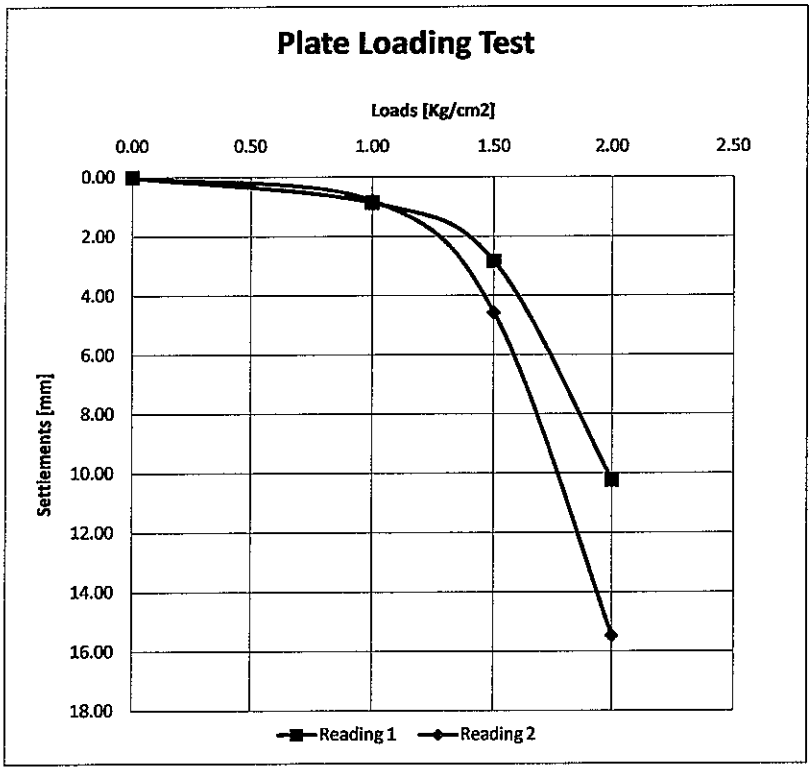


Figure 4.6 a: Plate loading Test for Skyline Service Reservoir

Table 4.6b: Tabulated Results of Plate Test in Skyline Service Reservior

Loads	Settlement 1	Settlement 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	0.61	0.44
1.00	2.93	3.33
1.50	5.56	5.85
2.00	13.76	16.18

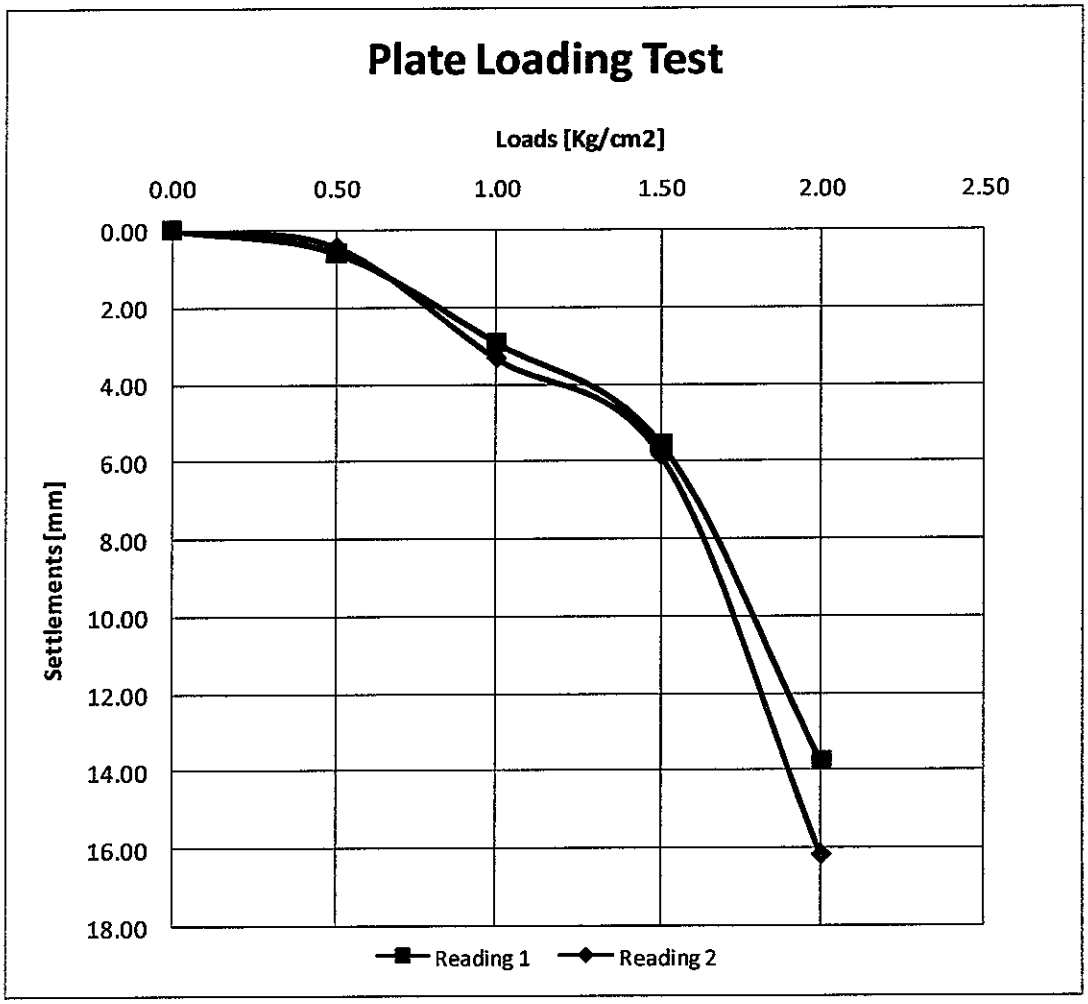


Figure 4.6b: Plate loading Test for Skyline Service Reservoir

4.6.4.2 Discussion

The ultimate bearing loading for the soil condition in Skyline is 1.50 kg / cm^2 or 15 ton / m^2. The skyline site will need to compact to improve the soil strength.

4.7 Tintinge service reservoir

Tintinge Service Reservoir is situated on the upper part of Rove area. There is an existing tank of 12m x 10.8m x 3m. The proposed reservoir of 16m x 18m x 5m, the soil is mostly coral gravel. The existing tank and concrete footing will be removed prior to the construction of the proposed new tank reservoir. Backhoe had been request to level the entrance of the gate in order that work could be done.

4.7.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The borehole log for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

4.7.2 Sampling and In situ Testing

4.7.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.7.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in Annex 7 below.

4.7.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.7.3.1 Soil Classification Tests

Moisture Content

Sample	3- 5 m depth	6 - 10 m depth
Moisture Content %	10.2	10.8

Plasticity Test

Sample	4 –6 m depth	8 – 10 m depth
	%	%
Liquid Limit %	42	34
Plastic limit %	27	25
Plasticity Index %	15	9
Linear Shrinkage %	11.4	8.6

From the Plasticity Chart for Soil Classification, the soil sample at Tintinge Service Reservoir is medium compressible inorganic clay.

Specific Gravity

Sample	1 – 5 m depth	6 – 10 m depth
Specific Gravity (G_s)	2.62	2.58

The average Particle Specific Gravity is 2.61

Grain size distribution analysis
The results of the Particle Size Distribution is tabulated in Annex 7.1 and presented in Annex 7.2

Sample	1-5 m depth	6 - 10m depth
D_{10}	0.075	0.075
D_{60}	2.7	5.8
C_u	36	77
	Well graded	Well graded
D_{30}	0.72	1
C_e	1.63	0.28
	Uniform	Medium Graded

From the Particle Size Distribution graph in Annex 7.2 the soil between 1 – 5 m is 30 % gravel, 50 % sand and 20 % clay and between 6 – 10 m is 40 % gravel, 40% sand and 20% clay. The soil is Gravelly sand y clay soil.

4.7.4 Plate Loading Testing

The soil condition at Tintinge is firmly dark brown graded coral gravel. Plate 4.7 below shows the soil condition at Tintinge Service Reservoir. The plate loading test was done on the 9 May 2008 and repeated on the 11 May 2008.

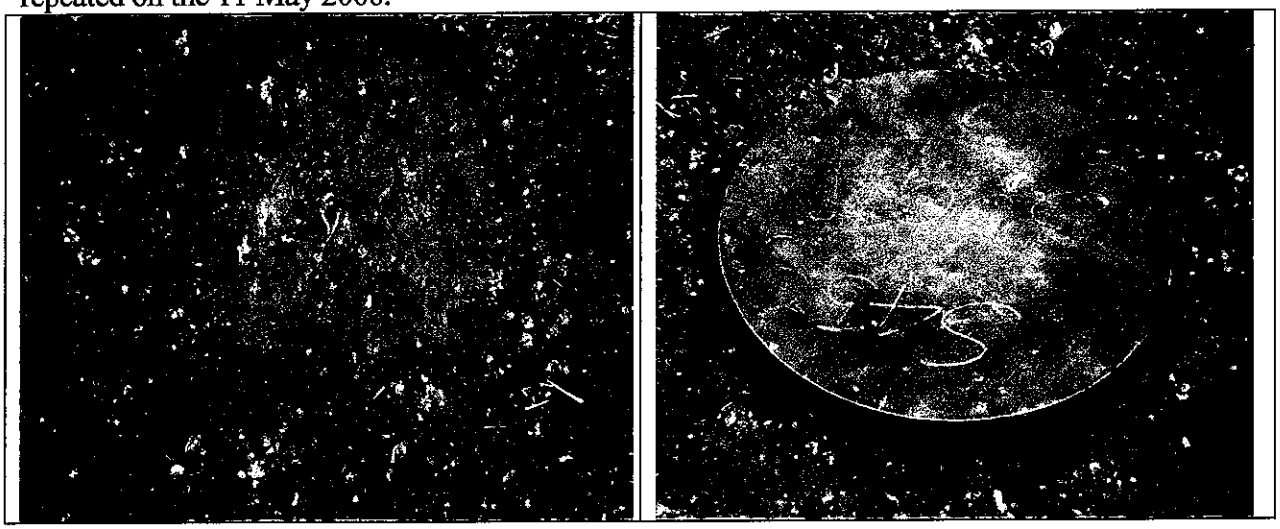


Plate 4.7: Soil Condition at Tintinge Service Reservoir

4.7.4.1 Results

The result of the plate loading test were tabulated in Table 4.7 and graphed in Figure 4.7. The maximum load of 32.5 ton / m^2 applied. However, the ultimate bearing loading for the soil condition in Tintinge is 3.0 kg / cm^2 or 30 ton / m^2.

Table1 4.7: Tabulated Results of Two Gauge

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	0.99	0.35
1.00	0.41	0.87
1.50	0.91	0.92
2.00	1.73	1.01
2.50	2.00	1.00
3.00	2.32	0.93
3.25	3.99	4.40

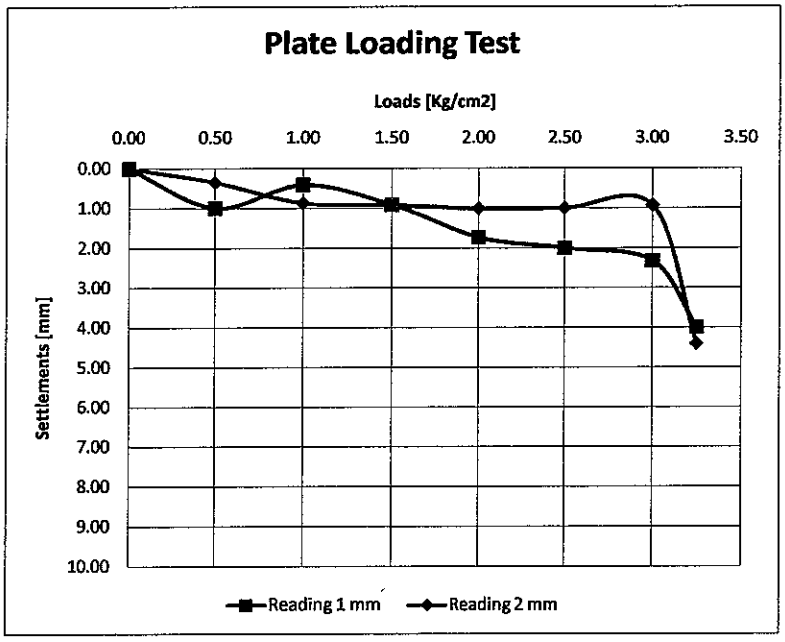


Figure 4.7: Plate loading Test for Tintinge Service Reservoir

4.7.4.2 Discussion

From the result on plate loading test, the maximum load of 32.5 ton /m^2 is applied and there is an indication of settlement occurring about 4 mm. The ultimate bearing capacity is 30 ton / m^2. The soil strength is acceptable with limited compaction.

4.8 Rove Water Treatment facility

The proposed Rove Water Treatment Facility is situated on the upper end of the Botanical Garden. Due to access limitation, the site which was suggested near the stream was not possible. The area which was tested was near the old tank foundation opposite the houses.

4.8.1 Borehole Drilling

The borehole drilling was done using boring rig equipment. The borehole log for each of the borehole is a borehole journal was document in a log sheet of paper to provide the description of strata of the soil.

4.8.2 Sampling and In situ Testing

4.8.2.1 Disturbed Sample

The recovered cutting and the core sample from the drilling and SPT respectively. The sample was group according to the soil properties from the drilling borehole log.

4.8.2.2 Standard Penetration Test

The Standard Penetration Test (SPT) was done according to AS 1289. The N value is the sum of the number of blow between 150 mm – 450mm. The result of the SPT at each depth of 1 m interval is provided on the borehole log in annex 8 below.

4.8.3 Laboratory Testing

The laboratory test was done according to British Standard (BS) by the Material Laboratory, Ministry of Infrastructure Development

4.8.3.1 Soil Classification Tests

Moisture Content

Sample	1-2 m depth	3 - 5 m depth	6 – 10 m depth
Moisture Content %	45.4	19.5	13.5

There is high presence of moisture content at depth 1 -2 m possibly due heavy rainfall and clay soils presence.

