GEOTECHNICAL INVESTIGATION FOR THE PROPOSED NEW DEVELOPMENTS AT THE SOUTHERN WASTE WATER TREATMENT WORKS IN MEREWENT, DURBAN

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ANNEXURES

1. INTRODUCTION

AECOM (Pty) Ltd was appointed by EThekwini Municipality to conduct a geotechnical investigation to determine the subsoil conditions for the proposed developments at the Southern Waste Water Treatment Works (SWWTW) in Merewent, located south of Durban. The proposed development will include the following new structures:

- Two conical shaped primary digesters with the base of the structure extending to approximately 8m below surface (diameter - 22.3m) ;
- a conical shaped secondary digester with the base of the structure extending to approximately 8m below surface (diameter - 20m);
- a gas holder (diameter – 23m);
- a thickener (diameter – 21m);
- a sludge drying facility (20m x 35m);
- two silos;
- a tanker bay facility (51m x 86m);
- a low level sump which extends to approximately 4m below surface (10m x 95m x 74m x 40m trapezoid); and
- approximately 70m of two parallel 1m diameter HDPE pipelines along the beach for the sewer outfall pipeline.

The geotechnical investigation aimed to identify the geotechnical and geological conditions within the SWWTW area and at the sewer outfall site, highlighting any geotechnical constraints for the construction of the proposed structures.

2. SITE DESCRIPTION

The proposed position of each structure within the existing Waste Water Treatment Works and the position of the sewer outfall pipeline are indicated on the locality plan included as Figure 1 in Annexure A. The treatment facility is bounded by residential suburbs in the north west and the south east, by Badulla Road on the north east and by the Umlaas canal on the south west. The facility is on a relatively flat and low lying topography with platforms created during the initial development.

The existing sewer outfall pipeline which underlies the paved road along the beachfront will be replaced with two newly constructed pipelines approximately 70m in length.

3. GEOLOGICAL SUMMARY

Based on the published 1:250 000 geological map, Sheet 2930 Durban, the proposed pipeline site is underlain by Beach Sands of Quaternary age and the SWWTW is underlain by Berea Formation also of Quaternary age. Based on the findings of the investigation, the alluvial soils that were encountered on the SWWTW site are most probably due to the site falling within the original Umlazi River floodplain which has now been diverted to the Umlaas canal.

4. METHOD OF INVESTIGATION

The following exploration methods were undertaken during the investigation:

- Drilling of five boreholes (wash boring) to depths of 15m with Standard Penetration Testing (SPT) undertaken at approximately 3m intervals.
- Excavation of seventeen test pits.
- Seventeen Dynamic Cone Penetrometer (DCP) tests conducted adjacent to the test pits.
- Thirteen Dynamic Probe Super Heavy (DPSH) tests taken to refusal.
- Representative samples were retrieved from the test pits and the boreholes for subsequent laboratory testing at an accredited laboratory.

All test pits and boreholes were logged by an engineering geologist according to the *"Guidelines for Soil and Rock Logging in South Africa" (Brink and Bruin, 2002)*. All test positions are indicated on Figure 1 in Annexure A and their locations listed in Table 1.

Table 1: Test Positions

Proposed Area	Test Pit and DCP's	Boreholes	DPSH
Tanker Bay Facility	TP01		DPSH1
	TP02		DPSH2
	TP03		
	TP04		
Sludge Drying Facility and Silos	TP05	BH04	DPSH3
	TP06		DPSH4
Primary Digester,	TP07	BH02A	DPSH5

Proposed Area	Test Pit and DCP's	Boreholes	DPSH
Secondary Digester, Thickener, Gas Holder, Mixing Building and Boiler House	TP08	BH03	DPSH6
	TP09		DPSH7
	TP10		DPSH8
	TP11		DPSH9
	TP12		
	TP17		
Low Level Sump	TP13	BH01	DPSH10
	TP14		DPSH11
	TP15		DPSH12
	TP16		
Sewer Outfall Pipeline		BH05	DPSH13

5. RESULTS OF THE INVESTIGATION

5.1 Review of Previous Boreholes Drilling Within and in Proximity to the SWWTW

Twenty six borehole logs from previous investigations undertaken within the treatment facility, along the Umlaas Canal near the beach (in proximity to the sewer outfall pipeline) and at the neighboring Beverley Gardens Residential Development were reviewed as part of the desktop study. The results of the logs indicate that the subsoil profile within and in proximity to the treatment facility comprises interlayered sand and silt of alluvial origin, extending to depths ranging between 26.15m and 37.19m. Sandstone rock was encountered in one borehole at a depth of 26.15m.

From the boreholes drilled within the treatment facility, a clayey organic layer underlies the upper sandy layer at a depth between 2.0m to 4.6m.

5.2 Borehole Log and Soil Profiles

The test pit profiles and borehole logs are included in Annexure B and summarized in Table 2 for ease of reference. The overall site is generally underlain by the following subsoils.

- Fill material comprising loose to dense silty sand which occurs from surface to depths ranging from 0.2m to 3.0m. Scattered occurrences of sandy silty clay, fill material were encountered in TP07 and TP10.

- The fill material is generally underlain by alluvial deposits comprising predominantly silty clayey sand extending to depths in excess of 15.5m. The sand layers are interlayered with lenses of silty (sometimes sandy) clay.
- The silty sand of alluvial origin in BH01 (at the position of the Low Level Sump) is underlain by alluvial sandy silty clay which occurs between 7.81 and 15.55m.
- Lenses of slightly organic rich soils can be expected below the fill and within the alluvial deposits, which were encountered randomly at various depths on site.
- The lithology referred to as Beach Sand comprising silty clayey sand underlies 2.6m of fill comprising sandy soils at the position of the Sewer Outfall Pipeline on the beach. The beach sand extends to depths in excess of 15m.

Tanker Bay Facility

The subsoil at the Tanker Bay facility generally comprise loose to medium dense, silty sand, fill, from surface to depths ranging between 0.6m and 2.0m. The fill is underlain by alluvial material comprising, loose to medium dense (occasionally dense to very dense), silty clayey sand, to depths in excess of 3.05m. Groundwater was encountered at depths between 1.7m and 2.6m in all four boreholes drilled in the area.

Sludge Drying Facility and Silos

Fill material comprising loose to very dense silty sand occurs from surface to an average depth of 1.5m (ranging from 1.2m-2.18m). The fill material is underlain by medium dense to dense silty clayey sand, alluvium which extends to depths in excess of 15.45m. Groundwater was encountered at depths between 1.0m (rest level in BH04) and 2.2m.

Primary Digesters (PD), Secondary Digester (SD), Thickener (TH), Gas Holder (GH), Mixing Building and Boiler House (M&B)

The area identified for the above mentioned structures is generally underlain by fill material comprising generally medium dense to dense (occasionally loose and very dense) silty clayey/gravelly sand which extends to depths between 0.6m and 3.0m. In TP07 (0.9-1.5m) and TP10 (1.6-1.9m and 2.4-2.8m) horizons of approximately 0.5m of stiff to very stiff clay (fill material) was encountered. The fill material is predominantly underlain by loose to medium dense silty clayey sand, alluvium which extends to depths greater than 15.03m.

Alluvial material comprising firm to stiff (sandy) silty clay underlies the fill layer in TP09 and TP11 extending to depths between 2.1-3.0m. Sandy silty clay of alluvial origin is interlayered with sandy alluvium in TP12 at depths between 1.5m and 2.4m.

Groundwater was encountered in all test pits and boreholes in the area at depths between 1.0m and 2.6m.

Low level Sump

Fill comprising loose to medium dense silty s (occasionally very loose and dense) and was encountered from surface to depths between 0.2m and 2.45m. The fill is generally underlain by alluvium comprising loose to dense (occasionally very loose and very dense) silty clayey sand to depths of approximately 7.43m bgl. Lenses of silty clay, with some organic matter was encountered in TP16 at depths of 1.4-1.5m and 3.0-3.2m. The alluvium is underlain by a second alluvial layer comprising very stiff sandy silty clay which extends to 15.55m.

Groundwater was encountered in three of the four test pits and in one borehole at depths between 1.5m and 3.0m.

Sewer Outfall Pipeline

The route proposed for the new sewer outfall pipeline is underlain by gravelly silty sand of fill origin from surface to depths of approximately 2.6m. The fill is underlain by Beach Sand comprising silty sand extending to depths in excess of 15.45m. The groundwater rest level in the borehole was at 3.2m.

Table 2: Soil Profile Summary

SITE	ID	FILL		BEACH SAND	ALLUVIUM			SEEPAGE	COMMENTS
		Silty (clayey / gravelly) SAND / SAND	Sandy silty CLAY	Silty (clayey) SAND	Silty SAND* / Silty CLAY with some organic matter	Silty (clayey) SAND / SAND	Silty (sandy) CLAY		
Tanker Bay Facility	TP01	0.0-1.3				1.3-1.9		Moderate to strong seepage at 1.7m	Collapse of pit hence stopped at 1.9m
	TP02	0.0-0.6				0.6-3.05		Slight seepage at 2.6m	
	TP03	0.0-0.9				0.9-3.0		Slight seepage at 1.8m	
	TP04	0.0-2.0				>2.0		Slight seepage at 1.9m	Collapse of pit hence stopped at 2.0m
Sludge Drying Facility and Silos	TP05	0.0-1.2				1.2-2.7			Collapse of pit hence stopped at 2.7m
	TP06	0.0-1.5				1.5-2.4		Slight seepage at 2.2m	Collapse of pit hence stopped at 2.4m
	BH04	0.0-2.18				2.18-15.45		Water rest level is at 1.0m	
SD, M&B, TH, GH and PD	TP07	0.0-0.9	0.9-1.5			1.5-2.8		Slight seepage at 2.2m	Collapse of pit hence stopped at 2.8m
	TP08	0.0-1.3				1.3-2.8		Strong seepage at 1.0m	Collapse of pit hence stopped at 2.8m
	TP09	0.0-1.8					1.8-3.0	Strong seepage at 1.5m	Collapse of pit
	TP10	0.0-1.6	1.6-1.9					Slight seepage at 2.2m	Collapse of pit
		1.9-2.4	2.4-2.8						
		2.8-3.0							

SITE	ID	FILL		BEACH SAND	ALLUVIUM			SEEPAGE	COMMENTS
		Silty (clayey / gravelly) SAND / SAND	Sandy silty CLAY	Silty (clayey) SAND	Silty SAND* / Silty CLAY with some organic matter	Silty (clayey) SAND / SAND	Silty (sandy) CLAY		
	TP11	0.0-2.1					>2.1	Strong seepage at 1.5m	Collapse of pit hence stopped at 2.1m
	TP12	0.0-0.6			0.6-1.5*		1.5-2.4	Slight seepage at 1.5m	Collapse of pit hence stopped at 2.5m
					2.4-2.5				
	TP17	0.0-2.6				2.6-3.0		Strong seepage at 2.6m	
	BH02A	0.0-1.7				1.7-15.51		Water rest level is at 1.2m	
	BH03	0.0-2.42			3.64-4.05	2.42-3.64		Water rest level is at 1.5m	
					11.1-11.64*	4.05-11.10			
						11.64-15.03			
Low Level Sump	TP13	0.0-1.7				1.7-3.0			
	TP14	0.0-0.8				0.8-2.4		Strong seepage at 1.7m	Collapse of pit hence stopped at 2.4m
	TP15	0.0-0.2				0.2-2.5		Slight seepage at 2.0m	Collapse of pit hence stopped at 2.5m
	TP16	0.0-0.4			3.0-3.2	0.4-1.4	1.4-1.5	Strong seepage at 3.0m	Collapse of pit
						1.5-3.0			
	BH01	0.0-2.47				2.47-7.43	7.43-7.81	Water rest level is at 1.5m	
							7.81-15.55		
Beach - Pipeline	BH05	0.0-2.6		2.6-15.45				Water rest level is at 3.2m	

5.3 DCP, DPSH and SPT Test Results

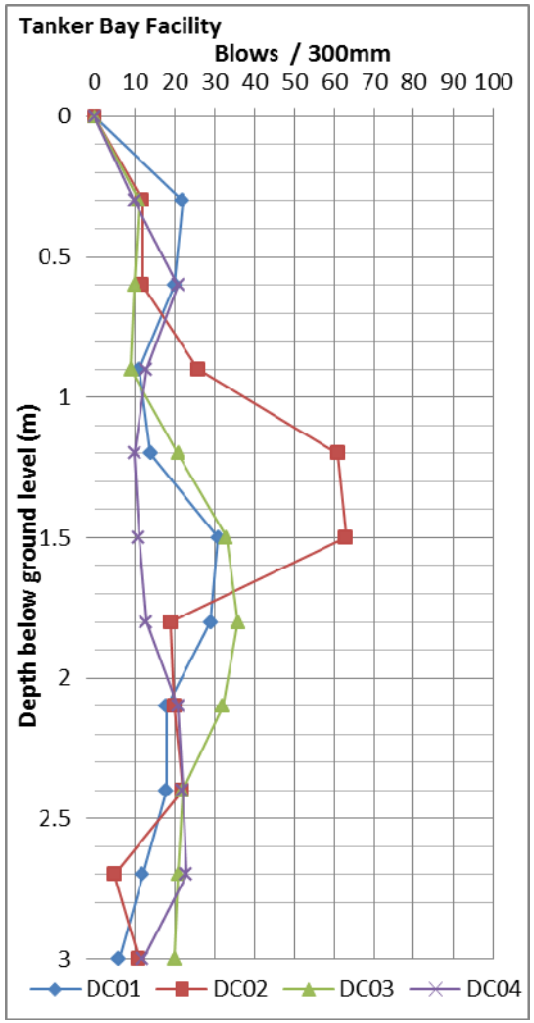
The results from the DCP, DPSH and SPT tests are presented graphically in Graph 1 to 3 with the raw data appended to this report in Annexure C. These tests were carried out to assess the consistency of the subsoils.

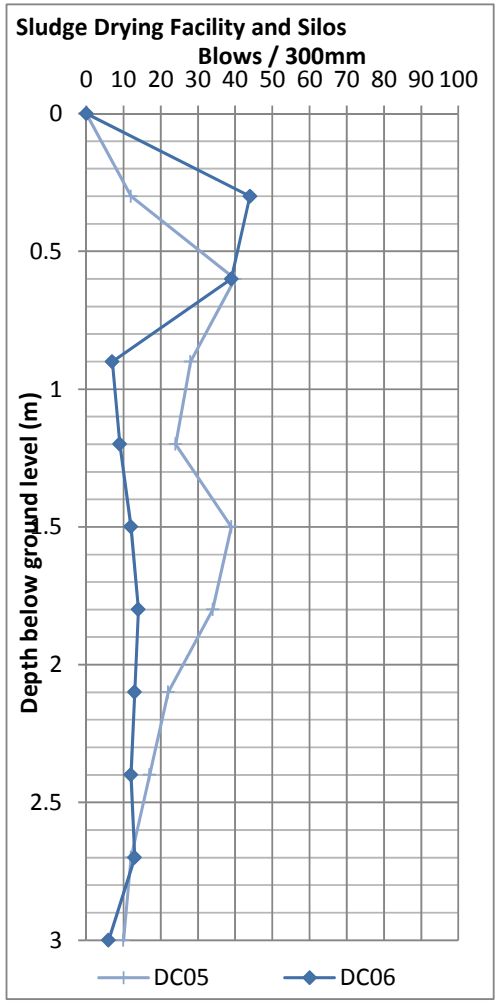
The results confirm that the fill generally comprise loose to medium dense sand with the lenses of clay having a firm to very stiff consistency to depths of approximately 3.0m. The alluvial sands encountered also have a loose to dense consistency with the clay alluvial soils having a firm to very stiff consistency. These consistencies are generally erratic to approximately 3.0m.

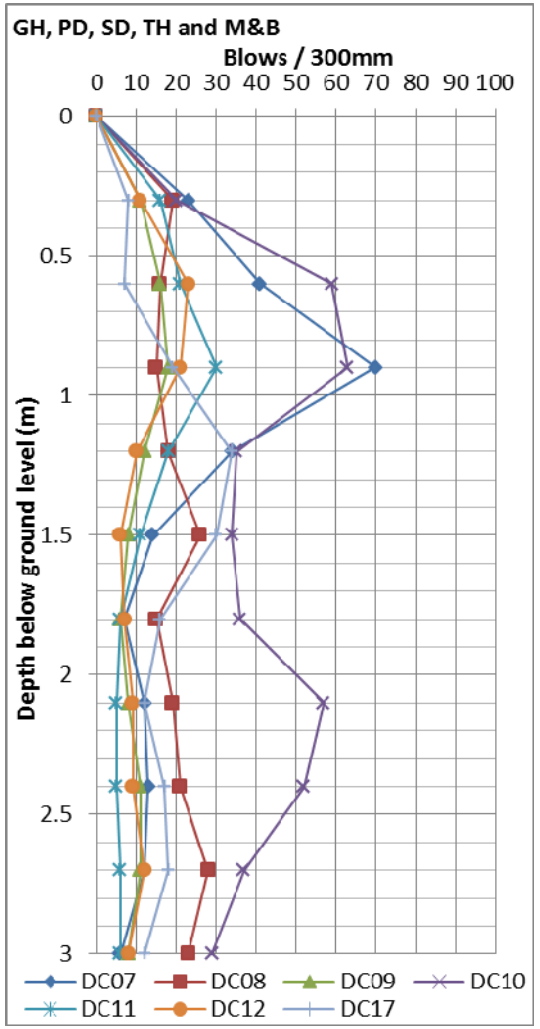
From 3.0m to 15.5m there is a general densification of the subsoils with depth, with scattered loose to medium dense layers identified within the subsoils at the position of the PD,SD, TH, GH and M&B structures and at the Low Level Sump. The subsoils along the sewer outfall pipeline is described as medium dense to very dense based on the SPT and DPSH results.

The allowable bearing pressures of the subsoil based on the DCP, SPT and DPSH results are given in Table 3.

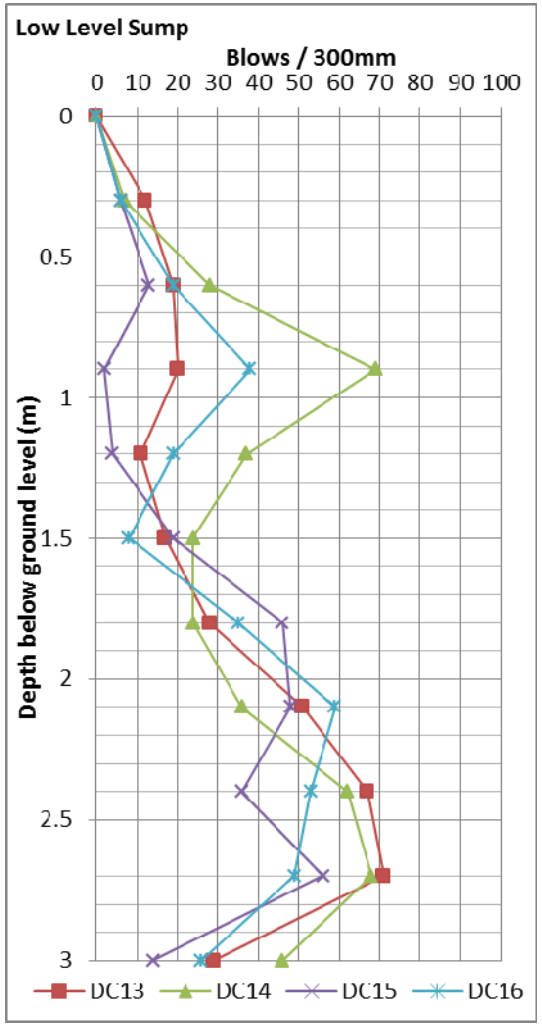
Graph 1: DCP Results



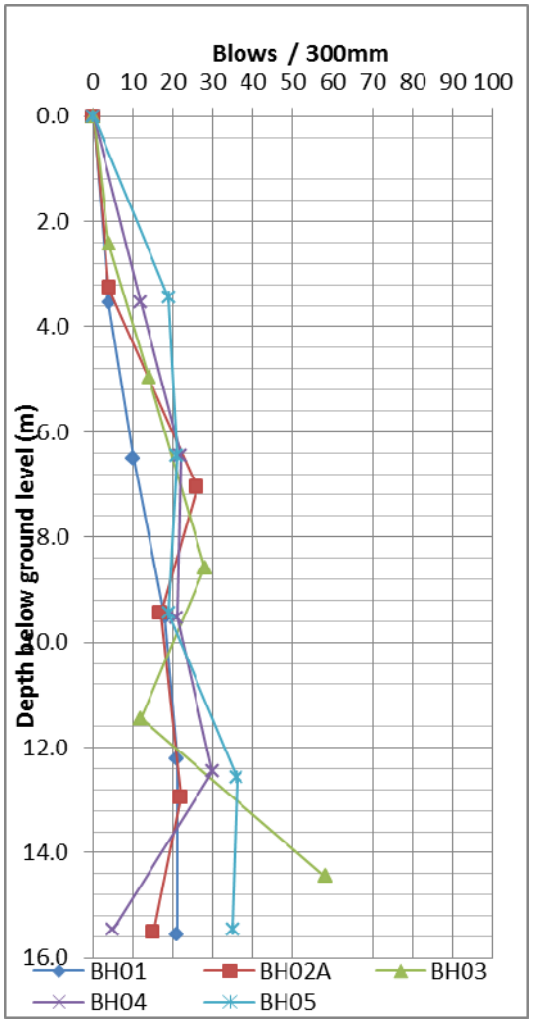




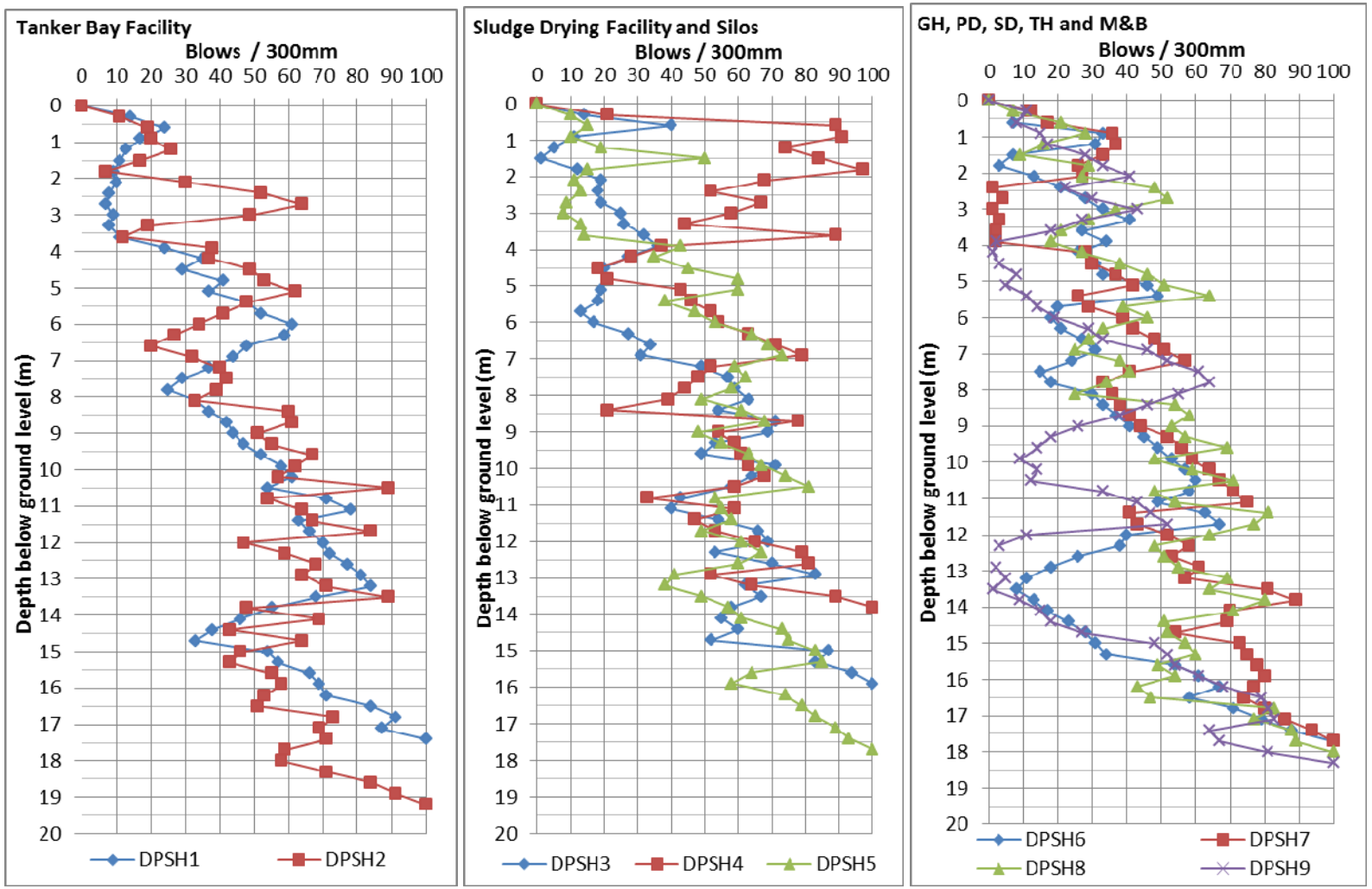
Graph 1 Continued: DCP Results



Graph 2: SPT Results



Graph 3: DPSH Results



Graph 3 Continued: DPSH Results

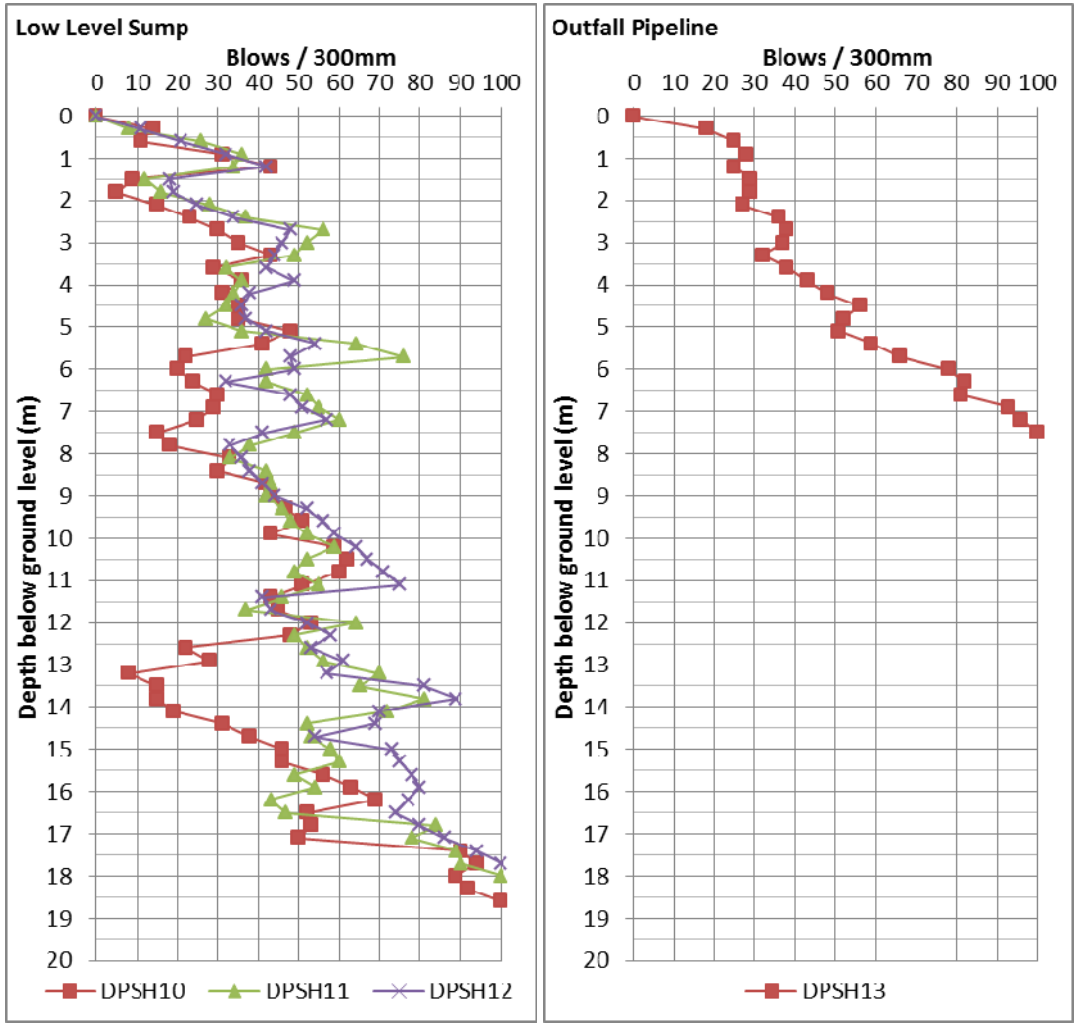


Table 3: Allowable Bearing Pressures

Structure	Depth	Allowable Bearing Pressure (kPa)
Tanker Bay Facility	0.0-3.9	150
	3.9-19.2	> 300
Sludge Drying facility and Silos	0.0-0.6	100
	0.6-1.5	200
	1.5-2.4	150
	2.4-3.0	200
	3.0-6.0	300
	6.0-10.0	400
	10.0-14.0	500
	14.0-15.45	600
	15.45-17.7	700
Gas Holder, Primary Digesters, Secondary Digesters, Thickeners, Mixing Building and Boiler House	0.0-0.6	100
	0.6-1.2	200
	1.2-4.5	150
	4.5-5.1	200
	5.1-7.8	300
	7.8-9.6	400
	9.6-12.0	500
	12.0-13.5	300
	13.5-14.1	250
	14.1-15.5	400
	15.5-18.3	600
Low Level Sump	0.0-0.6	100
	0.6-1.2	300
	1.2-2.4	200
	2.4-6.0	400
	6.0-7.8	300
	7.8-9.0	400
	9.0-12.9	500
	12.9-13.8	300
	13.8-18.6	600
Sewer Outfall	0.0-2.0	200
	2.0-5.0	400
	5.0-7.5	700

The allowable bearing pressure estimations assume 25mm of total settlement with 12-18mm of differential settlement.

In addition to the allowable bearing pressures, the SPT results may be used to determine the anticipated angle of friction of the soils (*Peck et al, 1974*). The expected angles of friction of the subsoil's with depth are tabulated on Table 4.

Table 4: Angle of Friction Based on the SPT Test Results

Proposed Area	Depth (m)	SPT N	Angle of friction (ø'-°)	Soil Type
BH01 – Low Level Sump	3.54	4	29	Silty Sand, Alluvium
	6.50	10	30	Silty Sand, Alluvium
	9.52	18	33	Sandy Silty Clay, Alluvium
	12.21	21	33	Sandy Silty Clay, Alluvium
	15.55	21	33	Sandy Silty Clay, Alluvium
BH02A - Primary Digester, Secondary Digester, Thickener, Gas Holder, Mixing Building and Boiler House	3.26	4	29	Silty Sand, Alluvium
	7.05	26	35	Silty Sand, Alluvium
	9.45	17	32	Silty Sand, Alluvium
	12.94	22	34	Silty Sand, Alluvium
	15.51	15	31	Silty Sand, Alluvium
BH03 - Primary Digester, Secondary Digester, Thickener, Gas Holder, Mixing Building and Boiler House	2.42	4	29	Clayey Silty Sand, Alluvium
	4.95	14	31	Silty Sand, Alluvium
	8.58	28	35	Silty Sand, Alluvium
	11.45	12	30	Clayey Silty Sand, Alluvium
	14.45	58	42	Silty Sand, Alluvium
BH04 - Silo and Sludge Drying Facility	3.55	12	30	Silty Sand, Alluvium
	6.45	22	34	Silty Sand, Alluvium
	9.53	21	33	Clayey Silty Sand, Alluvium
	12.45	30	36	Silty Sand, Alluvium
	15.45	5	29	Silty Sand, Alluvium
BH05 - Sewer Outfall Pipeline	3.45	19	33	Silty Sand, Beach Sand
	6.45	21	33	Silty Sand, Beach Sand
	9.45	19	33	Silty Sand, Beach Sand
	12.58	36	37	Clayey Silty Sand, Beach Sand
	15.45	35	37	Silty Sand, Beach Sand

5.4 Laboratory Test Results

The following sections discuss the results of the laboratory tests conducted on samples from site.

5.4.1 Foundation Indicator Tests

The laboratory test results on the fill material, alluvial soils and beach sand samples retrieved from the test pits and the boreholes are summarised in Table 5 with the detailed test results presented in Annexure D.

From surface to depths varying between 0.2m and 3.0m the fill layer classifies as either a poorly graded sand (SP) or as an inorganic low to medium plastic clay (CL) according to the Unified Soil Classification System. According to the laboratory results, the sands have a low expansiveness potential, while the clay has a medium potential expansiveness based on the results plotted on the Van der Merwe Chart. Typical properties of these soils in accordance with published literature are tabulated in Table 6.

The alluvial sandy soil encountered across the site generally classifies as either a poorly graded sand (SP), a silty sand (SM), a clayey sand (SC) or as a silty to clayey SAND (SM-SC). The clay lenses within the alluvial sands classify as a low to medium plasticity silty CLAY (CL). The clay layer underlying the alluvial sand encountered in BH01 (at the Low Level Sump) between 7.81m and 15.55m classified as an inorganic high plasticity CLAY (CH). According to the Van der Merwe Chart, the SC soils have a low to medium expansiveness potential, the CL clay has a low to high potential expansiveness and the CH clays have a high potential expansiveness. Typical properties of SP, SM, SC, SM-SC, CL and CH soils are indicated in Table 6.

The clayey soil encountered on site within the vicinity of the primary and secondary digesters and at the low level sump area classified as an organic clay (OH) with a low expansiveness potential based on the Van der Merwe Chart.

The beach sands encountered in BH05 along the new sewer outfall pipeline is a clayey SAND (SC) according to the Unified Soil Classification System and has a low expansiveness potential.