Plasticity Test

Sample	1 –2 m depth	6 m depth
	%	%
Liquid Limit %	64	34
Plastic limit %	39	25
Plasticity Index %	25	9
Linear Shrinkage %	19.5	5.0

From the Plasticity Chart for Soil Classification, the soil sample at Rove Water Treatment Facility Service Reservoir is medium compressible inorganic clay.

Specific Gravity

Sample	1 – 2 m depth	3 – 10 m depth
Specific Gravity (G_s)	2.66	2.57

Grain size distribution analysis

The results of the Particle Size Distribution is tabulated in Table 4.4 and presented in Graph 4.4

Sample	1-4 m depth	6 m depth
D_{10}	0.075	0.075
D_{60}	2.7	5.8
C_u	36	77
	Well graded	Well graded
D_{30}	0.72	1
C_c	3.6	2.3
	Uniform	Medium Graded

From the Particle Size Distribution graph in Annex 8.2 the soil between 1 – 2 m is 40 % medium to fine gravel, 40 % sand and 20 % clay, between 3 – 5 m is 52 % gravel, 30% sand and 18% clay. The soil is Gravelly sand y clay soil. The soil between 6 -10 m is 5 % gravel, 50 % sand and 45 % clay, which sandy clay soil.

4.8.4 Plate Loading Testing

As mentioned above, the plate loading test was done near the old reservoir tank foundation. The test was done after a heavy rainfall at night. The soil condition is clay cohesive soil. The test was done in spite of problem experienced during to slight drizzles during the test time.

4.8.4.1 Results

The result of the plate loading test were tabulated in Table 4.8 and graphed in Figure 4.8. The soil shows a steady increase as the load is applied. The Soil strength at the proposed site near the stream could be higher the clay soil tested. However ultimate bearing loading for the soil condition in Rove is 1.5 kg / cm^2 or 15 ton / m^2, the test was done upper part of the proposed site.

Table4.8: Tabulated Results of Plate Loading Test

Loads	Reading 1	Reading 2
kg/cm2	mm	mm
0.00	0.00	0.00
0.50	2.63	3.63
1.00	3.87	3.04
1.50	4.60	6.50
2.00	7.76	8.00
2.50	9.14	11.92

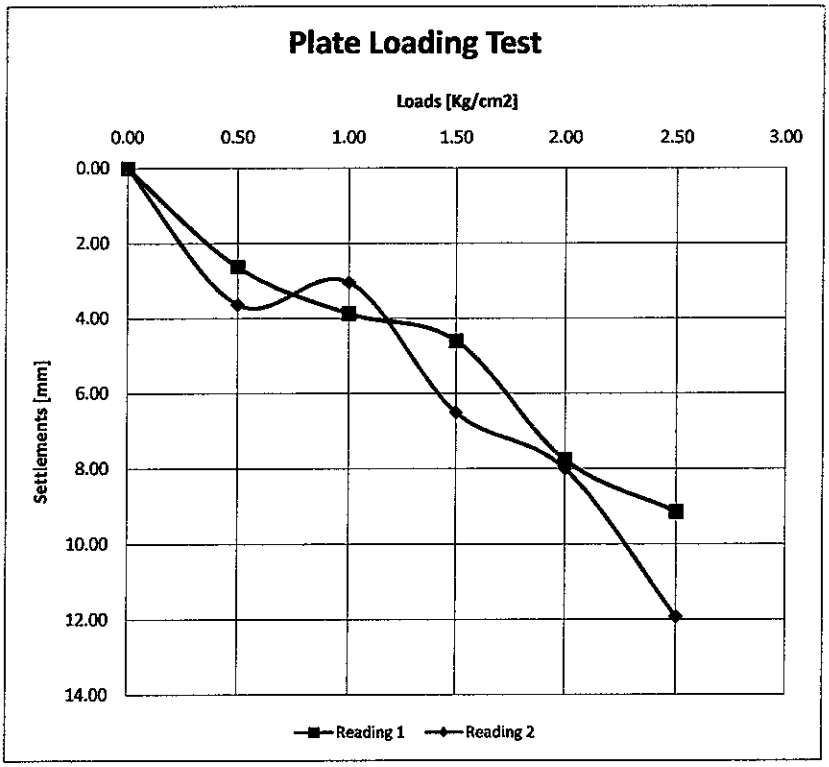


Figure 4.8: Plate loading Test for Proposed Rove Water Treatment Facility

4.8.4.2 Discussion

The test result shows that the ultimate bearing 15 ton / m^2. The site needs to be prepared to compact the soil sub-base level to improve the strength of the soil. The area that was proposed as the site for the proposed rove water treatment site is situated on the lower site from the test site. However, it needs to be compacted to accomplish the required strength.

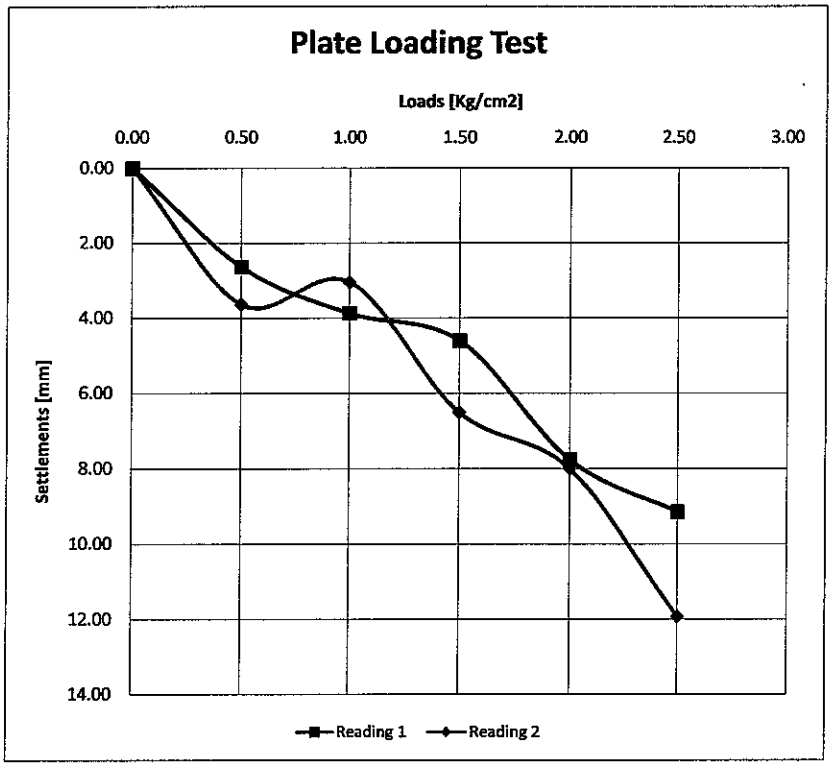


Figure 4.8: Plate loading Test for Proposed Rove Water Treatment Facility

4.8.4.2 Discussion

The test result shows that the ultimate bearing 15 ton / m^2. The site needs to be prepared to compact the soil sub-base level to improve the strength of the soil. The area that was proposed as the site for the proposed rove water treatment site is situated on the lower site from the test site. However, it needs to be compacted to accomplish the required strength.

5 Summary of Discussion

The results for laboratory test, drilling log and SPT were summaries in section 4 of this report.

The geology of immediate Honiara Area is mostly Honiara Reef Limestone. The area was associated with magnificent complex sequence of terraces ranging from 700m above to 100m below the sea level. The Mataniko area is consist of Mataniko Siltstones.

The soil classification for each of the sites shows is mostly coral gravel with various percentage amounts of clay and sand. The top soil mostly had a percentage of clay.

The soil condition at Tasahe, Kombito, Kongulai, and Tintinge can accommodate any footing design with the ultimate bearing capacity of 30 ton /m^2. The rest of the site had a ultimate bearing capacity of between 15 ton/m^2 and 25 ton/m^2 , therefore the compaction needs to be done to soil condition to improve the soil strength to accommodate the weight of the service reservoir.

6 Reference

1. **Hackman, B.D 1979** "Geology of the Honiara Area"
   Libra Press Limited, Hongkong
2. **Smith, G.N 1982** "Elements of Soil Mechanics for Civil and Mining Engineers"
   Collins Professional Books, London
3. **ASTM D 1194 – 1994** "Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footing"
   SAI Global Limited
4. **Vazirani V.N & Chandola, S.P 2001** "Civil Engineering Handbook"
   Khanna Publishers

5. **SAA 1998** "Australian Standards for Civil Engineering Students, Part 1: Materials and Testing"
   SAI Global Limited

Annex 1

Name of Project	**The improvement of Water Supply System Project**	**Borehole Number :**	**1**
Date Drilled:	26-Apr-08	**Location:**	Panatina Service Reservoir
Rig:	GEMCO 2106	**Elevation:**	70 m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level [m]	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Symbol	Symbol	Soil Description		Water Presents	Moisture Content %	Penetrometer N
				15	30	45				Lithology	Colour		10 30 50 70 90	10 20 30 40
0.0	70.0		S(30)	1	8	10	18	SC		Coral Clay	Black	Moist	⊗	⊗
1.0	69.0	D1	S(30)	11	12	11	23	GC		Well graded Coral Gravel	White	Dry	⊗	⊗
2.0	68.0	D2 B1	S(30)	13	9	8	17	GW		Well graded Coral Gravel	White	Dry	⊗	⊗
3.0	67.0	D3	S(30)	8	10	12	22	GW		Well graded Coral Gravel	White	Dry	⊗	⊗
4.0	66.0	D4 B2	S(30)	9	8	11	19	GW		Well graded Coral Gravel	White	Dry	⊗	⊗
5.0	65.0	D5	S(30)	8	8	8	16	GP		Poorly Graded Soft Coral Gravel	Brown	Moist	⊗	⊗
6.0	64.0	D6 B3	S(30)	9	6	7	13	GP		Poorly Graded Soft Coral Gravel	Brown	Moist	⊗	⊗
7.0	63.0	D7	S(30)	23	30		30	GW		Hard Coral Gravel	Brown	Moist	⊗	⊗
8.0	62.0							GW		Very Hard Coral Gravel	light Brown	Dry	⊗	⊗
9.0	61.0							GW		Very Hard Coral Gravel	light Brown	Dry		⊗
10.0	60.0							GW		Very Hard Coral Gravel	light Brown	Dry		⊗

REMARKS:
Coral started at 0.40 m
SPT at 8 m is bouncing
From 6.40 m good for diamond core drilling only, very hard coral experienced
At 7.00 m SPT hammer started bouncing at 30 cm
From 7.40 m hard drilling (coral) still no water circulation

Key:
D : Disturbed Sample
B : Bulk
W : Water
o : Core Recovery
S(30) : Standard Penetration Test
C(27) : Cone
(27) : No. Blows for 300mm Penetration
v : In-situ Vane Shear Test
U1/70 : Undisturbed Sample 100mm Dia
/70 : No. Of Blows to drive sample 450 mm
u-/70 : Undisturbed Sample - no recovery
S&A : Shell & Auger
DD :Rotary Diamond Drilled

Note:
This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

PS DL

Pacific Strata Drilling Limited

Borehole 1

Particle Size Distribution

Location: Panatina Service Reservior

Date: 30-Apr-08 **Analysed by:** Clifford Betokerah
Ministry of Infrastructure Developent

Method	Wet Seiving							
Total mass (g)	265	380	346	388	355	106	278	289
Depth of sampl	0	1	2	3	4	5	6	7
Seive	**Passing %**	**Passing %**	**Passing %**	**Passing %**	**Passing %**	**Passing %**	**Passing %**	**Passing %**
mm								
0.075	21.8	13.3	13.5	22.6	16.6	18.9	16.2	11.9
0.150	27.5	14.1	15.5	24.4	17.2	19.5	17.6	12.9
0.300	44.5	17.3	19.8	28.8	20.3	22.9	21.2	16.4
0.600	63.4	23.1	27.3	34.5	25.7	29.7	26.6	21.2
1.18	72.1	32.1	39.4	42.5	32.7	40.2	34.5	27.4
2.00	77	41.1	52.4	50.5	40	49.2	42.4	34
5.00	83.8	57.2	75.5	67	54.4	65.9	67.6	48.2
10.00	88.7	72.2	91.7	83.5	70.2	85.4	86.3	62.7
14.00	89.8	76.9	93.7	87.1	78.9	91.3	89.9	68.2
20.00	93.6	90.3	95.7	93	89.3	100	95.7	77.2
28.00	100	93.2	100	100	89.3		100	100
37.50		100			100			
50.00								
63.00								
75.00								
80.00								
90.00								
100.00								
200.00								