Table 5: Summary of Laboratory Indicator Tests

TEST ID	DEPTH	APPROXIMATE PERCENTAGES OF MATERIAL TYPE				GRADING MODULUS	PLASTICITY INDEX	LIQUID LIMIT (%)	LINEAR SHRINKAGE	% PASSING 0.425mm	USCS	POTENTIAL EXPANSIVENESS	MAXIMUM DRY DENSITY kg/m3	OPTIMUM MOISTURE CONTENT (%)	CBR VALUES AT % COMPACTION					TRH14 CLASSIFICATION
	(m)	Gravel	Sand	Silt	Clay										100	98	95	93	90	
FILL																				
TP01	0.5-1.3	1	94	5		1.33	NP	NP	0	62	SP	low	1856	9.6	20	18	17	16	15	G7
TP10	2.4-2.8	2	63	7	28	0.7	17	34	8.3	98	CL	medium								
ALLUVIUM																				
TP01	1.3-1.9	0	93	2	5	0.9	NP	NP	0	97	SP	low								
TP02	0.6-1.6	0	87	4	9	0.9	SP	SP	0.5	0.98	SM	low								
TP02	1.6-2.9	0	86	6	8	0.9	SP	SP	0.5	98	SM	low								
TP05	2.6-2.7	0	77	3	20	0.7	6	19	3.5	99	SM-SC	low								
TP07	1.5-2.8	0	95	2	3	1	NP	NP	0	96	SP	low								
TP08	1.3-2.8	0	69	5	26	0.7	11	25	5.1	96	SC	low to medium								
TP09	1.8-3.0	0	67	6	27	0.7	11	27	5	99	CL	low								
TP13	1.7-3.0	0	95	2	3	1	NP	NP	0	97	SP	low								
TP14	0.8-1.9	1	86	13		0.98	NP	NP	0	90	SM	low	1843	8.8	37	32	23	17	11	G7
TP15	1.6-2.5	3	94	2	1	1	NP	NP	0	95	SP	low								
TP16	2.4-3.0	0	84	6	10	0.8	SP	SP	0.5	98	SM	low								
TP17	2.6-3.0	0	89	6	5	0.9	SP	SP	0.5	97	SM	low								
BH01	8.05-8.6	0	21	54	25	0.2	27	46	13.5	100	CL	high								
BH01	9.52-10.07	2	14	60	24	0.2	27	56	12.9	96	CH	high								

TEST ID	DEPTH	APPROXIMATE PERCENTAGES OF MATERIAL TYPE				GRADING MODULUS	PLASTICITY INDEX	LIQUID LIMIT (%)	LINEAR SHRINKAGE	% PASSING 0.425mm	USCS	POTENTIAL EXPANSIVENESS	MAXIMUM DRY DENSITY kg/m3	OPTIMUM MOISTURE CONTENT (%)	CBR VALUES AT % COMPACTION					TRH14 CLASSIFICATION
	(m)	Gravel	Sand	Silt	Clay										100	98	95	93	90	
BH01	11.33-11.76	1	12	59	28	0.1	25	53	11.4	96	CH	high								
BH02A	10.23-10.77	0	82	7	11	0.9	SP	SP	0.5	93	SM	low								
BH02A	13.07-13.6	2	85	3	10	1.4	8	23	3.2	51	SC	low								
TP12	2.4-2.5	0	45	45	10	0.5	16	69	7.5	91	OH	low								
TP16	3.0-3.2	0	9	53	38	0	21	57	10.1	100	OH	medium								
BEACH SAND																				
BH05	11.08-11.47	0	79	2	19	0.8	9	24	4.9	95	SC	low								

Table 6: Typical Properties of Soils Based on Various Literatures

Soil Type	Angle of Friction (°)	Cohesion (c)	Workability as a Construction Material	Drainage Characteristics
SP	36±6	0	fair	excellent
SM	34±3	0	fair	fair to practically impervious
SC	32±4	0	good	poor to practically impervious
SM-SC	31±3	5±5	fair to good	fair to practically impervious
CL	27±4	20±10	good to fair	practically impervious
CH	22±4	25±10	poor	practically impervious
OH	22±4	10±5	poor	practically impervious

The poorly graded sand (SP) of fill origin encountered at the Tanker Bay Facility classified as a G7 soil according to the TRH 14 Guideline for Road Construction Material. The alluvial silty sand (SM) encountered at the Low Level Sump also classified as a G7 soil. G7 soils are generally considered suitable for use as bulk fill and as the subgrade and selected layer in pavement layers.

5.4.2 Tri-axial Test

A number of shelby tube samples were taken from the boreholes for tri-axial testing however during the extraction of the samples from the tubes, it was found that the samples were not intact given the presence of shell fragments, the loose nature of the material or significant quantities of water within the sample. As a result of these poor quality samples only one sample of the clayey sand (Beach sand from BH05) was tested to determine its shear strength properties. This material was encountered at depths between 10.05m and 13.63m at the sewer outfall pipeline. A consolidated undrained (CU) triaxial test was carried out whereby the cell pressure is applied by allowing drainage in the CU test sample (which represents long term properties). Drainage is prohibited during the loading application. The result of the test is summarized in Table 7.

The internal angle of friction from the SPT results are slightly higher than the values obtained from the triaxial tests conducted in the laboratory. The lower angle of friction determined by the laboratory results are possible due to the clay content of the soil (19%).

Table 7: Tri-axial Test Result

Test Position	Sample Depth (m)	Test Type	Soil Description	Angle of Internal Friction (Φ) - (°)	Apparent Cohesion (c) - (kPa)	Angle of Friction Interpreted from SPT Results	
						Depth Range (m)	Angle of Internal Friction (Φ) - (°)
BH05	11.08-11.47	Consolidated Undrained	Clayey SAND, BEACH SAND	30	41	9.45-12.58	33-37

5.4.3 Consolidation Test

A consolidation test was requested on the inorganic clay layer encountered between 7.81 and 15.55m (in BH01) at the Low Level Sump area, to determine the consolidation settlement parameters of the material under stresses between 25kPa and 1600kPa.

The test result is summarized in Table 8. The overburden pressure for the sample was calculated to be 113kPa. The coefficient of volume compressibility (m_v) was calculated using the void rate at the overburden pressure as the initial void ratio and the overburden pressure as the initial stress / pressure. Based on the m_v values the clay is considered to be a normally consolidated clay at depth with a medium compressibility under load.

Table 8: Oedometer test result

Proposed Structure	Test Position	Layer Depth (m)	Soil Description	m_v Range (m^2/MN) for 100kPa to 200kPa	Compressibility
Low Level Sump	BH01	8.87-15.55 (Sample depth 11.3-11.76m)	Slightly sandy silty CLAY, Alluvium	0.1925	Medium compressibility

The result from DPSH testing show that the m_v values are much lower than the results from the oedometer testing suggests, as shown in Table 9.

Table 9: Coefficient of volume compressibility m_v (m^2/MN) at each structure with depth

Depth (mBGL)	Structure				
	Tanker Bay Facility	Sludge Drying Facility	GH and TH	PD, SD & M&B	Low Level Sump
0-4	0.1	0.03	0.05		0.05
4-8	0.03	0.03	0.03		0.025
8-12	0.02	0.02	0.025		0.025
12-16	< 0.02	< 0.02	0.05	0.02	0.05

It can be seen from Table 9 that the compressibility decreases with depth across the sites and is generally low. The variance between the oedometer and DPSH derived m_v values is a common occurrence and can be attributed to sample disturbance.

6 Geotechnical Evaluation

6.1 Expansive Soils

Expansive soils are materials where variations in moisture content result in volumetric changes. Unless cognisance is taken of the potential for volumetric change when designing structures founded in or on this type of soil, distress of the structure may occur.

Based on laboratory results generally the clayey soils encountered classify as “potentially expansive” according to the Van der Merwe chart and are recorded in Table 5. The clay (fill material) in TP10, the clay (alluvium) in TP16 and the clay (alluvium) in BH01 have an expansiveness potential, however given the depth of these expansive layers, which is below the water table and considering the overburden pressure at these depths, the potential to heave is negligible within these clays.

For shallow foundations within expansive soils it is generally recommended that appropriate foundations and construction methods be implemented. This may include reinforced footings, beam-stiffened or cellular raft foundations, constructing a soil raft or split construction, depending on the settlement tolerances of the structure. In addition, care should be taken to ensure good site drainage and that all surface water is channeled away from the structure foundations avoiding ingress of water within the bedding.

6.2 Consolidation Settlement

Consolidation settlement is the vertical settlement or decrease in soil volume that occurs in a soil under an applied load owing to the time related reduction in volume as a result of dissipation of pore water.

As indicated previously a consolidation test was carried out on an undisturbed sample of clay, alluvium which was encountered at the position of the low level sump. This test determines the settlement parameters and the anticipated settlement behavior of the material under the influence of loading. The coefficient of volume compressibility calculated based on the test results confirm that the alluvial clay at the low level sump has a medium compressibility. DPSH

results do however indicate a low compressibility across the sites. Differential settlement may still be problematic as there is still a difference between compressibilities of the clay layers.

Techniques for mitigating potential settlement and differential settlement problems include reinforced strip / pad footings, deep strip/pad footings, founding within a soil raft, or pile foundations. The choice of foundation is generally dependent on the foundation loads and the sensitivity of the structure to settlement.

Given the depth of the clay layer (8.87m bgl) within the footprint of the proposed low level sump, consolidation settlement below shallow foundations is not anticipated to be a problem. However for deep piled foundations it is recommended that the piles be founded / extended to depths beyond the potentially compressible layer to minimize the settlement of the piles.

6.3 Excavatability

In accordance with the SANS 1200DA soft excavations can be expected to depths of approximately 19m based on the results of this investigation. All soft excavations may be carried out with conventional earthmoving equipment.

6.4 Drainage

Table 9 indicates the depth at which the groundwater table was encountered at each of the development sites.

Table 10: Groundwater Level

Site	Ground Water Depth (bgl)
Tanker Bay Facility	1.7-2.6m
Sludge Drying facility and Silos	1.0-2.2m
Gas Holder, Primary Digesters, Secondary Digesters, Thickeners, Mixing Building and Boiler House	1.0-2.6m
Low Level Sump	1.7-3.0m
Sewer Outfall	3.2m

It is recommended that surface and sub-surface drains will be required across the site during construction and post construction. It is important that all drainage should have adequate capacity to deal with the expected rainfall. The use of dewatering wells is not recommended due to the potential settlement of adjacent structures as a result of the extent of the cone of

depression that develops due to the dewatering process. Therefore it is recommended that a sump is excavated at the lowest position within deep excavations (greater than the water table) from which the water is pumped out.

6.5 Stability of Excavations

The sidewalls of the test pits were unstable with the test pits collapsing on several occasions. Unstable excavation conditions can be expected during construction as a result of the unconsolidated material and shallow groundwater table. As a result of the shallow water table, the unconsolidated materials are expected to flow into excavations.

Given the unstable excavation conditions, the shallow groundwater level and the depth of various proposed structures, battering of the sidewalls to 1V:1H is recommended in excavations to 1.0m depth, under dry conditions. Lateral support measures will be necessary for excavations greater than 1.0m.

Due to the shallow water table and given that dewatering of excavation sidewalls are not expected to be undertaken, due to the drop in the cone of depression (and its influence on surrounding structures), battering of the side walls is not considered an adequate solution for the various deep excavations anticipated.

All traffic, personnel, equipment etc. should be kept at a minimum of 2m from the crest of any excavation. All excavations should, also, be inspected by a competent person at least once a day and following any periods of rain or any long periods where no work has taken place.

7 RECOMMENDATIONS

7.1 Founding Conditions

Although allowable bearing pressures of between 100 kPa and >250kPa is achievable in the fill and alluvial soils for shallow foundations, these soils in its in-situ state are considered unsuitable as a founding medium for the proposed structures due to the variable consistency of the soils. Due to heavy anticipated loading of some of the structures, settlement problems are anticipated if founding within these soils.

The choice of the most suitable founding solution is dictated by various factors. For the SWWTW site, the main geotechnical factors to be considered are:-

- The variable subsoil conditions in terms of bearing and settlement in both the fill and the alluvial deposits.
- The structural loads, required tolerances and sensitivity of the structure to settlement (at the time of preparation of this report, the particular load cases and required tolerances of the structure were not available).

Based on these conditions, the following foundation recommendations are provided:

7.1.1 Shallow Foundations - Lightly to Moderately Loaded Structures

The lightly to moderately loaded structures on site are expected to be the following:-

- Sludge Drying Facility;
- Tanker Bay Facility;
- Mixing Building and Boiler House.

In order to reduce settlement and improve the allowable bearing capacity it is recommended that the sludge drying facility and the tanker bay facility should be founded on an engineered soil raft using conventional footings (strip or pad footings). This will involve the removal of the fill/alluvial soils below the footings to a depth and width of at least 1.5 times the foundation width. The in-situ soil at the base of the excavation should then be compacted to at least 95% Mod AASHTO. The removed material should be placed in compacted layers not exceeding 150mm to 95% Mod AASHTO density at the optimum moisture content up to the desired founding levels. A bearing capacity of at least 100kPa is achievable within the soil raft.

It is recommended that the proposed mixing building and boiler house should be founded, using conventional footings, on an engineered soil raft constructed of inert G6 material. This will involve the removal of the fill/alluvial soils below the footings to a depth and width of at least 1.5 times the foundation width. The in-situ soil at the base of the excavation should be compacted to at least 95% Mod AASHTO. The removed material should be replaced with G6 material to be placed in compacted layers not exceeding 150mm to 95% Mod AASHTO density at the

optimum moisture content up to the desired founding levels. A bearing capacity of 250kPa would be achievable within the soil raft if a G6 material is used and 150kPa if a G7 material is used.

As a general rule, settlement of the fill is taken as 0.1% of the fill height for the well compacted fill.

In cases where low settlement tolerances are anticipated, or where excessive load magnitudes result in stressing of the ground to depths which practically preclude the excavation and replacement of the in-situ soil, an alternative foundation approach should be considered, such as piled foundations or founding on a rock mattress.

Rock mattress

Depending on the settlement sensitivity of the structures founded on shallow footings, a rock mattress compacted by a 5-10t vibratory compactor will eliminate differential settlement. The rock fill is to be compacted in 300-500mm thick layers.

7.1.2 Piled Foundations - Heavily Loaded Structures

The following are considered to be heavily loaded structures:-

- Primary Digesters
- Secondary Digester
- Thickener
- Gas Holder
- Silos
- Low Level Sump

Given the variability of the consistency of the alluvial soils and the sensitivity of the above mentioned water bearing structures it is recommended that these heavy structures will have to be placed on piled foundations designed as friction piles. The pile types which may be considered are:

- ***Driven Precast Piles***

  These piles can be driven to unlimited depths however driven pre cast piles often meet with problems when penetrating materials with an SPT 'N' Value greater than 30. Such values were measured in Borehole BH05 (drilled along the sewer outfall) and in all the DPSH tests. This could be solved by using a rock shoe on each of the driven piles. Typical working loads are 750kN to 2000kN depending on the pile dimensions.

- ***Augered cast in situ piles***

  These piles are one of the most commonly used piling solutions in South Africa. However due to the presence of a shallow water table, it may be necessary to case the piles which would increase installation time and increase cost. Working loads on augered cast in situ piles vary from 200kN to 25 000kN depending on the diameter of pile used.

- ***Underslurry Piles***

  These piles are suitable for heavily loaded structures and are excavated under a head of bentonite slurry which prevents collapse of the pile excavation. This collapse of the sidewalls is likely on this site due to the shallow water level and sands over much of the pile length. Typical working loads are 1700kN to 14 000kN depending on the pile diameter.

Although CFA piles are a fast and economical solution which is widely used in South Africa, it is not considered a viable option given that when CFA piles are founded below the water table in sandy soils, this results in a reduction of soil strength immediately around the pile due to the drilling operation, hence the load/deflection performance of the pile is inferior to other systems such as a driven pile (*P114, Guide to Practical Geotechnical Engineering, 2008*).

The type of pile used will need to be selected according to the programme of work, economics of piling system and performance of the piled system.

All piles would need to be designed taking into account the presence of very loose and loose material in the upper subsoil layers (up to approximately 5m depth) and isolated weaker zones (poor consistencies) within the alluvial soils which may cause some downdrag.

Sewer Outfall Pipeline

Although the subsoil's have a medium dense to very dense consistency, the presence of a shallow water table and the possibility of tidal influences (due to the pipeline being located on the beach) may result in settlement / movement of the pipeline due to scouring removing material. It is therefore recommended that the pipeline be constructed on a concrete cradle founded on piles to mitigate any differential settlement and movement due to the effect of the cyclic increase and decrease of the water table on the pipe. The piling solutions considered appropriate is the driven precast piles, augered cast in-situ piles and micropiles.

The piling for the pipeline will be a cost consideration – buried pipeline with difficult maintenance vs elevated pipeline with possible security issues.

8 Conclusion

The site is developable providing cognisance is taken of the findings included herein. It is imperative that the recommendations within this report be re-visited once foundation types, dimensions and stresses are available.

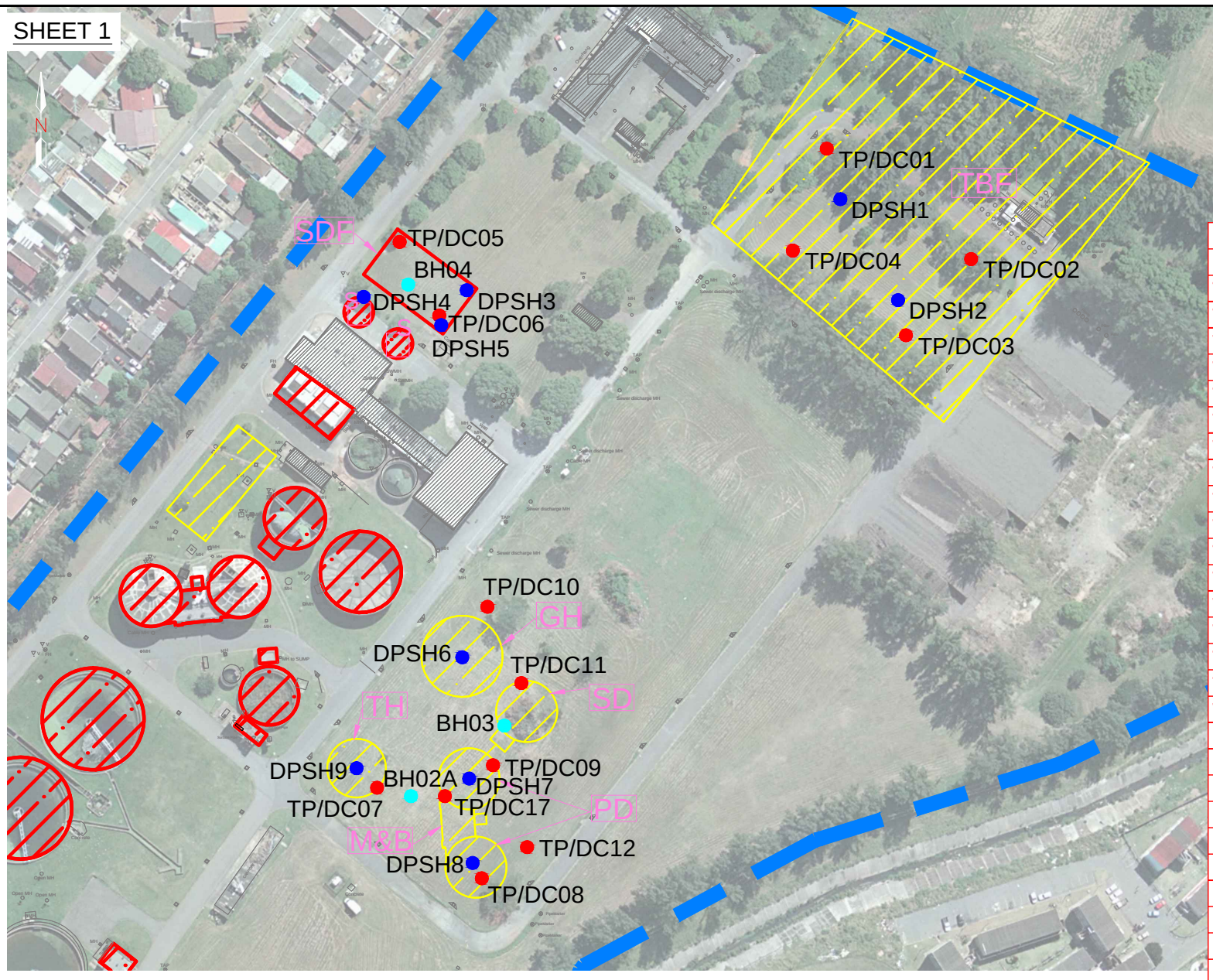
All light to medium loaded structures may be founded at shallow depths on a soil raft while the heavily loaded structures are to be founded on friction piles.

In addition, during construction an engineering geologist or geotechnical engineer should inspect all foundation excavations and provide input on the piling to ensure that conditions at variance to those found during the investigation are not present and to validate the findings of this report.

ANNEXURE A

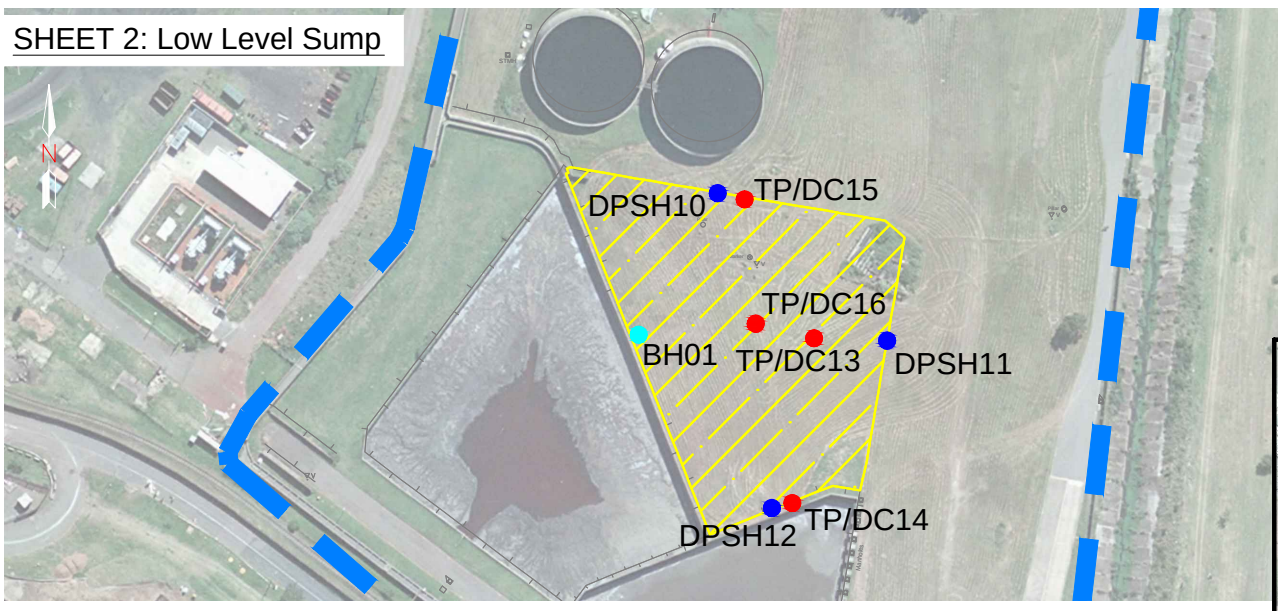
FIGURES

SHEET 1

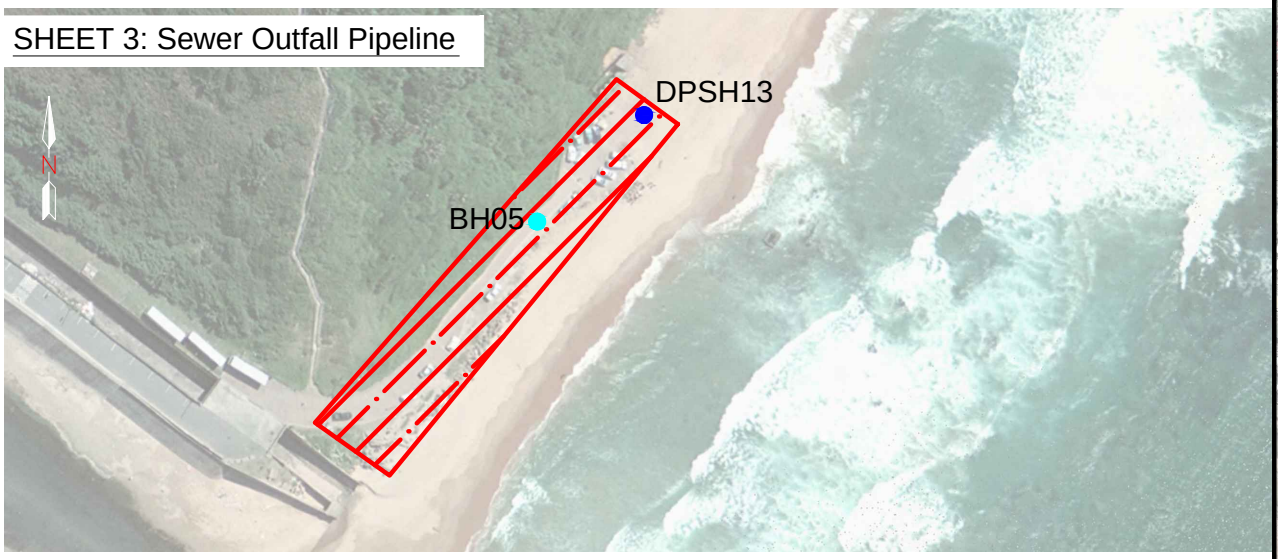


TP	X Coordinate	Y Coordinate
● TP/DC POINTS		
TP/DC01	3 315 083	2 408
TP/DC02	3 315 122	2 357
TP/DC03	3 315 149	2 380
TP/DC04	3 315 119	2 420
TP/DC05	3 315 116	2 559
TP/DC06	3 315 142	2 545
TP/DC07	3 315 309	2 567
TP/DC08	3 315 341	2 530
TP/DC09	3 315 301	2 526
TP/DC10	3 315 245	2 528
TP/DC11	3 315 272	2 516
TP/DC12	3 315 330	2 514
TP/DC13	3 316 056	2 561
TP/DC14	3 316 101	2 567
TP/DC15	3 316 018	2 580
TP/DC16	3 316 052	2 577
TP/DC17	3 315 312	2 543
● BH POINTS		
BH01	3 316 055	2 609
BH02A	3 315 312	2 555
BH03	3 315 287	2 522
BH04	3 315 131	2 556
BH05	3 316 585	2 000
● DPSH POINTS		
DPSH1	3 315 100.86	2 403.22
DPSH2	3 315 136.52	2 382.81
DPSH3	3 315 133.02	2 535.34
DPSH4	3 315 135.39	2 571.76
DPSH5	3 315 142.50	2 544.66
DPSH6	3 315 262.83	2 536.87
DPSH7	3 315 305.74	2 534.47
DPSH8	3 315 335.58	2 533.20
DPSH9	3 315 302.07	2 574.24
DPSH10	3 316 016.32	2 587.39
DPSH11	3 316 056.58	2 541.09
DPSH12	3 316 102.36	2 572.55
DPSH13	3 316 555.80	1 970.80

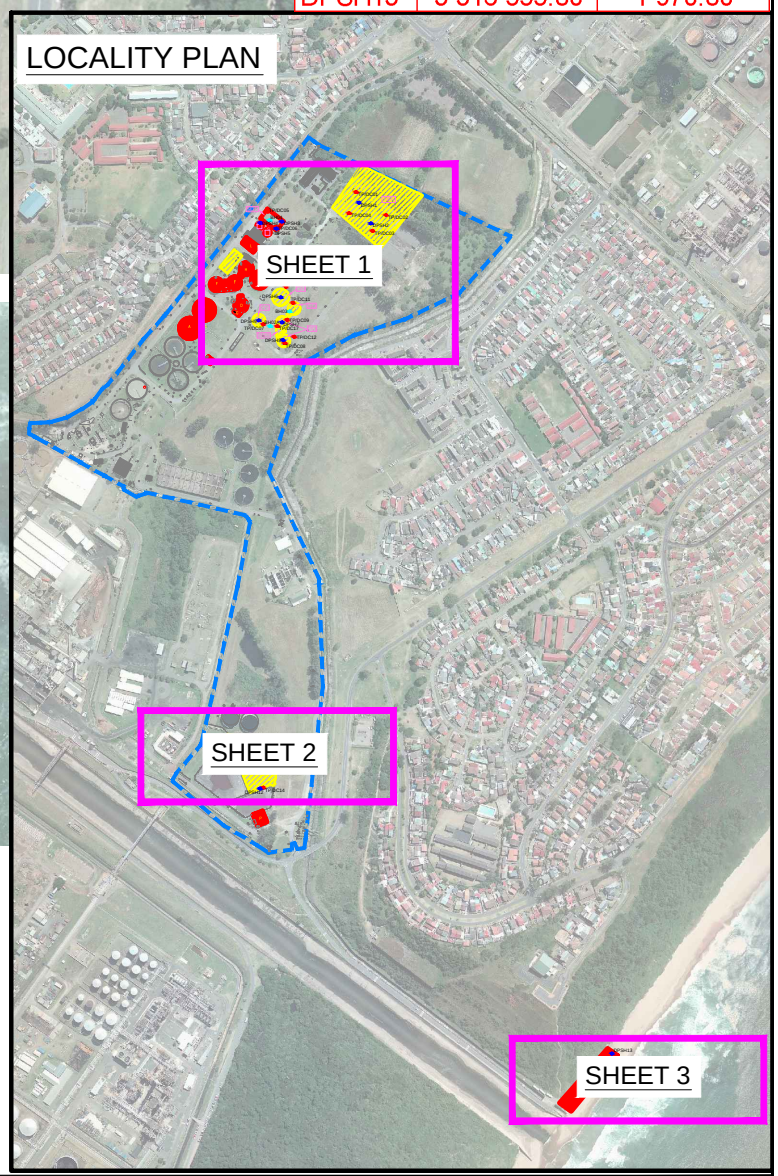
SHEET 2: Low Level Sump



SHEET 3: Sewer Outfall Pipeline



LOCALITY PLAN



KEY:

TBF-	TANKER BAY FACILIITY	S-	SILO
TH-	THICKNER	M&B-	MIXING BUILDING AND BOILER HOUSE
PD-	PRIMARY DIGESTER	SDF-	SLUDGE DRYING FACILITY
SD-	SECONDARY DIGESTER		
GH-	GAS HOLDER		
DW-	DEWATERING FACILITY		

AECOM

POSITION OF TESTS
GEOTECHNICAL INVESTIGATION
UPGRADE TO SOUTHERN WASTEWATER TREATMENT WORKS

AECOM DETAIL/FIGURE No.

01

ANNEXURE B

TEST PIT PROFILES & BOREHOLE LOGS

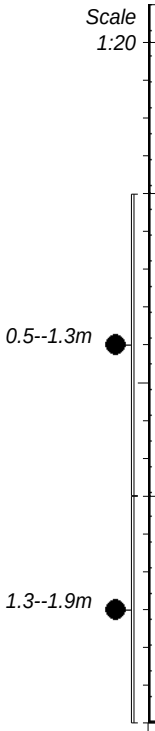
TEST PIT PROFILES

AECOM

EThekwini Municipality
SWWTW

TP01
Sheet 1 of 1

JOB NUMBER: J01945



0.00 Dry, dark grey, loose, silty SAND, FILL.

0.10 Dry, light grey, loose to medium dense, silty fine SAND, FILL.

0.50 Slightly moist to moist, orangey brown, medium dense, SAND, FILL.

1.30 Moist to wet, greyish orangey brown, medium dense, SAND, ALLUVIUM.

1.90

NOTES

1) Moderately to strong seepage at 1.7m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 1.9m.

3) Disturbed samples at 0.5--1.3m and 1.3--1.9m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 23/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315083
Y-COORD : 2408

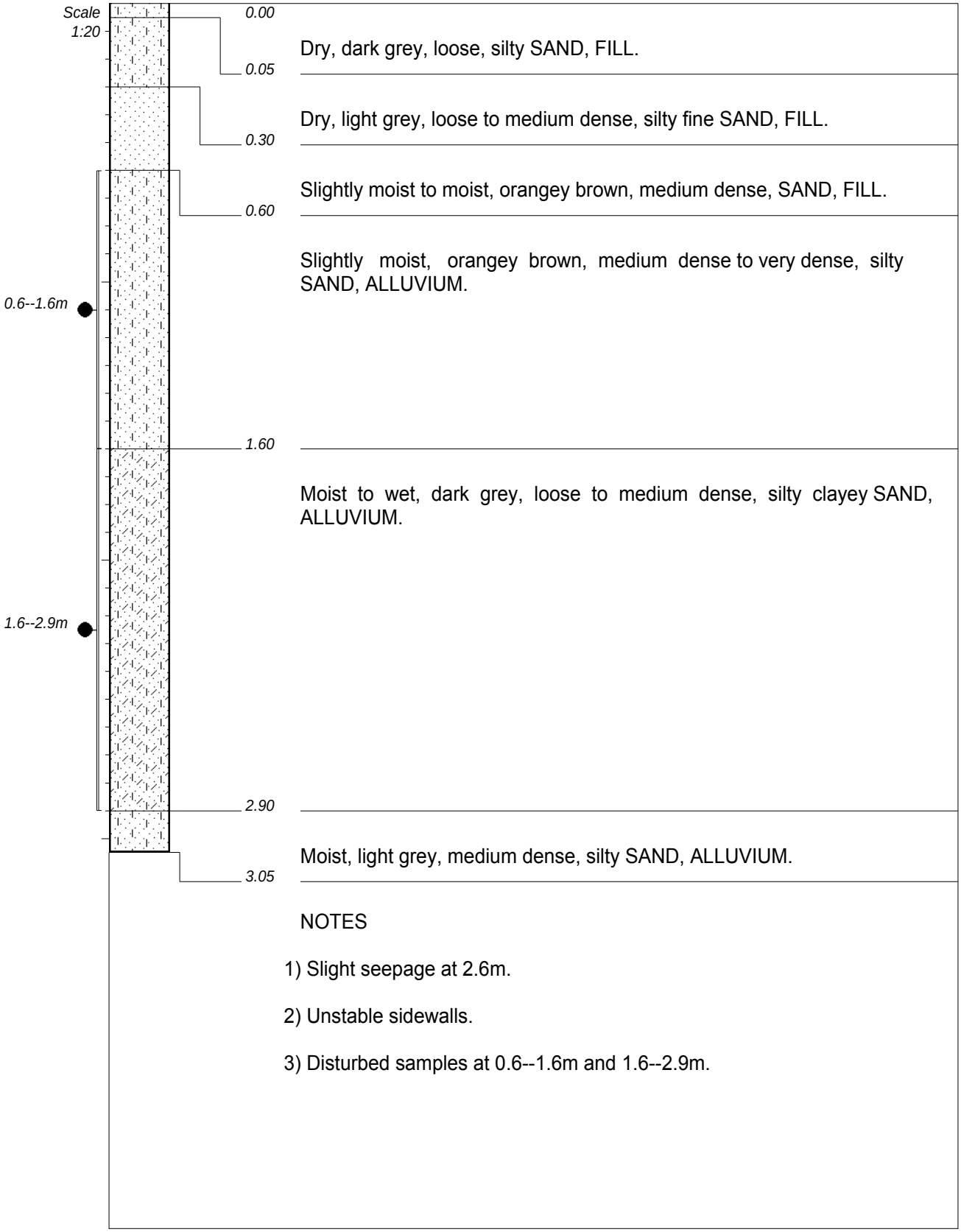
TP01

AECOM

EThekwini Municipality
SWWTW

TP02
Sheet 1 of 1

JOB NUMBER: J01945



0.00 – 0.05: Dry, dark grey, loose, silty SAND, FILL.

0.05 – 0.30: Dry, light grey, loose to medium dense, silty fine SAND, FILL.

0.30 – 0.60: Slightly moist to moist, orangey brown, medium dense, SAND, FILL.

0.60 – 1.60: Slightly moist, orangey brown, medium dense to very dense, silty SAND, ALLUVIUM.

1.60 – 2.90: Moist to wet, dark grey, loose to medium dense, silty clayey SAND, ALLUVIUM.

2.90 – 3.05: Moist, light grey, medium dense, silty SAND, ALLUVIUM.

NOTES

1) Slight seepage at 2.6m.

2) Unstable sidewalls.

3) Disturbed samples at 0.6--1.6m and 1.6--2.9m.