Annex 1.2

PARTICLE SIZE DISTRIBUTION

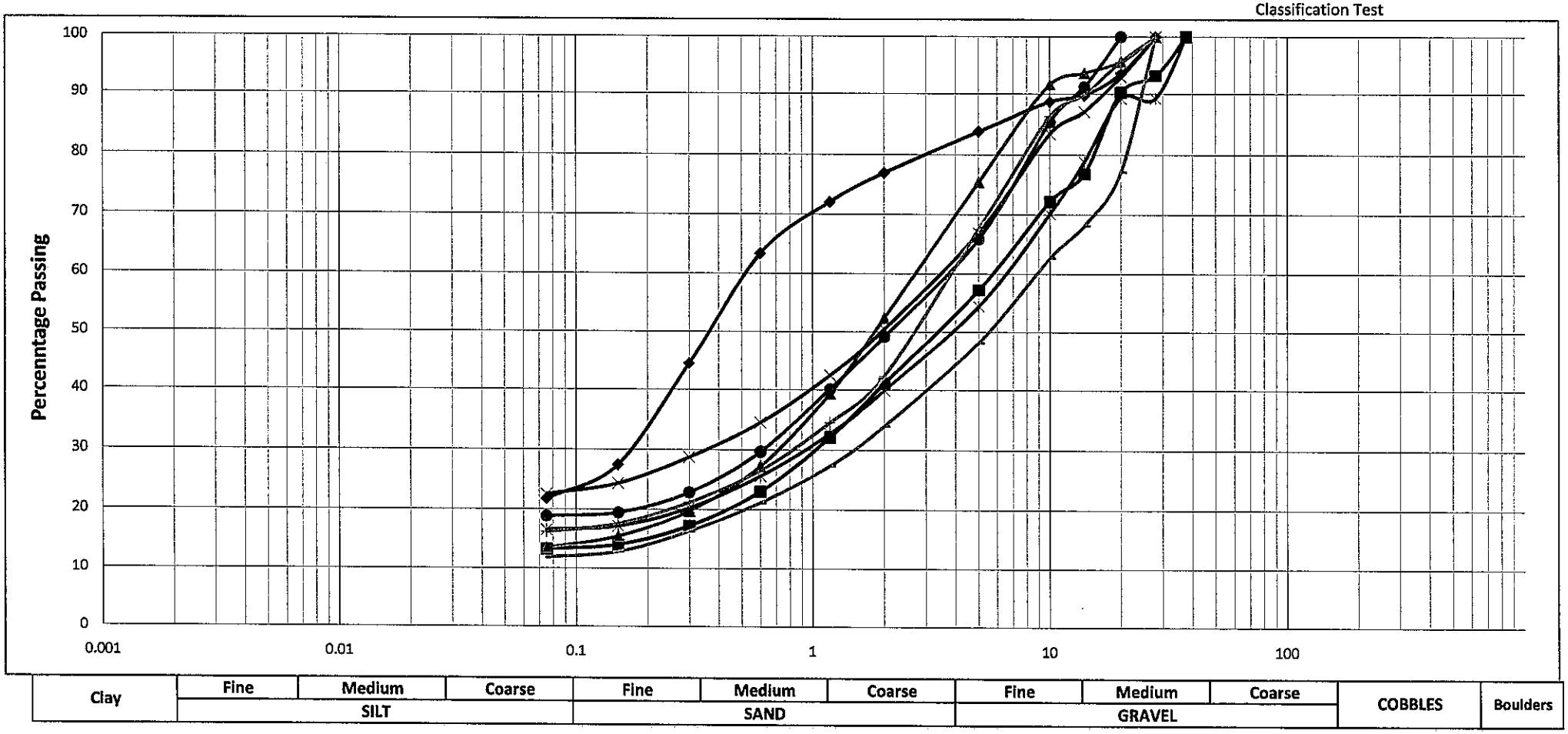
PS DL Pacific Strata Drilling Limited

Location : Panatina Service Reservoir

Date of Test : 20-May-2008

Borehole No: 1

Description : Particle Distribution Classification Test



PS Pacific Strata Drilling Limited

DL

Borehole Log

Annex 2

Name of Project	The improvement of Water Supply System Project	**Borehole Number :**	2
Date Drilled:	29-Apr-08	**Location:**	Tasahe Service Reservoir
Rig:	GEMCO 2106	**Elevation:**	140m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level (m)	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance N	Group Symbol	Symbol	Soil Description		Water Presents	Moisture Content	Penetrometer N
				15	30	45				Lithology	Colour		10 20 30 50 70 90	10 20 30 40
0.0	140.0							SC		Clay Topsoil	Black	dry		
1.0	139.0	D1	S(30)	4	6	15	21	GC		Clay Coral Gravel	Brown	moist	⊗	⊗
2.0	138.0	D2 B1	S(30)	8	16	11	27	GC		Clay Coral Gravel	Brown	moist	⊗	⊗
3.0	137.0	D3	S(30)	7	8	9	17	GC		Clay Coral Gravel	Brown	moist	⊗	⊗
4.0	136.0	D4 B2	S(30)	5	7	13	20	GC		Clay Coral Gravel	Brown	moist	⊗	⊗
5.0	135.0	D5	S(30)	8	8	13	21	SP		Poorly Granded Sandy Coral Gravel	Brown	moist	⊗	⊗
6.0	134.0	D6 B3	S(30)	8	6	8	14	SP		Poorly Granded Sandy Coral Gravel	Brown	moist		⊗
7.0	133.0	D7	S(30)	8	6	5	11	SP		Poorly Granded Sandy Coral Gravel	Brown	moist		⊗
8.0	132.0	D8 B4	S(30)	4	6	9	15	SP		Poorly Granded Sandy Coral Gravel	Brown	moist		⊗
9.0	131.0	D9	S(30)	6	6	6	12	SP		Poorly Granded Sandy Coral Gravel	Brown	moist		⊗
10.0	130.0	D10 B5	S(30)	10	13	11	24	SW		Firm Sandy Coral Gravel	Brown	moist	⊗	⊗

REMARKS: *Penetration test completed*

Key:
- D : Disturbed Sample
- B : Bulk
- W : Water
- o : Core Recovery
- S(30) : Standard Penetration Test
- C(27) : Cone
- (27) : No. Blows for 300mm Penetration
- v : In-situ Vane Shear Test
- U1/70 : Undisturbed Sample 100mm Dia
- /70 : No. Of Blows to drive sample 450 mm
- u-/70 : Undisturbed Sample - no recovery
- S&A : Shell & Auger
- DD : Rotary Diamond Drilled

Note: This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

Annex 2.1

PS DL **Pacific Strata Drilling Limited** **Borehole** **2**

Particle Size Distribution

Location: **Tasahe Service Reservior**

Date: **8-May-08** **Analysed by** **Clifford Betokerah**
Ministry of Infrastructure Developent

Method	Wet Seiving	
Total mass (g)	**1099**	**1010**
Depth of sample (m)	1-5 m	6 -10 m

Seive	Passing %	Passing %
mm		
0.075	23.5	25.4
0.150	24.7	28.2
0.300	28.3	33.5
0.600	33.8	40
1.18	40.8	47.1
2.00	48	54.2
5.00	67.3	79.9
10.00	81.6	91.9
14.00	88.5	97.6
20.00	96.2	98.5
28.00	100	100
37.50		
50.00		
63.00		
75.00		
80.00		
90.00		
100.00		
200.00		

Annex 2.2

PARTICLE SIZE DISTRIBUTION

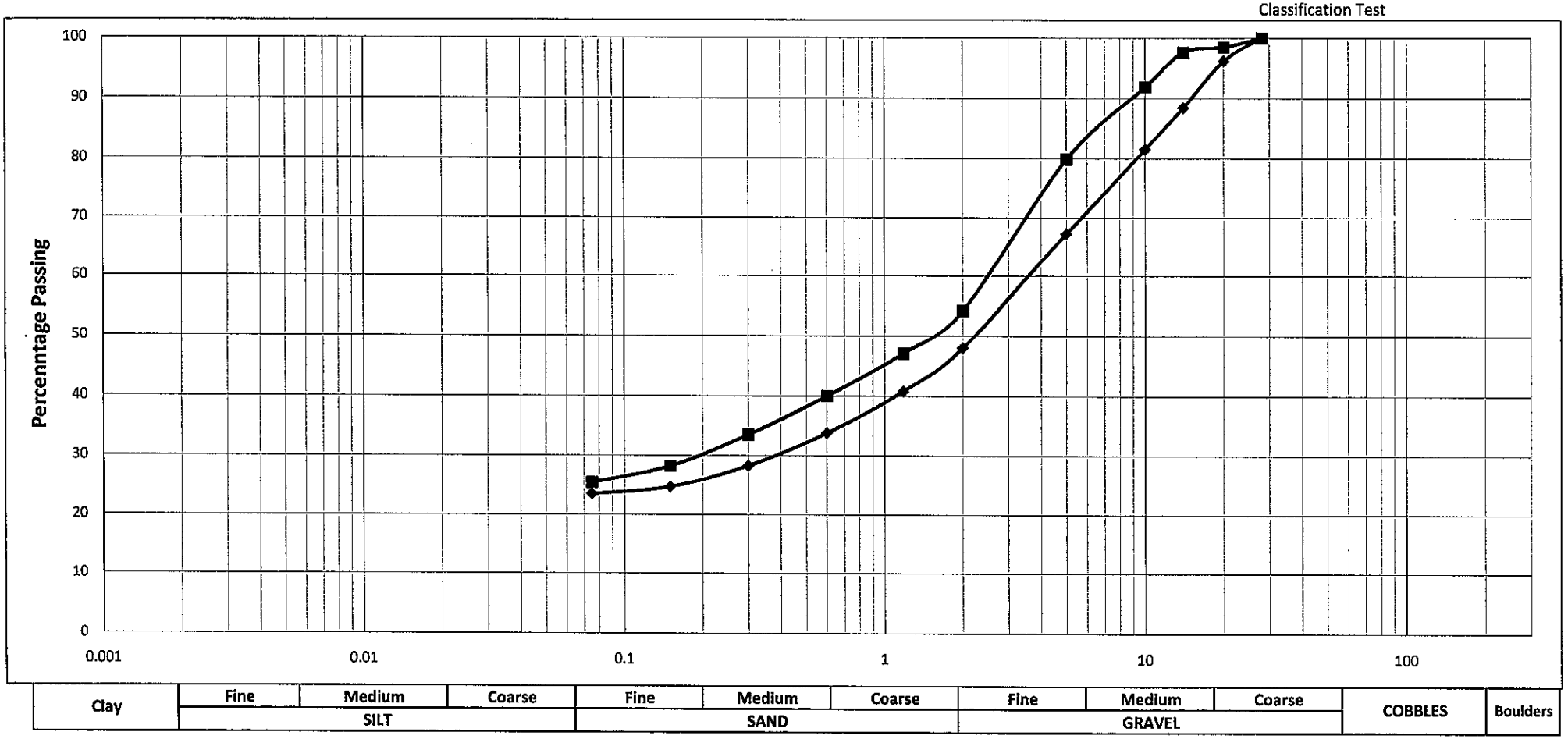
PS DL Pacific Strata Drilling Limited

Location : Tasahe Service Reservior

Date of Test : 30-April-2008

Borehole No: 2

Description : Particle Distribution Classification Test



Annex 3

Name of Project	**The improvement of Water Supply System Project**	**Borehole Number :**	**3**
Date Drilled:	1-May-08	**Location:**	Kogulai Water Treatment Facility
Rig:	GEMCO 2106	**Elevation:**	20m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level [m]	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Group Symbol	Symbol	Soil Description		Water Situation	Moisture Content	Penetrometer N
				15	30	45				Litthology	Colour			10 20 30 40
0.0	20.0							SC		Filled gravel	Gray			
1.0	19.0	D1	S(30)	3	4	3	7	SC		Fine Sandstone & Top soil	Black			⊗
2.0	18.0	D2	S(30)	2	4	7	11	GP		Clay Soil	Brown			⊗
3.0	17.0	D3	S(30)	1	2	4	6	GP		Clay Soil	Brown		⊗	⊗
4.0	16.0	D4	S(30)	6	3	2	5	GP		Clay Soil	Brown		⊗	⊗
5.0	15.0	D5	S(30)	5	5	8	13	GP		Clay Soil	Brown		⊗	⊗
6.0	14.0	D6	S(30)	10	8	20	28			Sandstone	Gray		⊗	⊗
7.0	13.0	D7	S(30)	2	3	6	9	GP		Clay Soil	Brown		⊗	⊗
8.0	12.0	D8	S(30)	9	10	8	18	GM		Coral Gravel	White		⊗	⊗
9.0	11.0	D9	S(30)	21	22	30	52	GM		Coral Gravel	White		⊗	⊗
10.0	10.0	D10	S(30)	27	29	30	59	GM		Coral Gravel	White		⊗	⊗

REMARKS: *Water circulation were lost at level 2 m, no bulk sample collected*

Water circulation started again at 7m but lost it again at 8 m

Key:

D : Disturbed Sample	S(30) : Standard Penetration Test	U1/70 : Undisturbed Sample 100mm Dia
B : Bulk	C(27) : Cone	/70 : No. Of Blows to drive sample 450 mm
W : Water	(27) : No. Blows for 300mm Penetration	u-/70 : Undisturbed Sample - no recovery
o : Core Recovery	v : In-situ Vane Shear Test	S&A : Shell & Auger
		DD :Rotary Diamond Drilled

Note:
This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

PS DL **Pacific Strata Drilling Limited** **Borehole** 3

Particle Size Distribution

Location: Kongulai Service Reservior

Date: 8-May-08 **Analysed by** Clifford Betokerah

Ministry of Infrastructure Development

Method	Wet Seiving		
Total mass (g)	717	227	694
Depth of sample (m)	3- 5 /7 m	6 m	8 - 10 m
Seive Size	Passing %	Passing %	Passing %
mm			
0.075	65.7	28.2	34.4
0.150	72	41.4	36
0.300	82.2	65.2	40.8
0.600	87.8	89	48.9
1.18	89.9	97.8	57.7
2.00	91.6	99.6	61.7
5.00	94.4	100	71.9
10.00	100		81.8
14.00			84.8
20.00			86.4
28.00			100
37.50			
50.00			
63.00			
75.00			
80.00			
90.00			
100.00			
200.00			

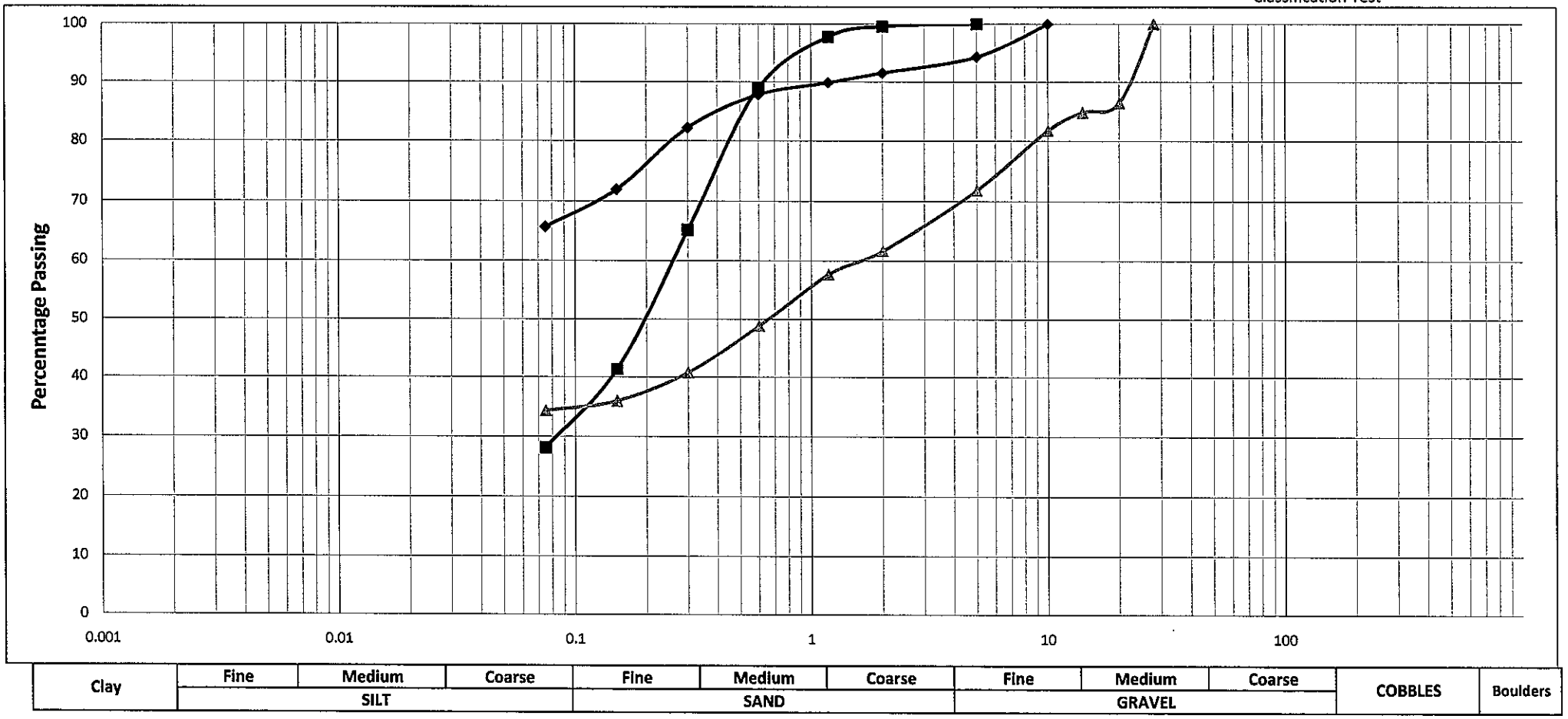
Annex 3.2

PARTICLE SIZE DISTRIBUTION

PS DL Pacific Strata Drilling Limited

Location : Kongulai Water Treatment Facility **Date of Test :** 30-April-2008

Borehole No: 3 **Description :** Particle Distribution Classification Test



Appendix 4

Name of Project	**The improvement of Water Supply System Project**	**Borehole Number :**	**4**
Date Drilled:	8-May-08	**Location:**	Kombito Water Treatment Facility
Rig:	GEMCO 210B	**Elevation:**	50m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level [m]	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Group Symbol	Symbol	Soil Description: Lithology	Soil Description: Colour	Water Presents	Moisture Content (10 30 50 70 90)	Penetrometer N (10 20 30 40)
				15	30	45								
0.0	50.0	PL						GW		Compacted Coral gravel	Light Brown	dry		
1.0	49.0	D1	S(30)	5	7	7	14	GC		Coral Gravel	Light Brown	dry	⊗	⊗
2.0	48.0	D2 B1	S(30)	2	2	2	4	GC		Coral Gravel with Clay	Brown	dry	⊗	⊗
3.0	47.0	D3	S(30)	3	4	6	10	GC		Coral Gravel with Clay	Brown	wet	⊗	⊗
4.0	46.0	D4 B2	S(30)	6	6	25	31	GC		Coral Gravel with Clay	Brown	wet	⊗	⊗
5.0	45.0	D5	S(30)	8	17	30	47	GC		Compacted Coral gravel clay	Light Brown	wet	⊗	⊗
6.0	44.0	D6 B3	S(30)	8	15	30	45	GC		Compacted Coral gravel clay	Light Brown	wet		⊗
7.0	43.0	D7	S(30)	10	6	7	13	GC		Coral Gravel with Clay	Light Brown	wet		⊗
8.0	42.0	D8 B4	S(30)	15	40	40	80	GW		Compacted Coral Gravel	Light Brown	wet		⊗
9.0	41.0	D9	S(30)	16	32	20	52	GW		Compacted Coral Gravel	Light Brown	wet		⊗
10.0	40.0	D10 B5	S(30)	10	9	40	49	GC		Compacted Coral gravel clay	Light Brown	wet	⊗	⊗

REMARKS: *Penetration test completed*

Hammer is bouncing up and down between 30cm - 45 cm at 8 m and 10 m level
Watertable level noted at 3 m level

Key:
D : Disturbed Sample
B : Bulk
W : Water
o : Core Recovery
PL: Plate Loading Test
S(30) : Standard Penetration Test
C(27) : Cone
(27) : No. Blows for 300mm Penetration
v : In-situ Vane Shear Test
U1/70 : Undisturbed Sample 100mm Dia
/70 : No. Of Blows to drive sample 450 mm
u-/70 : Undisturbed Sample - no recovery
S&A : Shell & Auger
DD : Rotary Diamond Drilled

Note:
This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

PS DL

Pacific Strata Drilling Limited

Borehole 4

Particle Size Distribution

Location: Kombito Water Treatment Facility

Date: 8-May-08 **Analysed by** Clifford Betokerah
Ministry of Infrastructure Developent

Method	Wet Seiving	
Total mass (g)	846	1460
Depth of sample (m)	1-4 m	5 -10 m
Seive	**Passing %**	**Passing %**
mm		
0.075	30.8	23.7
0.150	31.6	25.3
0.300	35.4	29.6
0.600	41.4	35.5
1.18	48.6	42.3
2.00	55.8	48.8
5.00	73.3	67.9
10.00	87.5	80.2
14.00	91.9	86.2
20.00	98.3	92.5
28.00	100	100
37.50		
50.00		
63.00		
75.00		
80.00		
90.00		
100.00		
200.00		

Annex 4.2

PARTICLE SIZE DISTRIBUTION

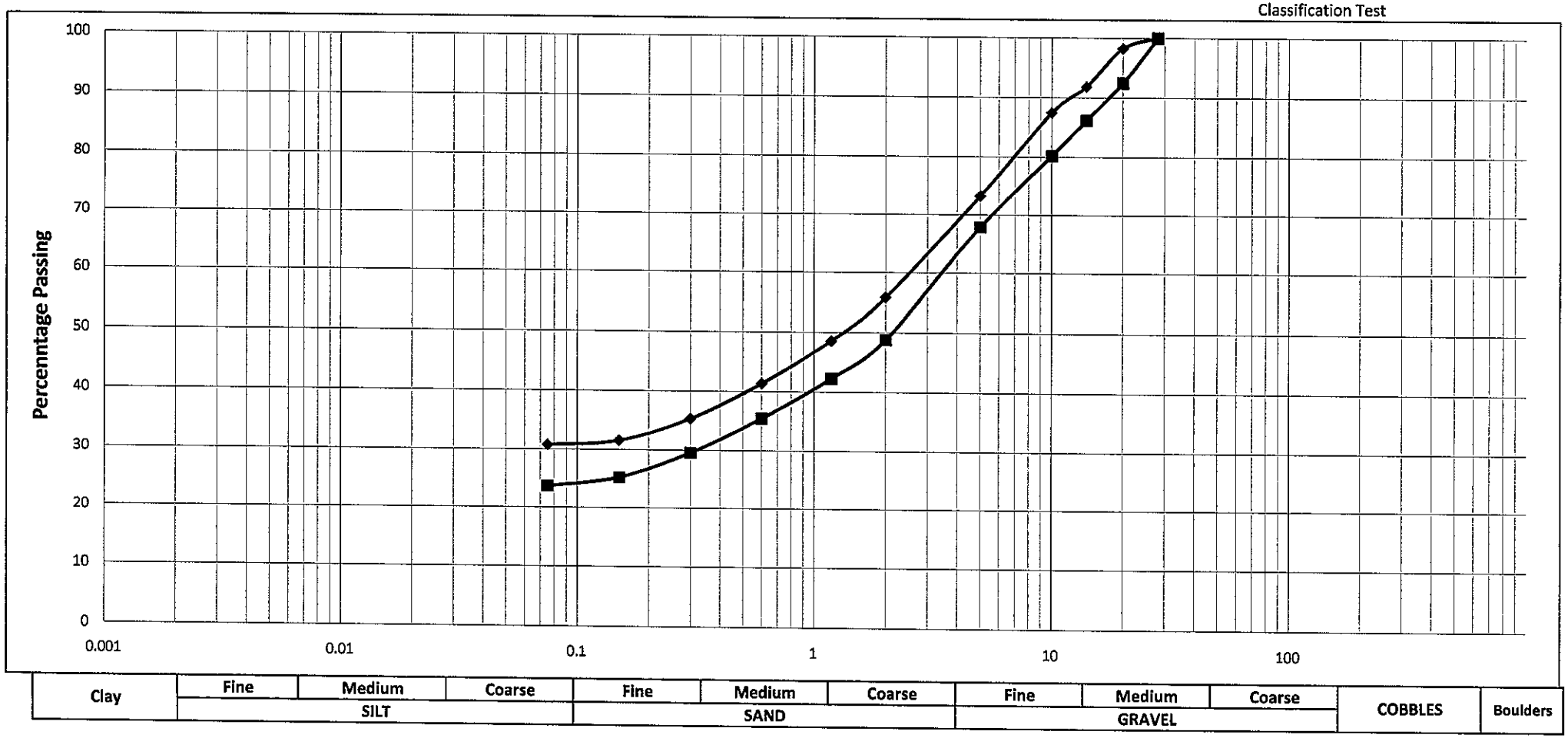
PS DL Pacific Strata Drilling Limited

Location : Kombito Water Treatment Facility

Date of Test : 30-April-2008

Borehole No: 4

Description : Particle Distribution Classification Test



PS Pacific Strata Drilling Limited

DL

Borehole Log

Annex 5

Name of Project	The improvement of Water Supply System Project	**Borehole Number :**	5
Date Drilled:	29-Apr-08	**Location:**	Lower Kola'a Service Reservoir
Rig:	GEMCO 2106	**Elevation:**	50 m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level [m]	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Group Symbol	Symbol	Soil Description		Water Presents	Moisture Content	Penetrometer
				15	30	45				Lithology	Colour		10 30 50 70 90	N 10 20 30 40
0.0	50.0							SC		Coral Gravel Clay	Brown			
1.0	49.0	D1	S(30)	18	22	30	52	GC		Clay Coral Gravel Sandstones	Brown		⊗	⊗
2.0	48.0	D2 B1	S(30)	27	30	30	60	GC		Massive Coral Sandstone	White		⊗	⊗
3.0	47.0	D3	S(30)	28	30	30	60	GC		Sandstone	Brown		⊗	⊗
4.0	46.0	D4 B2	S(30)	28	30	30	60	GC		Sandstone	Brown		⊗	⊗
5.0	45.0	D5	S(30)	20	30	30	60	SP		Sandstone	Brown		⊗	⊗
6.0	44.0	D6 B3	S(30)	30	30	30	60	SP		Sandstone	Brown		⊗	⊗
7.0	43.0	D7	S(30)	30	30	30	60	SP		Sandstone	Brown		⊗	⊗
8.0	42.0	D8 B4	S(30)	30	30	30	60	SP		Sandstone	Brown		⊗	⊗
9.0	41.0	D9	S(30)	30	30	30	60	SP		Sandstone	Brown		⊗	⊗
10.0	40.0	D10 B5	S(30)	30	30	30	60	SW		Sandstone	Brown		⊗	⊗

REMARKS: *Sandstone encountered at 3 m, easy to drill with rock bit, but hard to drive SPT through it*

Hammer bouncing up an down at 3 m - 10 m
SPT 30 means that the hammer is bouncing up and down otherwise specified

Key:
D : Disturbed Sample
B : Bulk
W : Water
o : Core Recovery
S(30) : Standard Penetration Test
C(27) : Cone
(27) : No. Blows for 300mm Penetration
v : In-situ Vane Shear Test
U1/70 : Undisturbed Sample 100mm Dia
/70 : No. Of Blows to drive sample 450 mm
u-/70 : Undisturbed Sample - no recovery
S&A : Shell & Auger
DD : Rotary Diamond Drilled

Note: This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

Annex 5.1

PS DL **Pacific Strata Drilling Limited** **Borehole** 5

Particle Size Distribution

Location: Proposed Lower West Kola'a Service Reservior

Date: 15-May-08 **Analysed by** Clifford Betokerah

Ministry of Infrastructure Development

Method	Wet Seiving	
Total mass (g)	323	1289
Depth of sample (m)	1-2 m	3 -10 m
Seive	**Passing %**	**Passing %**
mm		
0.075	17.7	35.1
0.150	18.6	40.6
0.300	22	55.7
0.600	25.7	65.9
1.18	29.7	71.3
2.00	34.3	75.3
5.00	43.9	82.2
10.00	55.1	88.3
14.00	59.7	92.4
20.00	77.2	96.7
28.00	100	100
37.50		
50.00		
63.00		
75.00		
80.00		
90.00		
100.00		
200.00		