CONTRACTOR :
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EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

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DIAM :
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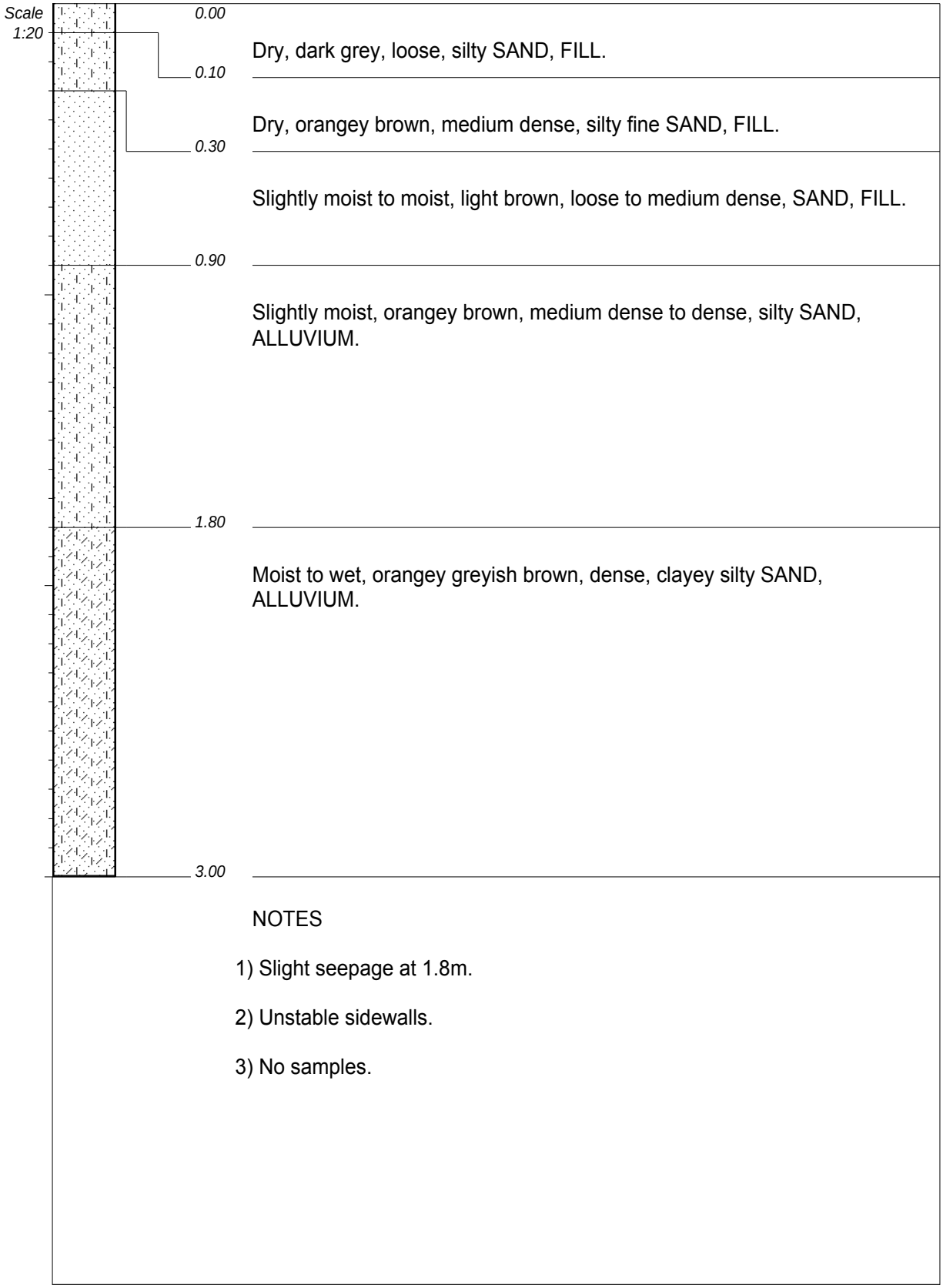
TP02

AECOM

EThekwini Municipality
SWWTW

TP03
Sheet 1 of 1

JOB NUMBER: J01945



Dry, dark grey, loose, silty SAND, FILL.

Dry, orangey brown, medium dense, silty fine SAND, FILL.

Slightly moist to moist, light brown, loose to medium dense, SAND, FILL.

Slightly moist, orangey brown, medium dense to dense, silty SAND, ALLUVIUM.

Moist to wet, orangey greyish brown, dense, clayey silty SAND, ALLUVIUM.

NOTES

1) Slight seepage at 1.8m.

2) Unstable sidewalls.

3) No samples.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 23/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
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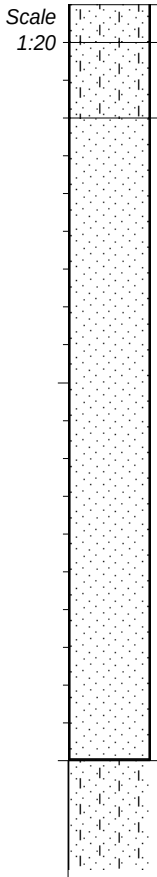
TP03

AECOM

EThekwini Municipality
SWWTW

TP04
Sheet 1 of 1

JOB NUMBER: J01945



0.00 – 0.10: Dry, dark grey, loose, silty SAND, FILL.

0.10 – 0.30: Dry, light grey, loose to medium dense, silty fine SAND, FILL.

0.30 – 2.00: Slightly moist to moist, light brown, loose to medium dense, SAND, FILL.

2.00 +: Wet, grey, medium dense, slightly silty SAND, ALLUVIUM.

NOTES

1) Slight seepage at 1.9m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.0m.

3) No samples.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 23/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

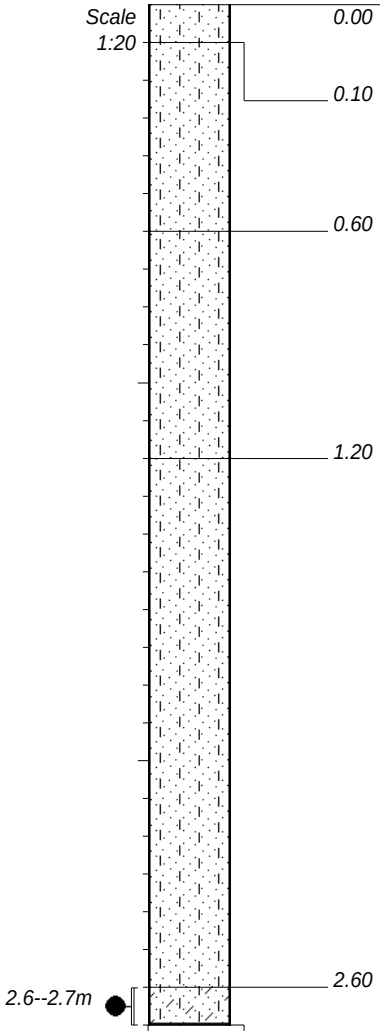
ELEVATION :
X-COORD : 3315119
Y-COORD : 2420

TP04

EThekwini Municipality
SWWTW

TP05
Sheet 1 of 1

JOB NUMBER: J01945



0.00 – 0.10: Dry, dark grey, loose, silty SAND, FILL.

0.10 – 0.60: Dry, orangey brown, medium dense to dense, silty SAND, FILL.

0.60 – 1.20: Slightly moist, orangey brown, medium dense to very dense, silty SAND, FILL.

1.20 – 2.60: Moist, light brown, medium dense to dense, slightly silty SAND, ALLUVIUM.

2.60 – 2.70: Moist, grey, loose to medium dense, slightly clayey silty SAND, ALLUVIUM.

NOTES

1) No seepage encountered.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.7m.

3) Disturbed samples at 2.6--2.7m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 23/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315116
Y-COORD : 2559

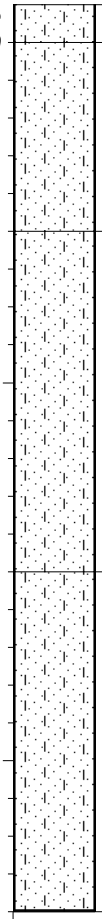
TP05

AECOM

EThekwini Municipality
SWWTW

TP06
Sheet 1 of 1

JOB NUMBER: J01945



0.00

Dry, dark grey, loose, silty SAND, FILL.

0.10

Dry to slightly moist, light orangey brown, dense, silty fine SAND, FILL.

0.60

Slightly moist, orangey brown, loose to medium dense, silty SAND, FILL.

1.50

Moist to wet, light grey, loose to medium dense, slightly silty SAND, ALLUVIUM.

2.40

NOTES

1) Slight seepage at 2.2m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.4m.

3) No samples taken.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 23/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315142
Y-COORD : 2545

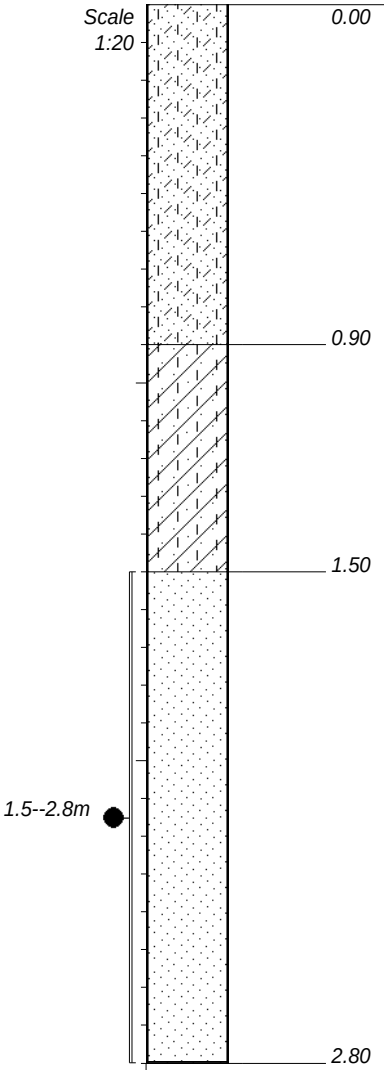
TP06

AECOM

EThekwini Municipality
SWWTW

TP07
Sheet 1 of 1

JOB NUMBER: J01945



Dry, orangey brown, medium dense to very dense, slightly clayey silty SAND, FILL.

Moist, grey blotched orangey brown, stiff to very stiff, sandy silty CLAY, FILL.

Moist to wet, dark grey, loose to medium dense, SAND, ALLUVIUM.

NOTES

1) Slight seepage at 2.2m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.8m.

3) Disturbed sample at 1.5--2.8m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 25/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315309
Y-COORD : 2567

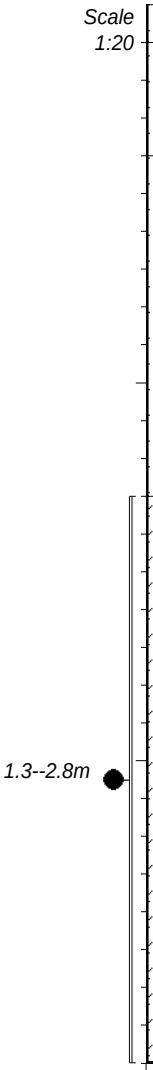
TP07

AECOM

EThekwini Municipality
SWWTW

TP08
Sheet 1 of 1

JOB NUMBER: J01945



0.00

Slightly moist, dark greyish brown, loose, silty SAND, FILL.

0.10

Slightly moist, light brown, medium dense, silty SAND, FILL.

0.40

Moist to wet, dark grey, medium dense, SAND, FILL.

1.30

Moist to wet, reddish brown, medium dense, clayey silty SAND, ALLUVIUM.

2.80

NOTES

1) Strong seepage at 1.0m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.8m.

3) Disturbed sample at 1.3--2.8m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 25/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

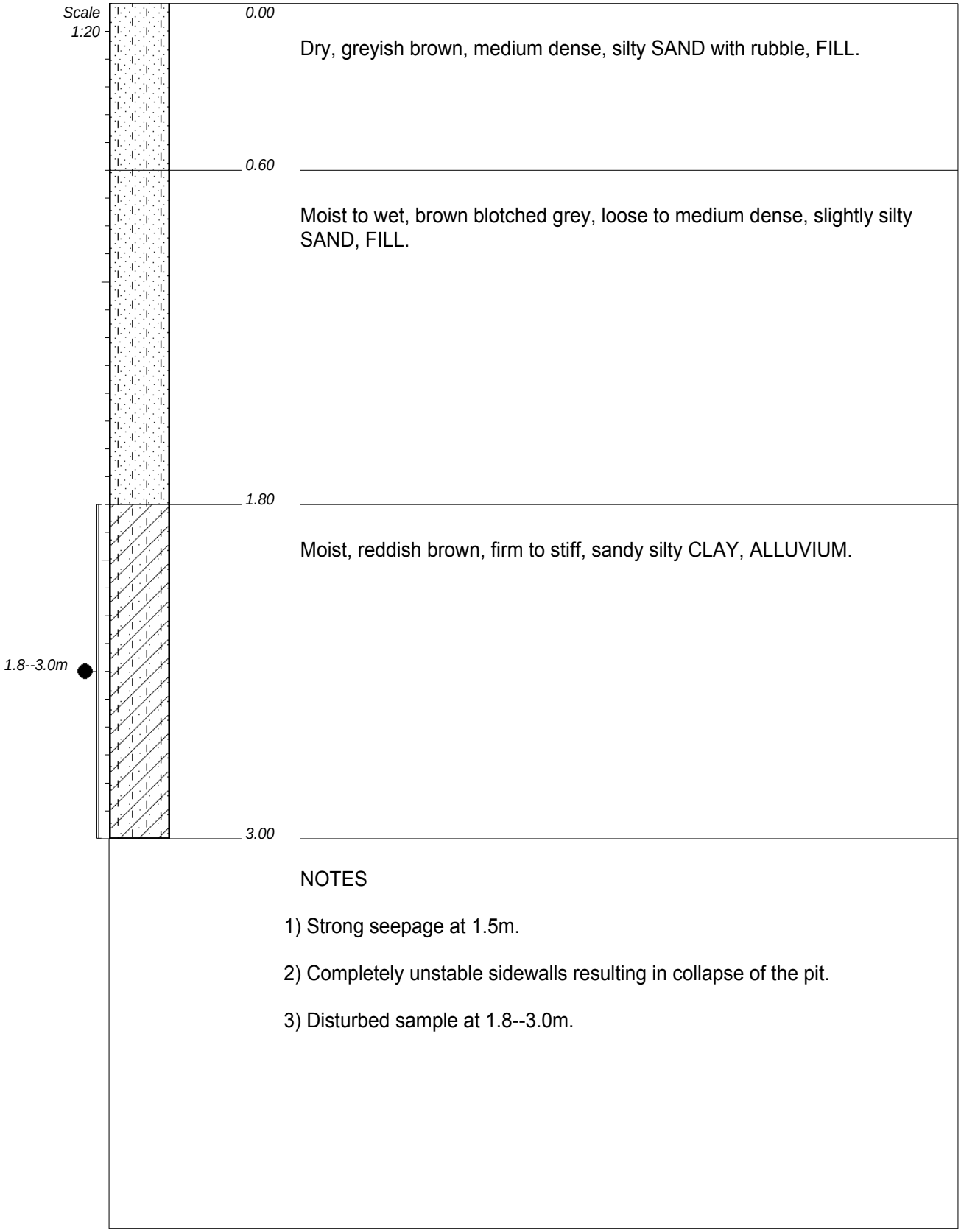
ELEVATION :
X-COORD : 3315341
Y-COORD : 2530

TP08

EThekwini Municipality
SWWTW

TP09
Sheet 1 of 1

JOB NUMBER: J01945



NOTES

1) Strong seepage at 1.5m.

2) Completely unstable sidewalls resulting in collapse of the pit.

3) Disturbed sample at 1.8--3.0m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 25/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315301
Y-COORD : 2526

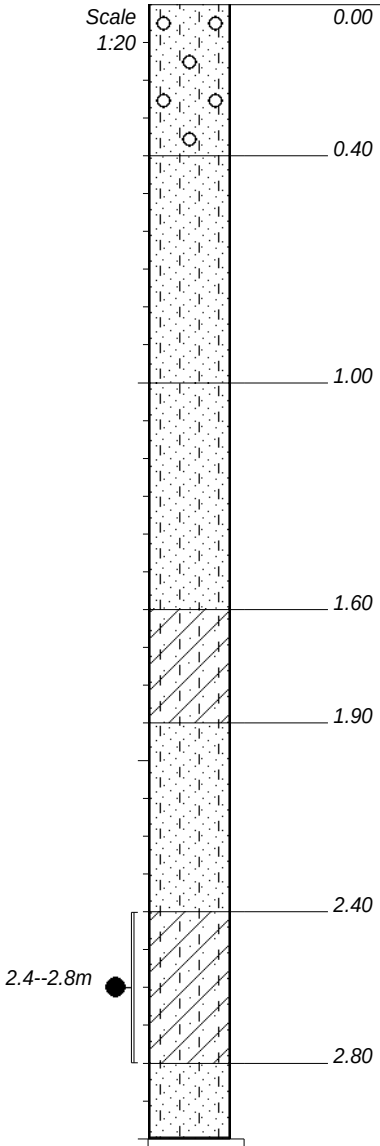
TP09

AECOM

EThekwini Municipality
SWWTW

TP10
Sheet 1 of 1

JOB NUMBER: J01945



0.00 — Dry, greyish brown, medium dense to dense, slightly gravelly silty SAND with refuse, FILL.

0.40 — Slightly moist, orangey brown, dense to very dense, silty SAND with refuse, FILL.

1.00 — Slightly moist, grey, dense, slightly silty SAND with refuse, FILL.

1.60 — Slightly moist, reddish brown, very stiff, sandy silty CLAY with refuse, FILL.

1.90 — Slightly moist, orangey brown, dense to very dense, silty SAND with scattered cobbles, FILL.