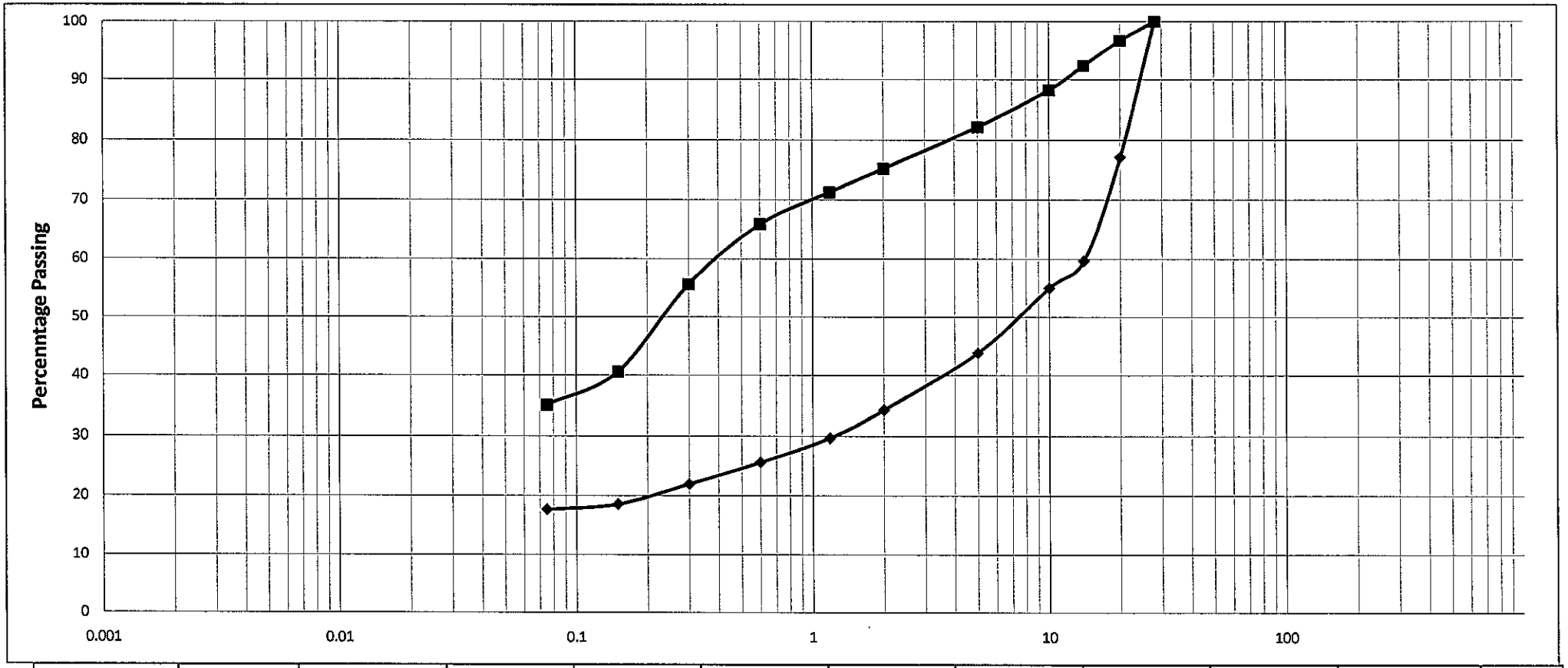
Annex 5.2

PARTICLE SIZE DISTRIBUTION

PS DL Pacific Strata Drilling Limited

Location : Lower West Kola'a Service Reservior **Date of Test :** 20-May-2008

Borehole No: 5 **Description :** Particle Distribution Classification Test



Name of Project	The improvement of Water Supply System Project	**Borehole Number :**	6
Date Drilled:	29-Apr-08	**Location:**	Skyline Service Reservoir
Rig:	GEMCO 210B	**Elevation:**	109.6 **m** asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level [m]	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Group Symbol	Symbol	Soil Description: Lithology	Soil Description: Colour	Water Presents	Moisture Content	Penetrometer N
				15	30	45							10 30 50 70 90	10 20 30 40
0.0	109.6							SC		Clay Coral Topsoil	Light Brown	moist		
1.0	108.6	D1	S(30)	7	9	11	20	GC		Clay Coral	Light Brown	Moist	⊗	⊗
2.0	107.6	D2 B1	S(30)	4	6	14	20	GC		Clay Coral	Light Brown	Moist	⊗	⊗
3.0	106.6	D3	S(30)	7	12	13	25	GC		Clay Coral	Light Brown	Moist	⊗	⊗
4.0	105.6	D4 B2	S(30)	7	10	12	22	GC		Clay Coral	Light Brown	Moist	⊗	⊗
5.0	104.6	D5	S(30)	7	7	11	18	GC		Clay Coral	Light Brown	Moist	⊗	⊗
6.0	103.6	D6 B3	S(30)	10	9	12	21	GC		Clay Coral	Light Brown	Moist	⊗	⊗
7.0	102.6	D7	S(30)	15	9	10	19	GC		Loosely graded Clay Coral	Light Brown	Moist	⊗	⊗
8.0	101.6	D8 B4	S(30)	9	8	7	15	GC		Loosely graded Clay Coral	Light Brown	Moist	⊗	⊗
9.0	100.6	D9	S(30)	11	13	14	27	GC		Loosely graded Clay Coral	Light Brown	Moist	⊗	⊗
10.0	99.6	D10 B5	S(30)	9	10	9	19	GC		Loosely graded Clay Coral	Light Brown	Moist	⊗	⊗

REMARKS: *Penetration test completed*

Key:	D : Disturbed Sample	S(30) : Standard Penetration Test	U1/70 : Undisturbed Sample 100mm Dia
	B : Bulk	C(27) : Cone	/70 : No. Of Blows to drive sample 450 mm
	W : Water	(27) : No. Blows for 300mm Penetration	u-/70 : Undisturbed Sample - no recovery
	o : Core Recovery	v : In-situ Vane Shear Test	S&A : Shell & Auger
			DD :Rotary Diamond Drilled

Note: This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

Annex 6.1

PS DL **Pacific Strata Drilling Limited**

Borehole 6

Particle Size Distribution

Location: Skyline Service Reservior

Date: 15-May-08 **Analysed by** Clifford Betokerah

Ministry of Infrastructure Development

Method	Wet Seiving	
Total mass (g)	1091	1414
Depth of sample (m)	1-5m	6 -10 m
Seive	**Passing %**	**Passing %**
mm		
0.075	25.5	24.4
0.150	26.4	25.6
0.300	29.3	28.9
0.600	33.5	34
1.18	38.6	40.6
2.00	44	48
5.00	56.4	78.6
10.00	71.4	93.3
14.00	78.8	96.6
20.00	88.9	100
28.00	95	
37.50	100	
50.00		
63.00		
75.00		
80.00		
90.00		
100.00		
200.00		

Annex 6.2

PARTICLE SIZE DISTRIBUTION

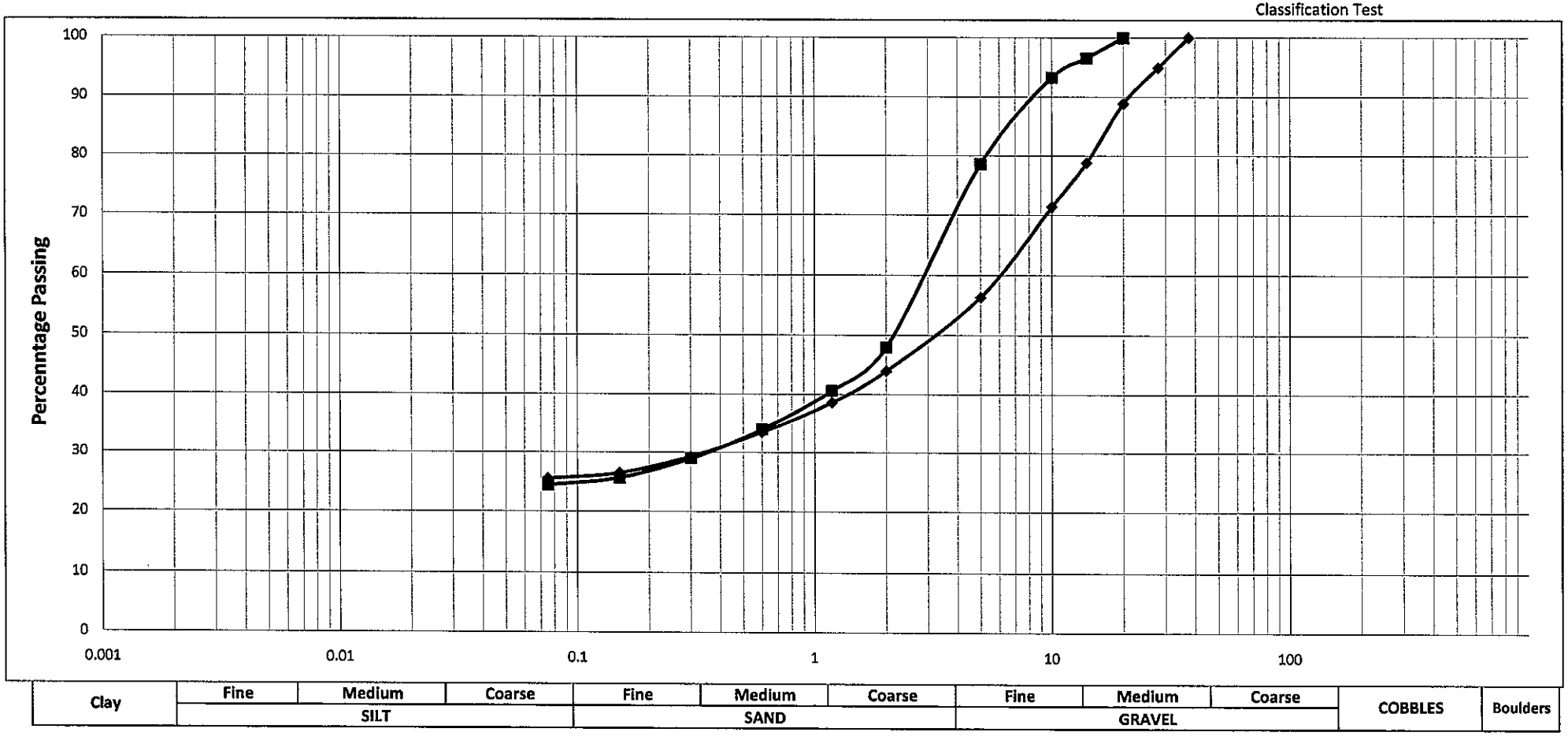
PS DL Pacific Strata Drilling Limited

Location : Skyline Service Reservior

Date of Test : 20-May-2008

Borehole No: 6

Description : Particle Distribution Classification Test



Annex 7

Name of Project	**The improvement of Water Supply System Project**	**Borehole Number :**	**7**
Date Drilled:	15-May-08	**Location:**	Tintinge Service Reservior
Rig:	GEMCO 210B	**Elevation:**	200m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level [m]	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Group Symbol	Symbol	Soil Description		Water present	Moisture Content	Penetrometer N
				15	30	45				Lithology	Colour		10 30 50 70 90	10 20 30 40
0.0	200.0							GW		Coral & Top soil	Black	Dry		
1.0	199.0	D1	S(30)	9	11	11	22	GC		Coral Gravel	Light Brown	Dry	⊗	⊗
2.0	198.0	D2 B1	S(30)	15	17	30	47	GC		Coral Sand	Light Brown	Moist	⊗	⊗
3.0	197.0	D3	S(30)	15	12	13	25	GC		Coral Sand	Light Brown	Moist	⊗	⊗
4.0	196.0	D4 B2	S(30)	11	5	6	11	GC		Coral Gravel with Clay	Light Brown	Moist	⊗	⊗
5.0	195.0	D5	S(30)	2	1	1	2	GC		Loose Coral Sand	Light Brown	Wet	⊗	⊗
6.0	194.0	D6 B3	S(30)	2	1	1	2	GC		Loose Coral Sand	Light Brown	Wet	⊗	⊗
7.0	193.0	D7	S(30)	11	12	13	25	GC		Loose Coral Sand	Light Brown	Wet	⊗	⊗
8.0	192.0	D8 B4	S(30)	14	10	12	22	GW		Coral Sand	Light Brown	Wet	⊗	⊗
9.0	191.0	D9	S(30)	22	14	23	37	GW		Coral Sand	Light Brown	Moist	⊗	⊗
10.0	190.0	D10 B5	S(30)	16	15	22	37	GC		Coral Sand	Light Brown	Moist	⊗	⊗

REMARKS: *Penetration test completed*

Key:
D : Disturbed Sample
B : Bulk
W : Water
o : Core Recovery

S(30) : Standard Penetration Test
C(27) : Cone
(27) : No. Blows for 300mm Penetration
v : In-situ Vane Shear Test

U1/70 : Undisturbed Sample 100mm Dia
/70 : No. Of Blows to drive sample 450 mm
u-/70 : Undisturbed Sample - no recovery
S&A : Shell & Auger
DD :Rotary Diamond Drilled

Note: This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

Annex 7.1

PS DL Pacific Strata Drilling Limited — Borehole **7**

Particle Size Distribution

Location: Proposed Tintinge Service Reservior

Date: 20-May-08 Analysed by Clifford Betokerah

Ministry of Infrastructure Development

Method	Wet Seiving	
Total mass (g)	1102	682
Depth of sample (m)	1-5m	6 -10 m
Seive	**Passing %**	**Passing %**
mm		
0.075	19.8	21.3
0.150	20.6	23.4
0.300	24	28.8
0.600	29	35.3
1.18	35.1	42.5
2.00	42.2	50.9
5.00	65.9	74.2
10.00	79.8	87.3
14.00	87.7	91.6
20.00	94.8	96.2
28.00	100	100
37.50		
50.00		
63.00		
75.00		
80.00		
90.00		
100.00		
200.00		

Annex 7.2

PARTICLE SIZE DISTRIBUTION

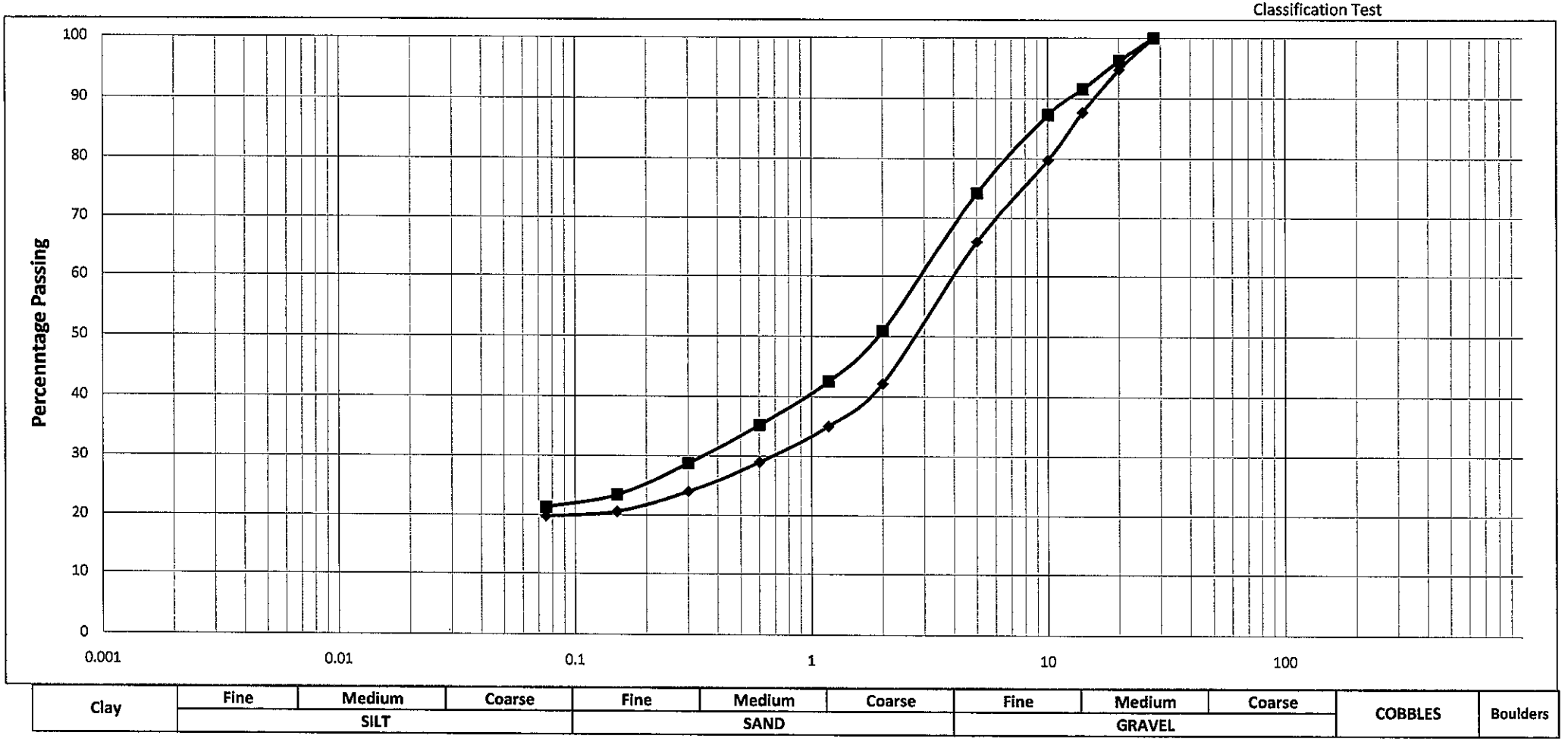
PS DL Pacific Strata Drilling Limited

Location : Tintinge Service Reservior

Date of Test : 20-May-2008

Borehole No: 7

Description : Particle Distribution Classification Test



A9-64

Name of Project	**The improvement of Water Supply System Project**	**Borehole Number :**	**8**
Date Drilled:	16-May-08	**Location:**	**Rove Water Treatment Facility**
Rig:	GEMCO 210B	**Elevation:**	30 m asl
Contractor:	Pacific Strata Drilling	**Operator:**	John
Bit Type	3.5" Rock Bit	**Ground Level:**	

Depth (m)	Level (m)	Sample Type	Standard Penetration Test	Number of Blows at each 15 cm			Penetration Resistance "N"	Group Symbol	Symbol	Soil Description		Water Presents	Moisture Content %	Penetrometer N
				15	30	45				Lithology	Colour		10 30 50 70 90	10 20 30 40
0.0	30.0							GW		Compacted Coral gravel	Brown	moist		
1.0	29.0	D1	S(30)	2	3	4	7	GC		Coral Gravel	Brown	moist	⊗	⊗
2.0	28.0	D2 B1	S(30)	3	4	6	10	GC		Coral Gravel with Clay	Dark brown	moist	⊗	⊗
3.0	27.0	D3	S(30)	2	3	8	11	GC		Coral Gravel with Clay	Brown	moist	⊗	⊗
4.0	26.0	D4 B2	S(30)	8	9	7	16	GC		Coral Gravel with Clay	Brown	wet	⊗	⊗
5.0	25.0	D5	S(30)	4	9	18	27	GC		Compacted Coral gravel clay	Brown	wet	⊗	⊗
6.0	24.0	D6 B3	S(30)	4	8	10	18	GC		Compacted Coral gravel clay	Light Brown	moist	⊗	⊗
7.0	23.0	D7	S(30)	30				GC		Coral Gravel with Clay	Light Brown	moist	⊗	⊗
8.0	22.0	D8 B4	S(30)	13	26	33	59	GW		Compacted Coral Gravel	Brown	moist	⊗	⊗
9.0	21.0	D9	S(30)	22	4	3	7	GW		Compacted Coral Gravel	Brown	wet	⊗	⊗
10.0	20.0	D10 B5	S(30)	30				GC		Compacted Coral gravel clay	Brown	wet	⊗	⊗

REMARKS: *Rock encountered at 7 m. SPT tube could not be driven further into rock (no SPT core sample collected)*

Hammer is bouncing up and down at 7 m and 10 m

Key:
- D : Disturbed Sample
- B : Bulk
- W : Water
- o : Core Recovery
- S(30) : Standard Penetration Test
- C(27) : Cone
- (27) : No. Blows for 300mm Penetration
- v : In-situ Vane Shear Test
- U1/70 : Undisturbed Sample 100mm Dia
- /70 : No. Of Blows to drive sample 450 mm
- u-/70 : Undisturbed Sample - no recovery
- S&A : Shell & Auger
- DD : Rotary Diamond Drilled

Note: This borehole log has been prepared for the purpose of Geotechnical Purpose and does not neccesarily contain information suitable for an a environmental assessment of the subsurface condition

PS DL **Pacific Strata Drilling Limited**

Particle Size Distribution

Borehole 8

Location: Proposed Rove Water Treatment Facility

Date: 20-May-08 **Analysed by** Clifford Betokerah

Ministry of Infrastructure Developent

Method	**Wet Seiving**		
Total mass (g)	**607**	**524**	**381**
Depth of sample (n	1-2 m	3-5 m	6 - 10 m

Seive	Passing %	Passing %	Passing %
mm			
0.075	21.9	16.6	44.3
0.150	22.7	18.1	48.2
0.300	26.2	22.1	61.6
0.600	31.8	27.4	79.5
1.18	38.6	32.9	89.5
2.00	46.2	38.4	92.4
5.00	64.2	52.1	95.3
10.00	72.6	66.4	98.2
14.00	75.6	75.6	100
20.00	88.3	85.9	
28.00	94.2	96.2	
37.50	100	100	
50.00			
63.00			
75.00			
80.00			
90.00			
100.00			
200.00			

Annex 8.2

PARTICLE SIZE DISTRIBUTION

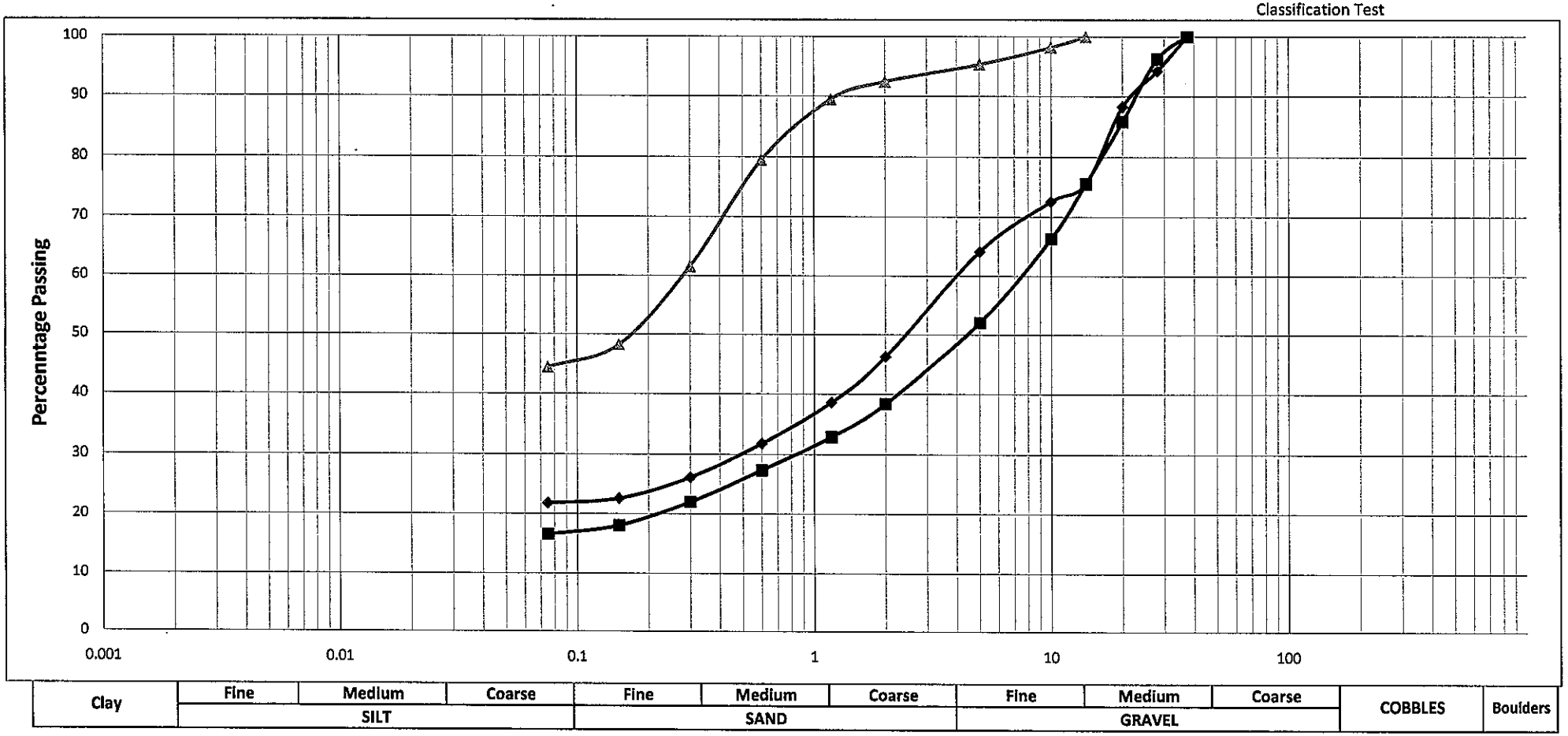
PS DL Pacific Strata Drilling Limited

Location : Rove Water Treatment Facility

Date of Test : 20-May-2008

Borehole No: 8

Description : Particle Distribution Classification Test

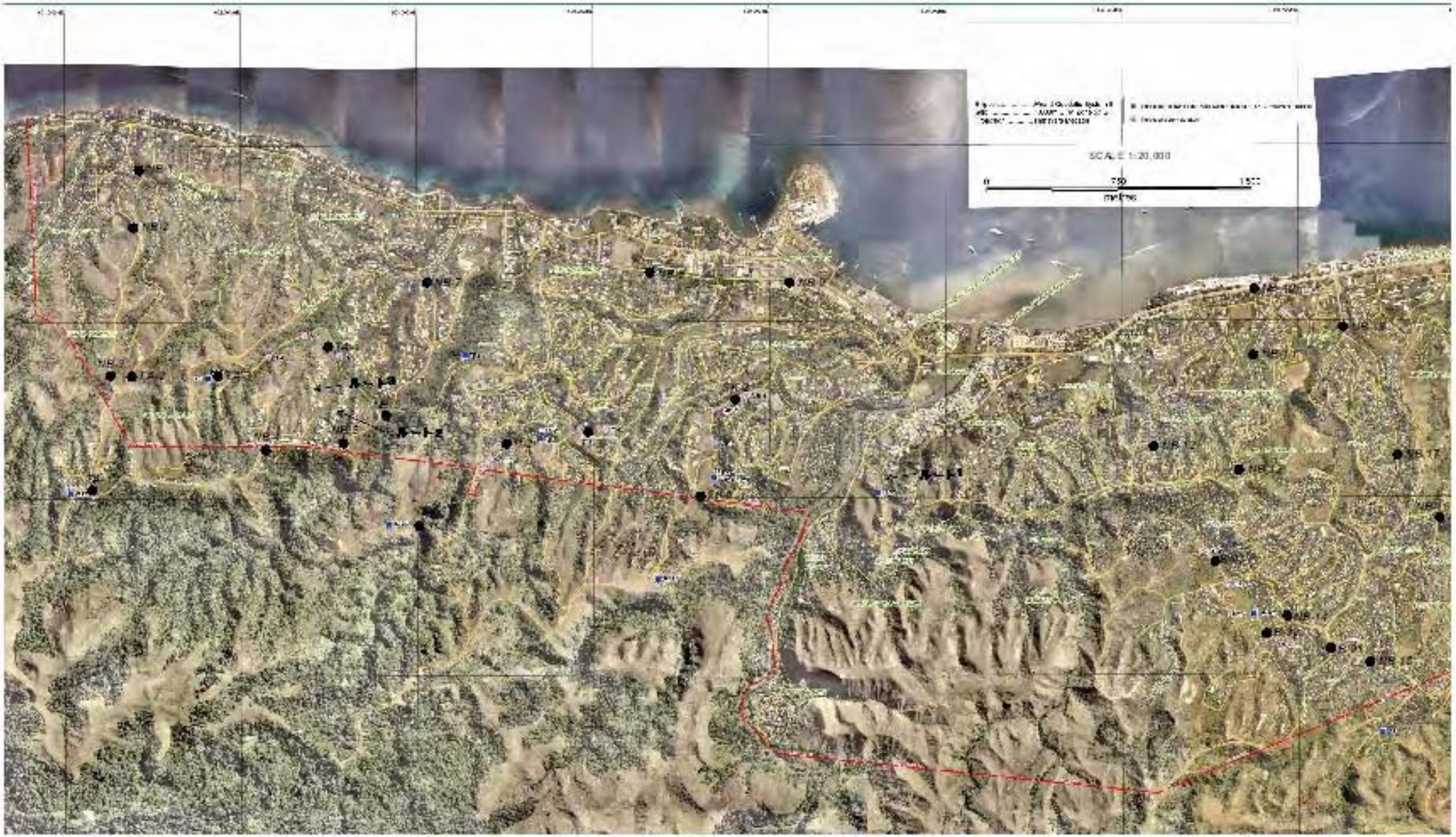


Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	Boulders
	SILT			SAND			GRAVEL				