2.40 — Moist, orangey brown, very stiff, sandy silty CLAY, FILL.

2.80 — Wet, light grey blotched black, dense, slightly silty SAND with refuse, FILL.

3.00

NOTES

1) Slight seepage at 2.2m.

2) Completely unstable sidewalls resulting in collapse of the pit.

3) Disturbed samples at 2.4--2.8m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 25/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315245
Y-COORD : 2528

TP10

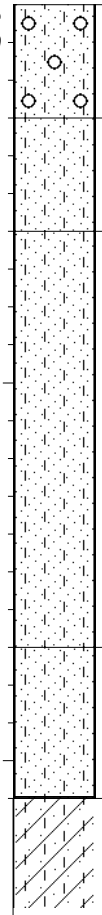
AECOM

EThekwini Municipality
SWWTW

TP11
Sheet 1 of 1

JOB NUMBER: J01945

Scale 1:20



0.00 Dry, brown, medium dense, slightly gravelly silty SAND, FILL.

0.30 Dry, orangey brown, medium dense, silty SAND, FILL.

0.60 Moist to wet, orangey brown, medium dense, slightly silty SAND with refuse, FILL.

1.70 Wet, grey, loose, slightly silty SAND with refuse, FILL.

2.10 Moist, reddish brown, firm, sandy silty CLAY, ALLUVIUM.

NOTES

1) Strong seepage at 1.5m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.1m.

3) No samples.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 26/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315272
Y-COORD : 2516

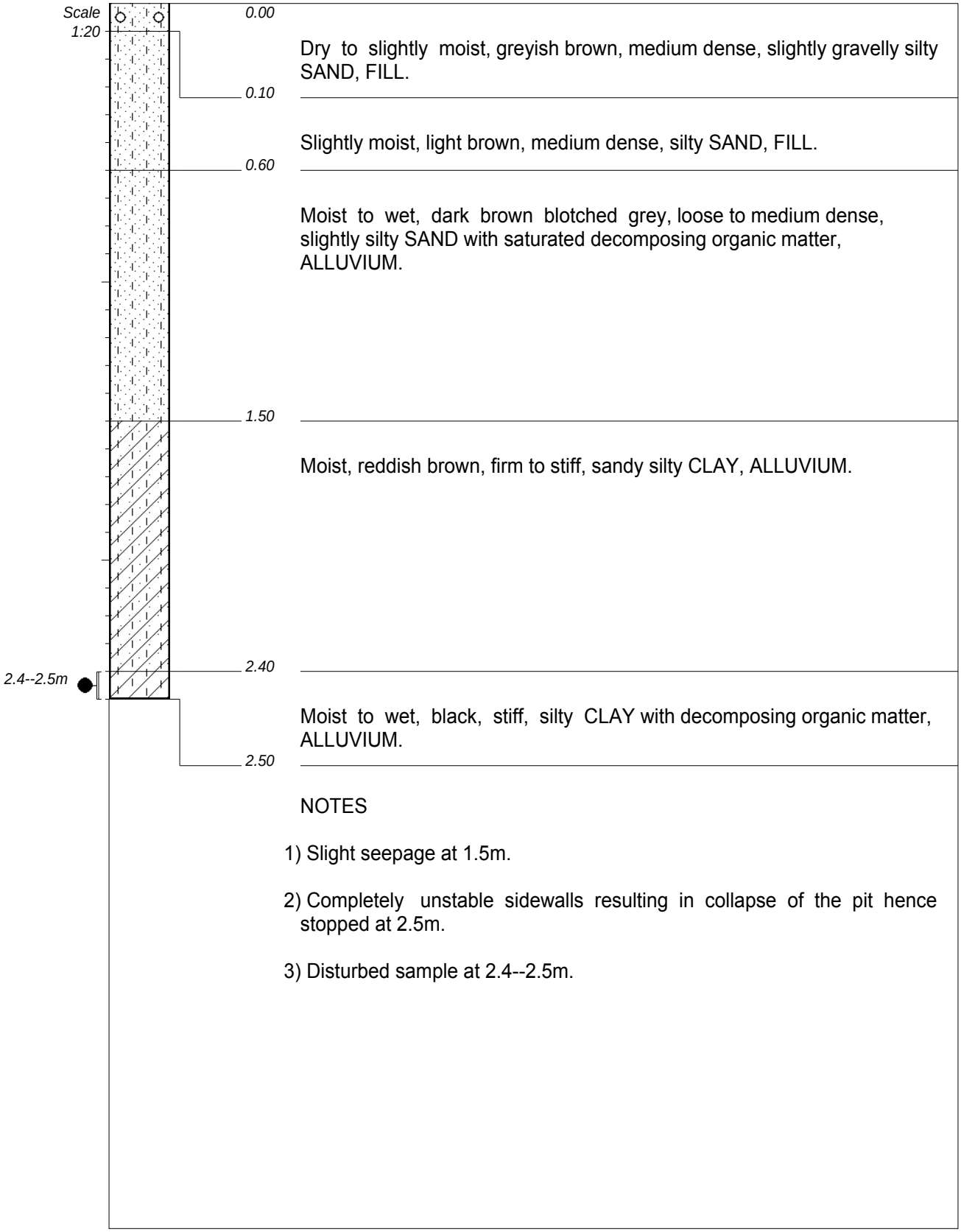
TP11

AECOM

EThekwini Municipality
SWWTW

TP12
Sheet 1 of 1

JOB NUMBER: J01945



0.00 – 0.10: Dry to slightly moist, greyish brown, medium dense, slightly gravelly silty SAND, FILL.

0.10 – 0.60: Slightly moist, light brown, medium dense, silty SAND, FILL.

0.60 – 1.50: Moist to wet, dark brown blotched grey, loose to medium dense, slightly silty SAND with saturated decomposing organic matter, ALLUVIUM.

1.50 – 2.40: Moist, reddish brown, firm to stiff, sandy silty CLAY, ALLUVIUM.

2.40 – 2.50: Moist to wet, black, stiff, silty CLAY with decomposing organic matter, ALLUVIUM.

NOTES

1) Slight seepage at 1.5m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.5m.

3) Disturbed sample at 2.4--2.5m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 30/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315330
Y-COORD : 2514

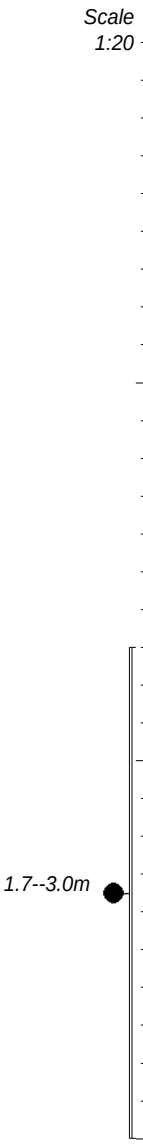
TP12

AECOM

EThekwini Municipality
SWWTW

TP13
Sheet 1 of 1

JOB NUMBER: J01945



0.00	Dry, brown, medium dense, silty SAND, FILL.
0.20	Slightly moist, orangey brown, medium dense, silty SAND with scattered gravels, FILL.
0.50	Slightly moist, orangey brown, medium dense, silty SAND with scattered gravels and shell fragments, FILL.
1.00	Moist, bluish grey, loose to medium dense, slightly silty SAND with shell fragments, FILL.
1.20	Moist, slightly greyish brown, loose to medium dense, silty SAND, FILL.
1.70	Moist, greenish brown, medium dense to very dense, SAND, ALLUVIUM.
3.00	

NOTES

1) No seepage encountered.

2) Slightly unstable.

3) Disturbed sample at 1.7--3.0m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 30/09/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3316056
Y-COORD : 2541

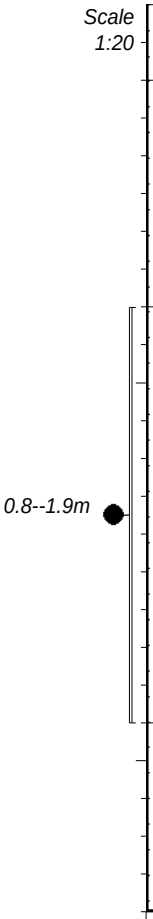
TP13

AECOM

EThekwini Municipality
SWWTW

TP14
Sheet 1 of 1

JOB NUMBER: J01945



0.00

Dry, brown, medium dense, silty SAND, FILL.

0.20

Slightly moist, orangey brown, medium dense to dense, silty SAND with scattered gravels, FILL.

0.80

Slightly moist, orangey brown, medium dense to very dense, slightly silty SAND, ALLUVIUM.

1.90

Moist to wet, grey, dense to very dense, slightly silty SAND, ALLUVIUM.

2.40

NOTES

1) Strong seepage at 1.7m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.4m.

3) Disturbed sample at 0.8--1.9m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 01/10/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3316101
Y-COORD : 2567

TP14

EThekwini Municipality
SWWTW

TP15
Sheet 1 of 1

JOB NUMBER: J01945

0.00	Slightly moist, brown, loose, silty SAND, FILL.
0.20	Slightly moist, orangey brown, very loose to medium dense, silty SAND, ALLUVIUM.
0.90	Moist, pinkish brown, very loose to loose, slightly silty SAND, ALLUVIUM.
1.30	Moist, greenish brown, loose to medium dense, SAND, ALLUVIUM.
1.60	Moist, orangey brown, medium dense, silty SAND, ALLUVIUM.
2.50	

NOTES

1) Slight seepage at 2.0m.

2) Completely unstable sidewalls resulting in collapse of the pit hence stopped at 2.5m.

3) Disturbed sample at 1.6--2.5m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 01/10/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3316018
Y-COORD : 2580

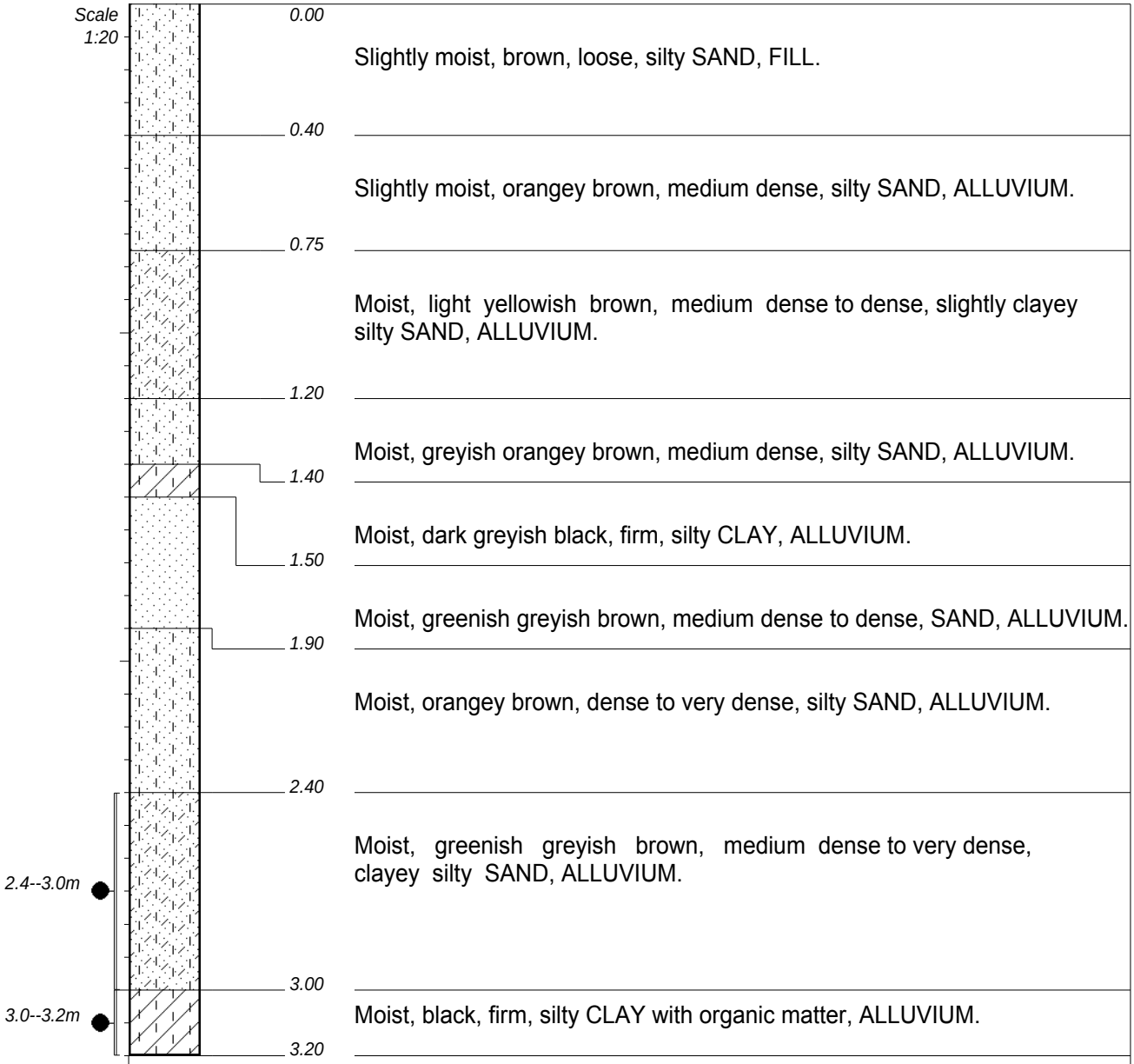
TP15

AECOM

EThekwini Municipality
SWWTW

TP16
Sheet 1 of 1

JOB NUMBER: J01945



NOTES

1) Strong seepage at 3.0m.

2) Unstable sidewalls resulting in collapse of the pit.

3) Disturbed samples at 2.4--3.0m and 3.0--3.2m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 01/10/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

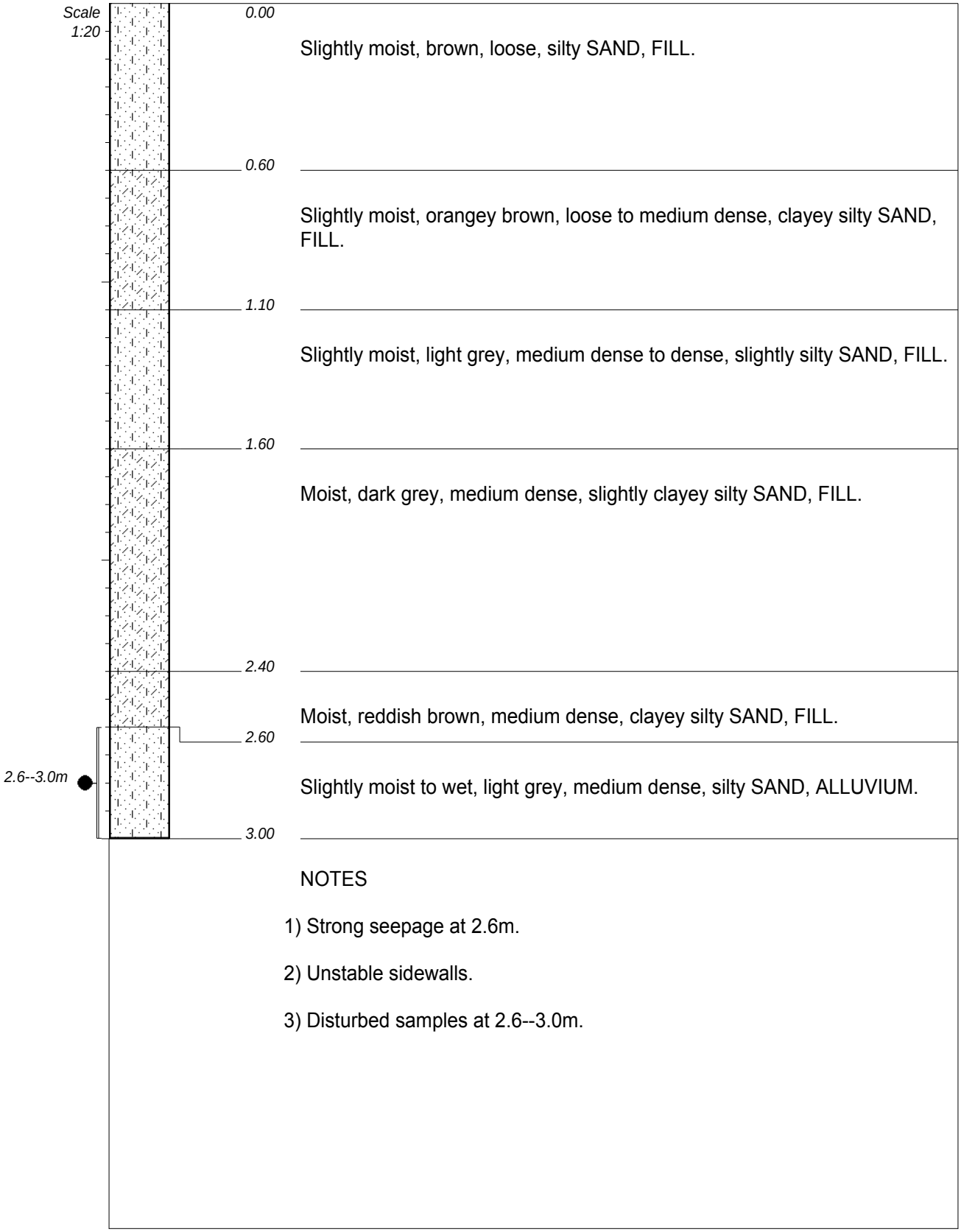
ELEVATION :
X-COORD : 3316052
Y-COORD : 2577

TP16

EThekwini Municipality
SWWTW

TP17
Sheet 1 of 1

JOB NUMBER: J01945



NOTES

1) Strong seepage at 2.6m.

2) Unstable sidewalls.

3) Disturbed samples at 2.6--3.0m.

CONTRACTOR :
MACHINE :
EXCAVATED BY :
PROFILED BY : R NAIDOO
CHECKED BY :
SETUP FILE : TESTPI~1.SET

INCLINATION :
DIAM :
DATE : 01/10/2014
DATE 03/11/2014 07:26
TEXT : ..lot\RevisedSWWTWTP's.txt

ELEVATION :
X-COORD : 3315312
Y-COORD : 2543

TP17

BOREHOLE LOGS

BH01 *Sheet 1 of 3*	*ROCK FABRIC*	*GRAIN SIZE*	*JOINT ROUGHNESS*	*ROCK HARDNESS*
JOB NUMBER: J01945	*MF -massive*	*FG -fine grained*	*SLJ-slickensided*	*EHR-extremely hard rock*
	BF -bedded	*MG -medium grain*	*SJ -smooth*	*VHR-very hard rock*
	FF -foliated	*CG -coarse grain*	*RJ -rough*	*HR -hard rock*
	CF -cleaved			*MHR-medium hard rock*
	SF -schistose	*JOINT SPACING*	*JOINT SHAPE*	*SR -soft rock*
	GF -gneissose	*VCJ-very close spacg*	*CUR-curvilinear*	*VSR-very soft rock*
	LF -laminated	*CJ -close spacing*	*PLA-planar*	
		MJ -medium spacing	*UND-undulating*	
		WJ -wide spacing	*STE-stepped*	
		VWJ-very wide spacng	*IRR-irregular*	

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH01 *Sheet 1 of 3*

JOB NUMBER: J01945

%Mater recov	*%Core recov*	*%RQD*	*Grain Size*	*Rock Fabric*	*Fabric Spacing (mm)*	*No. of Joints sets*	*Joints incl (deg)*	*Joints spacing*	*Joints rough & Shape*	*Fill type*	*Fill thick (mm)*	*Frac Freq (m)*	*DRILLING METHOD*	*SPT*
100	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
100	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
98	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
96	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
31	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
27	-	-	-	-	-	-	-	-	-	-	-	-	SPT	4
97	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
97	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
			-	-	-	-	-	-	-	-	-	-		
			-	-	-	-	-	-	-	-	-	-		
23	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
29	-	-	-	-	-	-	-	-	-	-	-	-	SPT	10
			-	-	-	-	-	-	-	-	-	-		

DEPTH Scale 1:30

Scale 1:30

0.00	Dark brown, silty SAND. FILL.
0.20	Orangey brown, silty SAND with scattered gravels. FILL.
1.12	Greyish yellowish brown, slightly clayey silty SAND. FILL.
2.47	Brown, slightly silty SAND with shell fragments. ALLUVIUM.
4.96	Brownish grey, silty SAND. ALLUVIUM.
5.20	Greyish brown, slightly silty SAND. ALLUVIUM.
5.40	Orangey greyish brown, slightly silty SAND with shell fragments. ALLUVIUM.
6.05	Light grey, slightly clayey silty SAND with shell fragments and organic matter. ALLUVIUM.

BH01
Sheet 2 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH01
Sheet 2 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
99	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	18
			-	-	-	-	-	-	-	-	-	-		
			-	-	-	-	-	-	-	-	-	-		
100	-	-	-	-	-	-	-	-	-	-	-	-	SHELBY	21
100	-	-											NWD4	21
100	-	-											NWD4	-
100	-	-											SPT	18
100	-	-											SHELBY	-
100	-	-											NWD4	-
100	-	-											NWD4	-
100	-	-											SHELBY	-
100	-	-											SPT	21
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-

DEPTH Scale 1:30

7
7.10 — Orangey brown, clayey silty SAND. ALLUVIUM.
7.43 — Dark grey, slightly fine sandy silty CLAY. ALLUVIUM.
7.81 — Dark grey, silty CLAY with shell fragments. ALLUVIUM.
8
8.05 — Blackish grey, slightly sandy silty CLAY. ALLUVIUM.
8.05--8.6m
8.87 — Blackish grey slightly fine sandy silty CLAY with shell fragments. ALLUVIUM.
9
9.52--10.07m
10
11
11.33--11.76m
12
13

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

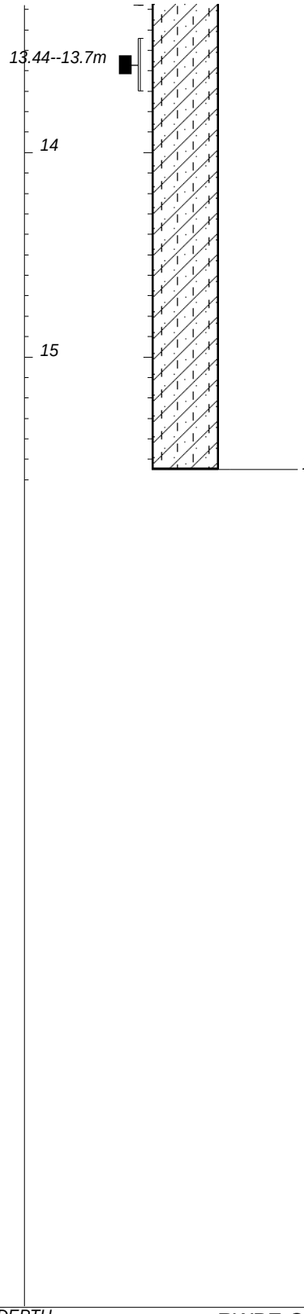
AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH01
Sheet 3 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT	DEPTH Scale 1:30
100	-	-											SHELBY	-	
100	-	-											NWD4	-	
98	-	-											SPT	21	



NOTES

1) Water level at 1.5m.

2) Undisturbed samples at 8.05--8.6m, 9.52--10.07m, 11.33--11.76m and 13.44--13.7m.

CONTRACTOR : RWBE Geotechnical Drilling
MACHINE : YWE - D8
EXCAVATED BY : Willy Motau
PROFILED BY : RSN
CHECKED BY : KD
SETUP FILE : Borehole.SET

INCLINATION : vertical
DIAM :
DATE : 02/10/2014
DATE 03/11/2014 07:31
TEXT : ..\Dotplot\RevisedBH01.txt

ELEVATION :
X-COORD : 3316055.08
Y-COORD : 2609

BH01

BH02A
Sheet 1 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH02A
Sheet 1 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT SPT
67	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
93	-	-											NXC	-
71	-	-											NXC	-
97	-	-											NWD4	-
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
38	-	-											SPT	4
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-											NWD4	-
95	-	-											NWD4	-
92	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
-	-	-											SHELBY	-
100	-	-											NWD4	-
24	-	-	-	-	-	-	-	-	-	-	-	-	SPT	-
100	-	-											NWD4	-

DEPTH Scale 1:30

Scale 1:30

1
2
3
4
5
6

0.00 Slightly orangey brown, slightly gravelly silty SAND with scattered gravels. FILL

1.54 Orangey grey, clayey silty SAND. FILL.

1.70 Grey, slightly silty SAND with scattered gravels. ALLUVIUM.

5.11 Dark grey, slightly clayey silty SAND. ALLUVIUM.

5.20 Dark grey, silty SAND. ALLUVIUM.

5.47 Grey, slightly silty SAND. ALLUVIUM.

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VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH02A
Sheet 2 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT SPT
58	-	-											SPT	26
43	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
22	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
-	-	-	-	-	-	-	-	-	-	-	-	-	SPT	17
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-	-	-	-	-	-	-	-	-	-	-	SHELBY	-
100	-	-											NWD4	-
93	-	-											NWD4	-
99	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
60	-	-											SPT	22
38	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-

DEPTH Scale 1:30

7
8
9
10
11
12
13

10.23--10.77m

7.05 Grey, slightly silty SAND. ALLUVIUM.

8.01 Light grey, slightly silty SAND. ALLUVIUM.

9.00 Interpreted as slightly silty SAND. ALLUVIUM.

9.45 Orangey yellowish grey, slightly silty SAND. ALLUVIUM.

10.23 Orangey grey, slightly silty SAND. ALLUVIUM.

10.77 Orangey pinkish grey, slightly silty SAND. ALLUVIUM.

12.94 Interpreted as slightly silty SAND. ALLUVIUM.

13.07

BH02A
Sheet 3 of 3

JOB NUMBER: J01945

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CG -coarse grain

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CJ -close spacing
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WJ -wide spacing
VWJ-very wide spacng

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RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH02A
Sheet 3 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT SPT	DEPTH Scale 1:30
100	-	-	-	-	-	-	-	-	-	-	-	-	SHELBY	-	13.07--13.6m
90	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	14
73	-	-											SPT	15	15

13.07--13.6m

Orangey grey, slightly clayey SAND. ALLUVIUM.

13.60

Yellowish brown with scattered bluish grey streaks, slightly silty SAND. ALLUVIUM.

15.51

NOTES

1) Water level at 1.2m.

2) Undisturbed sample at 10.23--10.77m, 13.07--13.6m.

CONTRACTOR : RWBE Geotechnical Drilling
MACHINE : YWE - D8
EXCAVATED BY : Willy Motau
PROFILED BY : RSN
CHECKED BY : KD
SETUP FILE : Borehole.SET

INCLINATION : vertical
DIAM :
DATE : 30/09/2014
DATE 03/11/2014 07:31
TEXT : ..Dotplot\RevisedBH02A.txt

ELEVATION :
X-COORD : 3315312
Y-COORD : 2555

BH02A

BH03
Sheet 1 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

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VCJ-very close spacg
CJ -close spacing
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RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

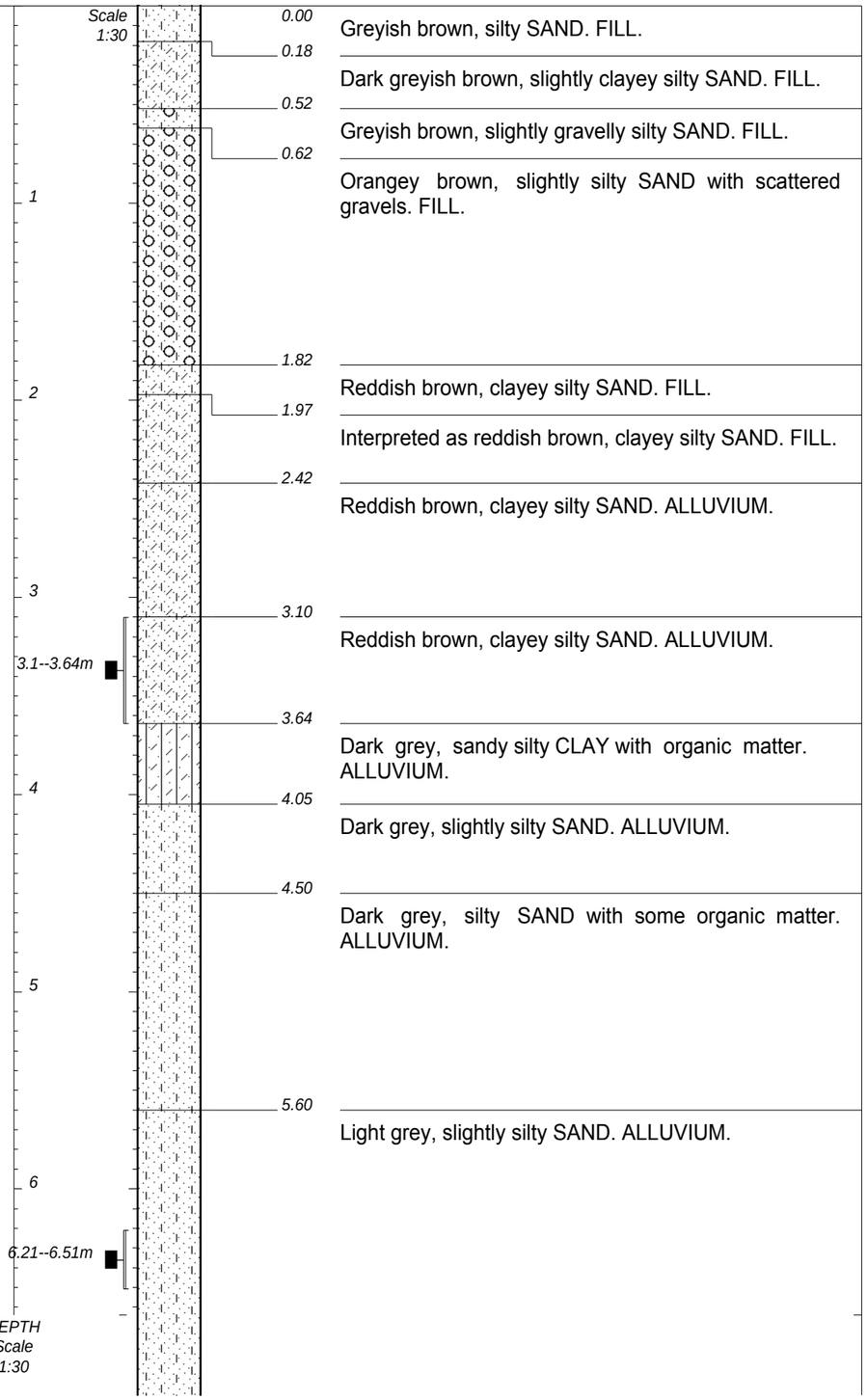
AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH03
Sheet 1 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
100	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
77	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
49	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
-	-	-	-	-	-	-	-	-	-	-	-	-	SPT	4
74	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-	-	-	-	-	-	-	-	-	-	-	SHELBY	-
74	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
96	-	-	-	-	-	-	-	-	-	-	-	-	SPT	14
65	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
-	-	-	-	-	-	-	-	-	-	-	-	-	SHELBY	-



Greyish brown, silty SAND. FILL.

Dark greyish brown, slightly clayey silty SAND. FILL.

Greyish brown, slightly gravelly silty SAND. FILL.

Orangey brown, slightly silty SAND with scattered gravels. FILL.

Reddish brown, clayey silty SAND. FILL.

Interpreted as reddish brown, clayey silty SAND. FILL.

Reddish brown, clayey silty SAND. ALLUVIUM.

Reddish brown, clayey silty SAND. ALLUVIUM.

Dark grey, sandy silty CLAY with organic matter. ALLUVIUM.

Dark grey, slightly silty SAND. ALLUVIUM.

Dark grey, silty SAND with some organic matter. ALLUVIUM.

Light grey, slightly silty SAND. ALLUVIUM.

BH03
Sheet 2 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
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SLJ-slickensided
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RJ -rough

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PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
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AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH03
Sheet 2 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT	DEPTH Scale 1:30
100	-	-											NWD4	-	7
99	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	8
60	-	-											SPT	28	
37	-	-											NWD4	-	9
16	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	10
58	-	-	-	-	-	-	-	-	-	-	-	-	SPT	12	11
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	
63	-	-											NWD4	-	12
52	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	
															13

9.50 Light grey, slightly silty SAND. ALLUVIUM.

11.10 Black, clayey silty SAND with organic matter. ALLUVIUM.

11.64 Black, silty SAND. ALLUVIUM.

11.91 Light grey, slightly silty SAND. ALLUVIUM.

13.00 Light brown, slightly silty SAND. ALLUVIUM.

ROCK FABRIC
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WJ -wide spacing
VWJ-very wide spacng

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RJ -rough

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PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
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SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH03
Sheet 3 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
31	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
93	-	-											SPT	58
36	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-

DEPTH Scale 1:30

14

15

14.45

Light grey, slightly silty SAND. ALLUVIUM.

15.03

NOTES

1) Water level at 1.5m.

2) Undisturbed samples at 3.1--3.64m and 6.21--6.51m.

CONTRACTOR : RWBE Geotechnical Drilling
MACHINE : YWE - D8
EXCAVATED BY : Willy Motau
PROFILED BY : RSN
CHECKED BY : KD
SETUP FILE : Borehole.SET

INCLINATION : vertical
DIAM :
DATE : 30/09/2014
DATE 03/11/2014 07:31
TEXT : ..\Dotplot\RevisedBH03.txt

ELEVATION :
X-COORD : 3315287
Y-COORD : 2522

BH03

BH04
Sheet 1 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH04
Sheet 1 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT	DEPTH Scale 1:30
91	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-	0.00 Brown, silty SAND with scattered gravels. FILL.
			-	-	-	-	-	-	-	-	-	-			0.15 Orangey brown, silty SAND with scattered gravels. FILL.
58	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	0.60 Light brown, slightly silty SAND. FILL.
			-	-	-	-	-	-	-	-	-	-			0.93 Grey, silty SAND. FILL.
78	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	1.60 Light brown, slightly silty SAND. FILL.
			-	-	-	-	-	-	-	-	-	-			2.05 Light grey, slightly silty SAND. FILL.
58	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	2.18 Light brown, slightly silty SAND. ALLUVIUM.
44	-	-											NWD4	-	
62	-	-	-	-	-	-	-	-	-	-	-	-	SPT	12	3.10 Light brown, silty SAND. ALLUVIUM.
80	-	-											NWD4	-	
			-	-	-	-	-	-	-	-	-	-			4.15 Light brown, slightly silty SAND. ALLUVIUM.
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	4.85 Light brown, slightly clayey silty SAND. ALLUVIUM.
															5.04 Orangey light brown, silty SAND. ALLUVIUM.
51	-	-											SPT	22	

Scale 1:30

BH04
Sheet 2 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

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AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH04
Sheet 2 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
98	-	-											NWD4	-
-	-	-	-	-	-	-	-	-	-	-	-	-	SHELBY	-
100	-	-											NWD4	-
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-											NWD4	-
91	-	-											SPT	21
97	-	-											NWD4	-
99	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
-	-	-											SPT	30
100	-	-											NWD4	-

DEPTH Scale 1:30

7
8
9
10
11
12
13

6.90

Interpreted as orangey light brown, silty SAND. ALLUVIUM.

7.40

Orangey light brown, silty SAND. ALLUVIUM.

8.40

Orangey light brown, slightly clayey silty SAND. ALLUVIUM.