A9-67

Appendix – 10

Test Pit Survey for Pipe Route



A10-1


NB-20
NB-21
LEGEND
TA-1 ~ TA-4 : CONVEYANS AND TRANSMISSION PIPELINE (WELLS TO TASAHE RESERVOIR)
TI-1 ~ TI-4 : CONVEYANS AND TRANSMISSION PIPELINE (WELLS TO TITINGE RESERVOIR)
SK-1, SK-2 : CONVEYANS AND TRANSMISSION PIPELINE (WELLS TO SKYLINE RESERVOIR)
B-01 ~ B-03 : CONVEYANS AND TRANSMISSION PIPELINE (WELLS TO BORDERLINE RESERVOIR)
NB-1 ~ NB-21 : DISTRIBUTION MAIN PIPELINE

(1) Result of test pit survey in Honiara

1) Intake and transmisson pipe route	Location			
Borahore～Tasahe reservoir	TA-1 Clay	TA-2 Sandy clay	TA-3 Clay	TA-4 Clay
				
Borehole～Titnge reservoir	TI-1 Clay with coral gravel	TI-2 Clay	TI-3 Clay with coral gravel	
				
Borehole～Skyline reservoir	SK-1 Clay with coral gravel	SK-2 Clay		
				
Borehole～Borderline reservoir	BO-1 Clay with coral gravel	BO-2 Clay with coral gravel	BO-3 Clay	
				

2) Distribution pipe route	Location		
West side of Honiara	NB-1 Clay with coral gravel	NB-2 Sandy soil	NB-3 Clay with coral gravel
			
	NB-4 Clay with coral gravel	NB-5 Clay with coral gravel	NB-6 Clay
			
	NB-7 Clay with coral gravel	NB-8 Clay with coral gravel	NB-9 Clay with coral gravel
			

2) Distribution pipe route	Location		
Center of Honiara	NB-10	NB-11	NB-12
	Clay	Clay	Sandy soil
			
	NB-13	NB-14	NB-15
	Clay with coral gravel	Sandy soil	Clay with coral gravel
			
	NB-16	NB-17	NB-18
	Sandy soil	Clay	Sandy soil
			
East side of Honiara	NB-19	NB-20	NB-21
	Clay	Clay	Clay
			

(2) Outcrops of rock in pipe route in Honiara

Outcrops of rock in pipe route in Honiara	Route-1		Route-2	
	Acess road around Lower west kolaa reservoir		Distribution pipe (1)	
				
	Route-3	Acess road around Konglai Settling Basin		
	Distribution pipe (2)			
				

(3) Test pit survey in Auki city

1) Intake pipe route	Location	
Borehole～High level reservoir	AB-1	AB-2
	Clay with coral gravel	Clay
		

Appendix – 11

Result of Water Quality Survey

1. Method for surveying water source quality

Some sample was taken from each water source and measured with official and simplified analysis. Simplified analysis methods are shown in Fig 8-1. Official analysis methods shall be referred to 2.Resurt of water analysis.

Fig 8-1 Simplified analysis methods

Item	Methods	Measurable low value
Water temp.	With alcohol thermometer	0.1(℃)
Turbidity	Turbid metric analysis	0.5(°)
Color	Colorimetry	2(°)
pH	Electrode analysis	0.1(-)
Conductivity	Electrode analysis	10(μs/cm)
NO_3-N	Colorimetry with reduction of naphtyl-ethylenediameine (PACKTEST)	0.2(mg/l)
NH^4-N	Colorimetry with indophenol-blue (PACKTEST)	0.1(mg/l)
Manganese	Colorimetry with potassium periodate (PACKTEST)	0.5(mg/l)
Chromium	Colorimetry with diphenylcarbazide(PACKTEST)	0.05(mg/l)
Chlorine demand	Based on standard methods for the examination of water	-
Coli from bacteria	Simplified analysis paper	-

The relation between planned water source and sampling point is shown in Fig 8-2. Because trial boring are not to be done on this survey, so instead of four new borehole, white river 1, white river 2, konbito borehole, and mataniko borehole are analyzed for substitution.

Fig 8-2 Relation between planned water source and sampling points

	Planned water source	Sampling points
Water source	Konglai spring	Konglai spring
	Rove spring	Rove spring
	Konbito spring	Konbito spring
	Tasahe new borehole	White river borehole 1
	Titinge new borehole	White river borehole 2
	Skyline new borehole	Mataniko borehole
	Borderline new borehole	Konbito borehole

2. Result of water analysis (Official methods)

Chugai Technos Corporation
Kanto environmental technical center
2-2-16 Ohnodai Midori Ward
Chiba City Chiba Prefecture
Tel +81-43-295-1101

Messrs. Yachiyo Engineering Co., Ltd.

Date of Reporting; May 30,2008
Report No. E081172
Receipt No. G08-01459

CERTIFICATE of Water Analysis Results

The Basic Design Study on the Project

for Improvement of Water Supply System

in Honiara and Provincial Centers in the Solomon Islands

(Client;JICA STUDY TEAM)

2. Result of water analysis

Page; 2/8

Location of Sample; ① KONGLAI

Date of Sampling; April 19,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	1.3	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	200	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	170	2.5	Titration Method
4	Total Coliforms	MPN/100mL	23	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	0.9	0.5	Titration Method
6	Magnesium	mg/L	2.3	0.01	ICP Method
7	Calcium	mg/L	68	0.01	ICP Method
8	Fluorine	mg/L	ND	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	1.5	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	0.26	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	0.07	0.01	UV Method
12	Sulfate Ion	mg/L	1.2	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	ND	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.11	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	ND	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	ND	0.001	AA Method
25	Selenium	mg/L	ND	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	ND	0.01	ICP Method

This sample was brought from Messrs. Yachiyo Engineering Co., Ltd to our laboratory ,and analyzed.

※All methods are based on standard method for examination of water.

ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

Location of Sample; ②ROVE

Date of Sampling; April 19,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	ND	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	300	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	230	2.5	Titration Method
4	Total Coliforms	MPN/100mL	3	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	ND	0.5	Titration Method
6	Magnesium	mg/L	4.0	0.01	ICP Method
7	Calcium	mg/L	96	0.01	ICP Method
8	Fluorine	mg/L	0.08	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	4.0	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	1.1	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	0.03	0.01	UV Method
12	Sulfate Ion	mg/L	3.6	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	ND	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.03	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	0.002	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	ND	0.001	AA Method
25	Selenium	mg/L	ND	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	ND	0.01	ICP Method

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ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

Location of Sample; ③KONBITO

Date of Sampling; April 19,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	9.9	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	220	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	180	2.5	Titration Method
4	Total Coliforms	MPN/100mL	6	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	1.4	0.5	Titration Method
6	Magnesium	mg/L	4.1	0.01	ICP Method
7	Calcium	mg/L	69	0.01	ICP Method
8	Fluorine	mg/L	ND	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	2.0	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	0.33	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	0.06	0.01	UV Method
12	Sulfate Ion	mg/L	0.8	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	0.02	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.70	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	0.002	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	ND	0.001	AA Method
25	Selenium	mg/L	0.002	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	ND	0.01	ICP Method

This sample was brought from Messrs. Yachiyo Engineering Co., Ltd to our laboratory ,and analyzed.

※All methods are based on standard method for examination of water.

ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

Location of Sample; ④WHITE RIVER BH1

Date of Sampling; April 18,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	ND	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	330	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	240	2.5	Titration Method
4	Total Coliforms	MPN/100mL	ND	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	ND	0.5	Titration Method
6	Magnesium	mg/L	8.2	0.01	ICP Method
7	Calcium	mg/L	87	0.01	ICP Method
8	Fluorine	mg/L	0.13	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	2.7	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	ND	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	ND	0.01	UV Method
12	Sulfate Ion	mg/L	10	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	ND	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.12	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	ND	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	ND	0.001	AA Method
25	Selenium	mg/L	ND	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	ND	0.01	ICP Method

This sample was brought from Messrs. Yachiyo Engineering Co., Ltd to our laboratory ,and analyzed.

※All methods are based on standard method for examination of water.

ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

Location of Sample; ⑤WHITE RIVER BH2

Date of Sampling; April 18,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	ND	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	310	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	250	2.5	Titration Method
4	Total Coliforms	MPN/100mL	ND	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	ND	0.5	Titration Method
6	Magnesium	mg/L	13	0.01	ICP Method
7	Calcium	mg/L	74	0.01	ICP Method
8	Fluorine	mg/L	0.23	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	1.6	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	0.06	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	0.03	0.01	UV Method
12	Sulfate Ion	mg/L	6.1	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	ND	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.12	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	0.001	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	ND	0.001	AA Method
25	Selenium	mg/L	ND	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	0.02	0.01	ICP Method

This sample was brought from Messrs. Yachiyo Engineering Co., Ltd to our laboratory ,and analyzed.

※All methods are based on standard method for examination of water.

ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

Location of Sample; ⑥KONBITO BH

Date of Sampling; April 18,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	ND	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	370	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	230	2.5	Titration Method
4	Total Coliforms	MPN/100mL	1	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	ND	0.5	Titration Method
6	Magnesium	mg/L	4.3	0.01	ICP Method
7	Calcium	mg/L	100	0.01	ICP Method
8	Fluorine	mg/L	0.09	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	13	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	0.34	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	0.04	0.01	UV Method
12	Sulfate Ion	mg/L	5.9	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	ND	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.01	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	0.003	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	ND	0.001	AA Method
25	Selenium	mg/L	ND	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	0.01	0.01	ICP Method

This sample was brought from Messrs. Yachiyo Engineering Co., Ltd to our laboratory ,and analyzed.

※All methods are based on standard method for examination of water.

ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

Location of Sample; ⑦MATANIKO BH

Date of Sampling; April 18,2008

Sl.No.	Parameter	Unit	Measured Value	Limit value for analysis	Method
1	Suspended Solids	mg/L	ND	0.5	Gravimetric Analysis Method
2	Total Dissolved Solids	mg/L	290	10	Gravimetric Analysis Method
3	Alkalinity (pH4.8)	mg/L	200	2.5	Titration Method
4	Total Coliforms	MPN/100mL	ND	1	Most Probable Number Method
5	Chemical Oxygen Demand	mg/L	0.5	0.5	Titration Method
6	Magnesium	mg/L	22	0.01	ICP Method
7	Calcium	mg/L	53	0.01	ICP Method
8	Fluorine	mg/L	0.40	0.05	Ion Chromatography Method
9	Chloride Ion	mg/L	8.3	0.05	Ion Chromatography Method
10	Nitrogen Nitrate	mg/L	0.07	0.02	Ion Chromatography Method
11	Phosphate Ion	mg/L	0.11	0.01	UV Method
12	Sulfate Ion	mg/L	9.3	0.2	Ion Chromatography Method
13	Cyanide	mg/L	ND	0.01	UV Method
14	Nitrogen Ammonia	mg/L	ND	0.05	UV Method
15	Manganese	mg/L	0.02	0.01	ICP Method
16	Molybdenum	mg/L	ND	0.005	ICP Method
17	Iron	mg/L	0.09	0.01	ICP Method
18	Nickel	mg/L	ND	0.002	ICP Method
19	Zinc	mg/L	0.003	0.001	ICP Method
20	Barium	mg/L	ND	0.05	ICP Method
21	Lead	mg/L	ND	0.001	ICP Method
22	Chromium	mg/L	ND	0.005	ICP Method
23	Copper	mg/L	ND	0.01	ICP Method
24	Arsenic	mg/L	0.001	0.001	AA Method
25	Selenium	mg/L	ND	0.001	AA Method
26	Cadmium	mg/L	ND	0.0005	ICP Method
27	Total Mercury	mg/L	ND	0.00005	AA Method
28	Boron	mg/L	0.02	0.01	ICP Method

This sample was brought from Messrs. Yachiyo Engineering Co., Ltd to our laboratory ,and analyzed.

※All methods are based on standard method for examination of water.

ND:Denotes"Not Detectable"

Environmental Certified Public Measurers.

Yuji Tanaka Sig. Yuji Tanaka

Person in analysis charge.

Hidenori Inoue Sig. Hidenori Inoue

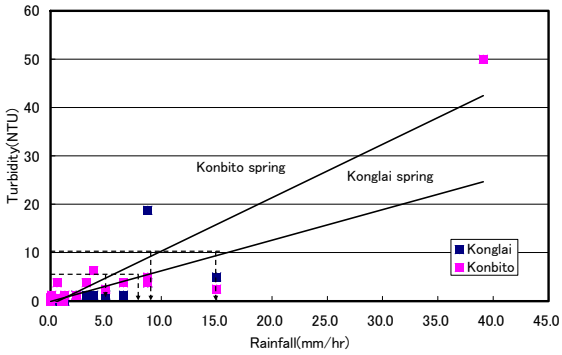
3. Result of daily water analysis

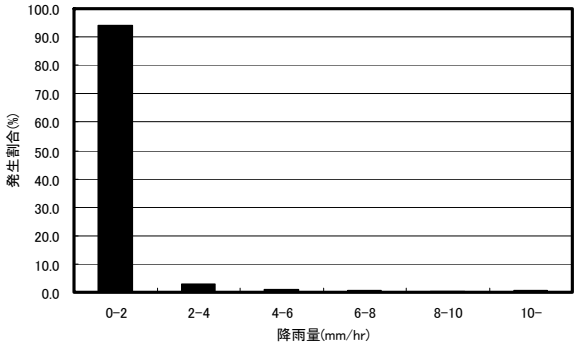
	Date		Meteorology			Konglai						Rove						Kombito					
			Wether	Temp.(℃)	Rainfall(mm/	Time	Temp.(℃)	pH(−)	EC(us/cm	urbidity(°	Color(°)	Time	Temp.(℃)	pH(−)	EC(us/cm	urbidity(°	Color(°)	Time	Temp.(℃)	pH(−)	EC(us/cm	urbidity(°	Color(°)
1	3/24	Mon	FINE	29.3	0.0	11:10	23.6	8.0	290	0	5	10:00	27.0	7.3	450	0	2	12:30	−	7.5	420	0	2
2	3/25	Tue	FINE	28.3	5.2	11:25	23.8	8.0	310	0	2	10:10	26.1	7.6	450	0	2	12:15	25.0	7.5	410	0	0
3	3/26	Wed	CLUDY	27.6	22.0	16:00	23.6	8.0	300	0	0	16:45	28.6	7.6	440	0	2	15:10	25.0	7.5	400	0	0
4	3/27	Thu	FINE	27.0	6.3	10:50	23.9	8.0	320	0	4	10:00	26.7	7.6	480	0	0	12:10	25.0	7.5	400	1	2
5	3/28	Fri	CLUDY	27.4	0.4	10:00	23.5	8.3	340	0	2	9:23	25.5	7.5	460	0	0	10:55	24.6	7.5	390	0	2
6	3/29	Sat	FINE	27.8	9.5	10:56	23.8	8.5	330	0	2	10:23	26.9	7.6	440	0	0	12:00	24.9	7.5	360	0	2
7	3/30	Sun			0.0																		
8	3/31	Mon	FINE	29.2	0.0	10:34	23.8	8.0	340	0	2	9:57	27.3	7.3	480	0	0	9:15	25.9	7.5	360	0	2
9	4/1	Tue	FINE	28.5	0.0	11:28	23.8	8.0	310	0	0	10:48	27.7	7.5	420	0	0	9:46	25.2	8.0	410	0	2
10	4/2	Wed	CLUDY	24.2	88.7	10:14	23.7	8.0	320	4	0	9:35	25.8	7.4	460	3	0	10:57	25.3	8.0	410	2	2
11	4/3	Thu	FINE	30.1	14.8	11:15	24.8	8.2	400	0	0	14:42	23.8	7.6	310	0	0	13:42	28.6	7.6	460	0.5	2
12	4/4	Fri	FINE	26.2	2.7	10:27	23.5	8.0	320	0	0	9:50	26.9	7.5	460	0.5	0	9:15	26.2	7.5	390	0.5	2
13	4/5	Sat	CLUDY	27.2	43.9	9:25	23.6	8.2	340	3	2	10:45	28.6	7.6	470	0.5	0	11:20	25.3	8.0	400	4	2
14			RAIN							15	20					0	2					3	2
15	4/6	Sun	RAIN	23.8	42.0	7:45	23.2	8.0	250	1	2	8:40	25.1	7.6	450	0	2	9:20	24.0	7.6	300	3	2
16	4/7	Mon	RAIN	24.2	17.7	10:37	23.8	8.0	280	1	5	8:40	26.9	7.6	470	1	2	12:10	25.0	7.5	330	3	2
17	4/8	Tue	CLUDY	23.8	11.4	10:16	23.8	−	310	1	2	11:14	26.7	−	470	1	2	9:13	25.0	−	330	1	2
18	4/9	Wed	FINE	26.5	6.2	11:19	24.8	8.0	330	0	2	10:41	26.8	7.6	480	0	2	9:46	25.0	7.6	370	0	2
19	4/10	Thu	FINE	25.4	0.0	9:53	23.8	8.1	340	0	2	9:14	25.9	7.6	480	0	2	10:42	25.0	7.7	380	0.5	2
20	4/11	Fri	FINE	27.8	0.0	11:30	23.6	8.0	330	0	0	10:19	28.0	7.5	450	0	0	9:24	25.2	7.8	390	0.5	2
21	4/12	Sat	FINE	26.3	0.0	11:20	23.8	8.0	320	0	0	9:22	26.0	7.5	470	0	0	10:33	25.3	7.7	380	0	2
22	4/13	Sun			11.5																		
23	4/14	Mon	CLUDY	25.0	2.8	11:23	24.3	8.5	310	0	0	10:50	27.0	7.5	460	0.5	2	10:00	24.9	7.5	360	3	4
24	4/15	Tue	FINE	24.9	10.6	14:50	23.8	8.4	320	0	0	14:10	29.0	7.5	490	0	0	13:32	24.8	7.6	390	0	0
25	4/16	Wed	CLUDY	27.5	195.5	10:30	23.5	7.8	240	2	6	11:17	27.9	7.5	470	0.5	2	9:30	24.2	7.8	200	40	20
26	4/17	Thu	CLUDY	25.5	21.3	11:30	23.8	8.0	310	1	2	12:00	27.8	7.6	480	0.5	2	10:35	24.8	7.8	340	5	10
27	4/18	Fri	CLUDY	24.3	26.8	11:00	24.1	8.4	330	1	2	11:30	26.2	7.6	470	0.5	2	10:11	24.1	7.6	340	2	4
28	4/19	Sat	CLUDY	25.5	0.7	8.55	23.6	8.0	370	0	0	9:30	26.7	7.5	510	0	0	10:26	25.0	7.8	390	1	2
	NUM.			25	27		25	24	25	26	26		25	24	25	26	26		24	24	25	26	26
	AVE.			26.5	20.0		23.8	8.1	318	1	2		26.8	7.5	459	0	1		25.1	7.7	372	3	3
	MAX.			30.1	195.5		24.8	8.5	400	15	20		29.0	7.6	510	3	2		28.6	8.0	460	40	20
	MIN.			23.8	0.0		23.2	7.8	240	0	0		23.8	7.3	310	0	0		24.0	7.5	200	0	0
	DIV.			1.8	39.3		0.4	0.2	32.0	3.0	3.9		1.1	0.1	35.4	0.6	1.0		0.9	0.2	48.7	7.6	3.9

Note: shows the day when it rained heavily at the previous night in honiara.
Less than 0.5° on Turbidity and less than 2° on color are described as 0° here.

4. Study for frequency of high turbidity on raw water

We predicted yearly frequency of high turbidity on Konglai springs and Konbito springs to study how many times settling basin for high turbidity are need. The relation between rainfall intensity and turbidity on raw water in Konglai spring and Kombito spring is studied using turbidity data on dairy water analysis. These results are shown in Fig 1. The yearly frequency on each rainfall intensity from April 2007 to March 2008 is shown in Fig 2.





※1 Turbidity1° =0.8NTU

Fig-1 Relation between rainfall intensity and turbidly on raw water

Fig-2 Yearly frequency of each rainfall intensity (April 2007-March 2008)

Yearly frequency of 5 NTU or more and 10NTU or more on raw water in Kongali spring and Konbito spring are predicted using Fig-1 and Fig-2. The results are shown in Table 1.

Table-1 Predicted yearly frequency of high turbidity

	5NTU※1 or more		10NTU※2 or more	
	Rainfall intensity	Frequency※3	Rainfall intensity	Frequency※3
Konglai springs	8mm/hr or more	1.2%(18 times)	16mm/hr or more	0.3%(4times)
Konbito springs	6mm/hr or more	1.9%(28 times)	10mm/hr or more	0.8%(12times)

※ 1 Target treated water quality on settling basin for high turbidity

※ 2 In case the turbidity continues over 8 hours, the value which settling basin for high turbidity is not acceptable for.

※ 3 The periods which heavy rainfall continues for are assumed to within 6hours, so one day is divided by 4 terms.

According to this study, settling basin will be needed 18 times per year in Konbito springs and 28 times per year in Konbito springs, respectively.

5. Methods for simplified jar test

(1)Methods

①Sedimentation test and ②coagulation and sedimentation test are done for water on konglai spring and konbito spring.

① sedimentation verlocity using 500ml beaker by visual observation, turbidity on supernatant and color on supernatant are measured.

② Methods for coagulation and sedimentation test are shown in Fig 1. Water from Konglai spring is added with soils because of low turbidity.

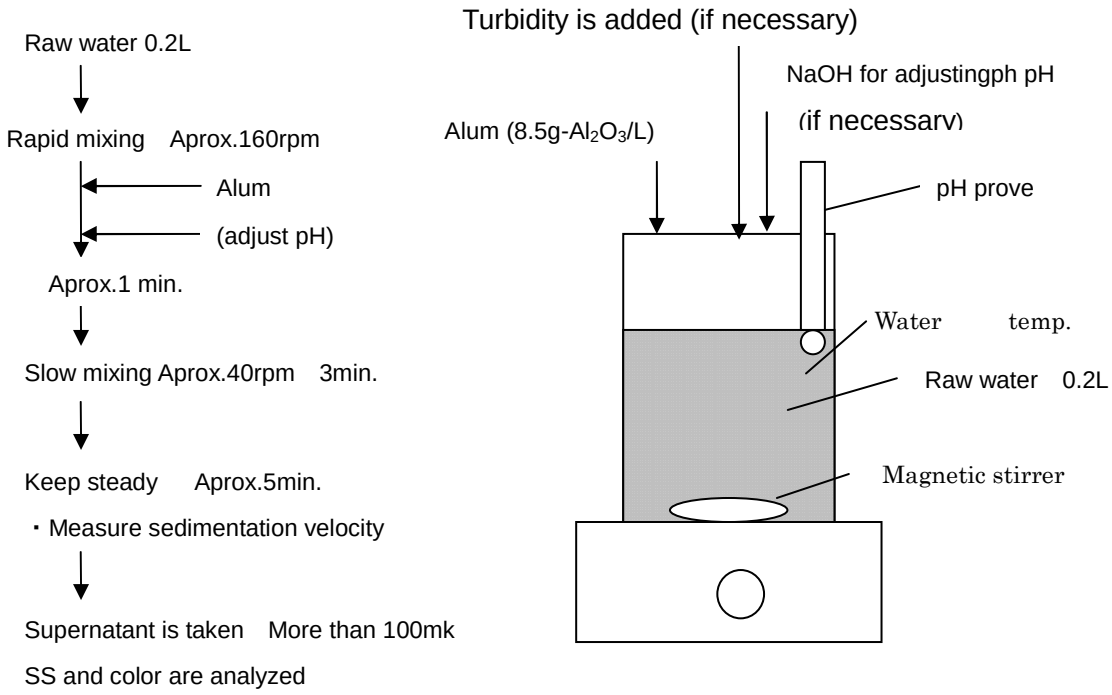


Fig.1 Methods for congregation and sedimentation

(2) Results

1) Result of sedimentation velocity test

1)-1 Raw water

Spring	Konglai spring		Konbito spring
Sampling date	5 April	6 April (turbidity added)	16 April
pH	-	8.8(-)	8.3(-)
Turbidity	15°	20°	40°
Color	20°	20°	20°

1)-2 Result of sedimentation velocity

Spring	Konglai spring		Konbito spring
Sampling date	5 April	6 April (turbidity added)	16 April
Supernatant pH	-	8.8(-)	8.3(-)
Supernatant turbidity	7°	10°	15°
Supernatant color	20°※2	10°	10°
Sedimentation velocity※1	Aprox.30mm/min	Aprox.30mm/min	Aprox.30mm/min

※1 Sedimentation velocity on particle size aprox.0.3 um, minimum size which can be measured by visual observation is adopted.※2 Color of raw water filtrated with 5C filter is 10°

2) Result of coagulation and sedimentation test

2)-1 Raw water

Spring	Konglai spring		Konbito spring	
Raw water No.	1	2	3	4
Sampling date	6 April	6 April (turbidity added)	6 April	16 April
pH	8.3(-)	8.8(-)	8.3(-)	8.3(-)
Turbidity	1°	20°	3°	40°
Color	2°	20°	2°	20°

2)-2 Result of Coagulation and sedimentation test

①Konglai spring

Raw water No.		1	1	1	1	1	1	1	2
Dosage of Alum (mg-Al_2O_3/L)		85	43	43	43	21	10	10	10
pH after alum is added (-)		4.5	6.1	6.2	6.2	6.8	7.5	7.6	7.8
Dosage of NaOH (mg-Al_2O_3/L)		75	-	13	25	-	-	-	-
pH after NaOH is added (-)		6.3		6.5	6.8				
Performance	Coagulation	○	△	△	△	△	△	△	○
	Sedimentation velocity (mm/min)	-	-	-	-	-	Aprox. 30	Aprox. 30	Aprox. 50
	Turbidity supernatant (°)	-	-	-	-	-	2	2	3
	Color supernatant(°)	-	-	-	-	-	<2	<2	5
Note								No slow mix.	

②Konbito spring

Raw water No.		3	3	3	4
Dosage of Alum (mg-Al_2O_3/L)		43	21	10	10
pH after alum is added (-)		7.1	7.3	7.6	7.8
Dosage of NaOH (mg-Al_2O_3/L)		-	-	-	-
pH after NaOH is added (-)					
Performance	Coagulation	○	△	△	○
	Sedimentation velocity (mm/min)	-	-	Aprox. 30	Aprox. 50
	Turbidity supernatant (°)	-	-	2	1
	Color supernatant(°)	-	-	<2	2
備考					