9.82

Light grey blotched light orange, silty SAND with some organic matter. ALLUVIUM.

12.00

Light greyish brown, silty SAND. ALLUVIUM.

BH04
Sheet 3 of 3

JOB NUMBER: J01945

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AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH04
Sheet 3 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
95	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
67	-	-											SPT	5

DEPTH Scale 1:30

14

15

15.45

NOTES

1) Water level at 1.0m.

CONTRACTOR : RWBE Geotechnical Drilling
MACHINE : YWE - D8
EXCAVATED BY : Willy Motau
PROFILED BY : RSN
CHECKED BY : KD
SETUP FILE : Borehole.SET

INCLINATION : vertical
DIAM :
DATE : 02/10/2014
DATE 03/11/2014 07:32
TEXT : ..\Dotplot\RevisedBH04.txt

ELEVATION :
X-COORD : 331531.45
Y-COORD : 2556

BH04

BH05
Sheet 1 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
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AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH05
Sheet 1 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
97	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
100	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
62	-	-	-	-	-	-	-	-	-	-	-	-	NXC	-
35	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
98	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
82	-	-	-	-	-	-	-	-	-	-	-	-	SPT	19
67	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
60	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
89	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-	-	-	-	-	-	-	-	-	-	-	SPT	21

DEPTH Scale 1:30

Scale 1:30

0.00	Dark brown, gravelly silty SAND. FILL.
0.60	Light brown, SAND. FILL.
1.00	Brown, gravelly SAND. FILL.
1.14	Greyish brown, silty SAND with scattered gravels. FILL.
1.20	Brown, slightly silty SAND. FILL.
1.50	Dark brown, slightly silty SAND. FILL.
2.40	Light greyish brown, slightly clayey silty SAND. FILL.
2.60	Brown, SAND. BEACH SAND.
2.73	Black speckled brown, silty fine SAND. BEACH SAND.
2.85	Greyish brown clayey silty SAND. BEACH SAND.
3.00	Brown, SAND. BEACH SAND.
3.23	Black speckled brown, silty fine SAND. BEACH SAND.
3.34	Brown, silty SAND. BEACH SAND.
3.45	Black speckled brown, silty fine SAND. BEACH SAND.
3.50	Brown, silty SAND. BEACH SAND.
4.20	Brown blotched greyish black, silty fine SAND. BEACH SAND.
4.80	Orangey brown, silty fine SAND. BEACH SAND.
5.10	Greyish brown, silty SAND. BEACH SAND.
5.59	Dark brown blotched orange, silty SAND. BEACH SAND.
6.00	Orangey brown, silty SAND. BEACH SAND.
6.45	

BH05
Sheet 2 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH05
Sheet 2 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT	DEPTH Scale 1:30	
85	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	7	Light orangey brown blotched grey, silty SAND. BEACH SAND.
			-	-	-	-	-	-	-	-	-	-				
95	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-		
			-	-	-	-	-	-	-	-	-	-				
91	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-		
			-	-	-	-	-	-	-	-	-	-				
38	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-	8	
47	-	-											SPT	19		
92	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-		
100	-	-											NWD4	-	9	
100	-	-											SHELBY	-		
100	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-		
100	-	-											SPT	36		
60	-	-											NWD4	-	10	
															11	
															12	
															13	

11.08--11.47m

6.90 Dark grey, slightly clayey silty SAND. BEACH SAND.

7.00 Orangey blotched grey, silty SAND. BEACH SAND.

7.10 Orangey brown, silty SAND. BEACH SAND.

7.40 Orangey brown, slightly silty SAND. BEACH SAND.

7.55 Orangey brown, silty SAND. BEACH SAND.

7.87 Greyish brown, silty SAND. BEACH SAND.

8.00 Orangey brown, silty SAND. BEACH SAND.

9.00 Light grey, silty SAND. BEACH SAND.

10.05 Light grey, slightly clayey SAND. BEACH SAND.

BH05
Sheet 3 of 3

JOB NUMBER: J01945

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

AECOM

EThekwini Municipality
Southern Waste Water Treatment Works

BH05
Sheet 3 of 3

JOB NUMBER: J01945

%Mater recov	%Core recov	%RQD	Grain Size	Rock Fabric	Fabric Spacing (mm)	No. of Joints sets	Joints incl (deg)	Joints spacing	Joints rough & Shape	Fill type	Fill thick (mm)	Frac Freq (m)	DRILLING METHOD	SPT
31	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
30	-	-	-	-	-	-	-	-	-	-	-	-	NWD4	-
100	-	-											SPT	35

DEPTH Scale 1:30

14

15

13.63

Light grey, silty SAND. BEACH SAND.

15.45

NOTES

1) Water level at 3.2m.

2) Undisturbed sample at 11.08--11.47m.

CONTRACTOR : RWBE Geotechnical Drilling
MACHINE : YWE - D8
EXCAVATED BY : Willy Motau
PROFILED BY : RSN
CHECKED BY : KD
SETUP FILE : Borehole.SET

INCLINATION : vertical
DIAM :
DATE : 02/10/2014
DATE 03/11/2014 07:32
TEXT : ..\Dotplot\RevisedBH05.txt

ELEVATION :
X-COORD : 3316585
Y-COORD : 2000

BH05

Southern Waste Water Treatment Works
SWWTW, Durban , The Bluff
AECOM SA

RWBE Geotechnical Drilling

Location:	SWWTW Plant
Bore Hole No.:	BH 01
Box No.:	1 to 2
Depth Range:	0.00 to 15.55
Date of Works:	Sept - Oct 2014

Southern Waste Water Treatment Works
SWWTW, Durban , The Bluff
AECOM SA

RWBE Geotechnical Drilling

Location:	SWWTW Plant
Bore Hole No.:	BH 2A
Box No.:	1 to 2
Depth Range:	0.00 to 15.52
Date of Works:	Sept - Oct 2014

Southern Waste Water Treatment Works
SWWTW, Durban , The Bluff
AECOM SA

RWBE Geotechnical Drilling

Location:	SWWTW Plant
Bore Hole No.:	BH 03
Box No.:	1 to 2
Depth Range:	0.00 to 15.03
Date of Works:	Sept - Oct 2014

Southern Waste Water Treatment Works
SWWTW, Durban , The Bluff
AECOM SA

RWBE Geotechnical Drilling

Location:	SWWTW Plant
Bore Hole No.:	BH 04
Box No.:	1 to 2
Depth Range:	0.00 to 15.45
Date of Works:	Sept - Oct 2014

Southern Waste Water Treatment Works
SWWTW, Durban , The Bluff
AECOM SA

RWBE Geotechnical Drilling

Location:	SWWTW Plant
Bore Hole No.:	BH 05
Box No.:	1 to 2
Depth Range:	0.00 to 15.45
Date of Works:	Sept - Oct 2014

ANNEXURE C

DCP & DPSH RESULTS

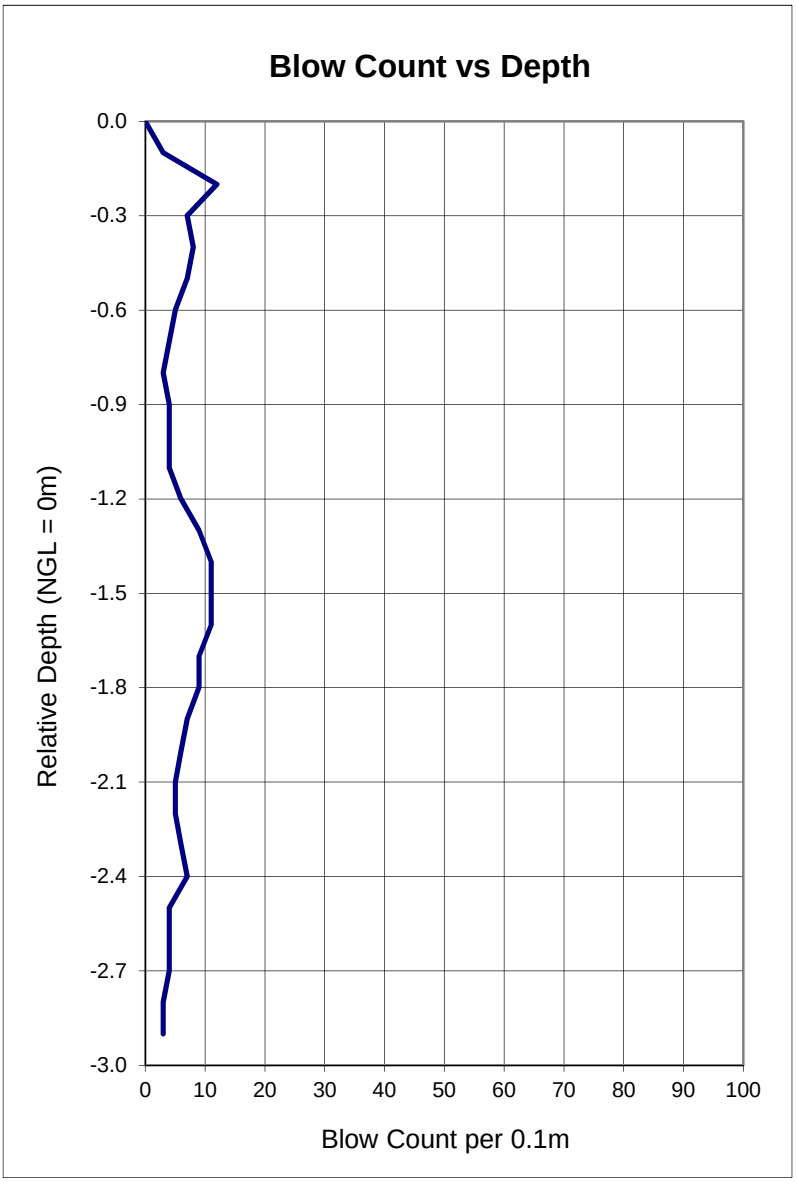
DCP RESULTS

Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC01

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	12
-0.3	7
-0.4	8
-0.5	7
-0.6	5
-0.7	4
-0.8	3
-0.9	4
-1.0	4
-1.1	4
-1.2	6
-1.3	9
-1.4	11
-1.5	11
-1.6	11
-1.7	9
-1.8	9
-1.9	7
-2.0	6
-2.1	5
-2.2	5
-2.3	6
-2.4	7
-2.5	4
-2.6	4
-2.7	4
-2.8	3
-2.9	3
-3.0	

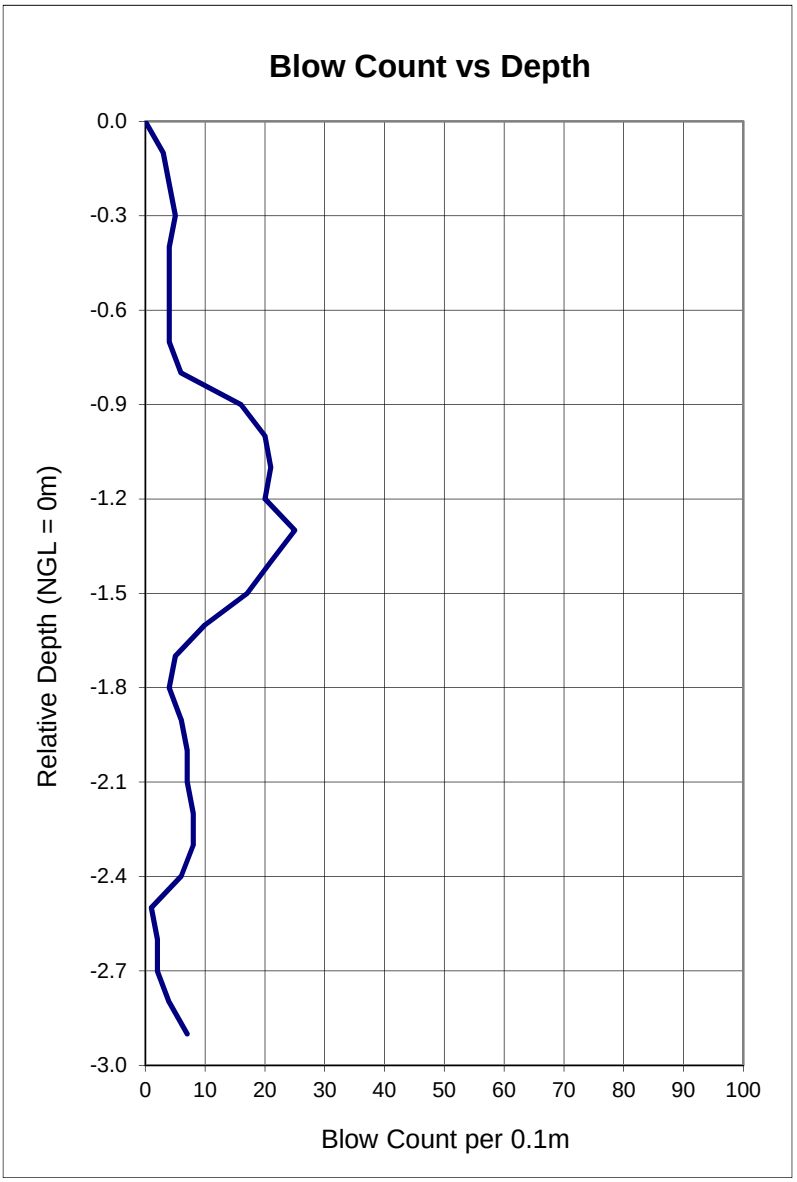


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC02

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	4
-0.3	5
-0.4	4
-0.5	4
-0.6	4
-0.7	4
-0.8	6
-0.9	16
-1.0	20
-1.1	21
-1.2	20
-1.3	25
-1.4	21
-1.5	17
-1.6	10
-1.7	5
-1.8	4
-1.9	6
-2.0	7
-2.1	7
-2.2	8
-2.3	8
-2.4	6
-2.5	1
-2.6	2
-2.7	2
-2.8	4
-2.9	7
-3.0	

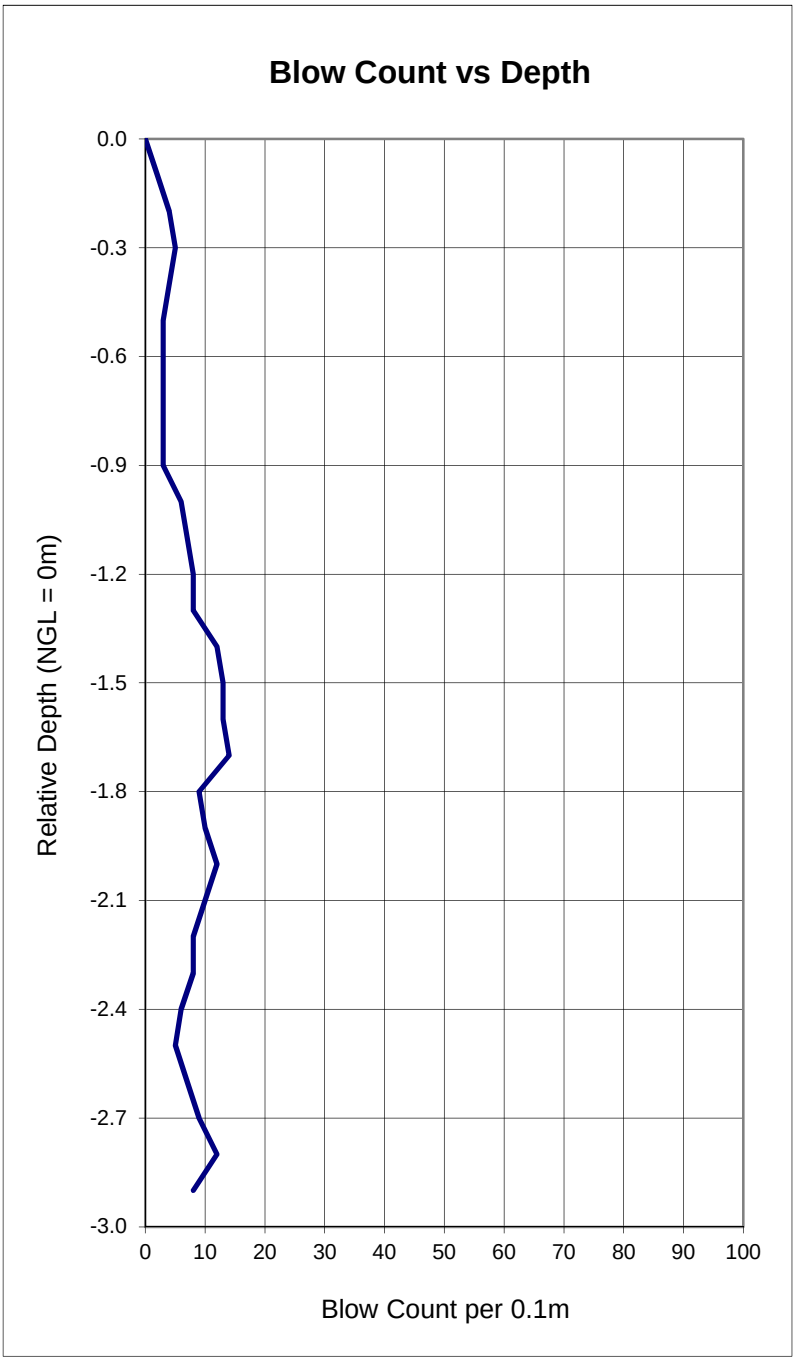


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC03

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	2
-0.2	4
-0.3	5
-0.4	4
-0.5	3
-0.6	3
-0.7	3
-0.8	3
-0.9	3
-1.0	6
-1.1	7
-1.2	8
-1.3	8
-1.4	12
-1.5	13
-1.6	13
-1.7	14
-1.8	9
-1.9	10
-2.0	12
-2.1	10
-2.2	8
-2.3	8
-2.4	6
-2.5	5
-2.6	7
-2.7	9
-2.8	12
-2.9	8
-3.0	

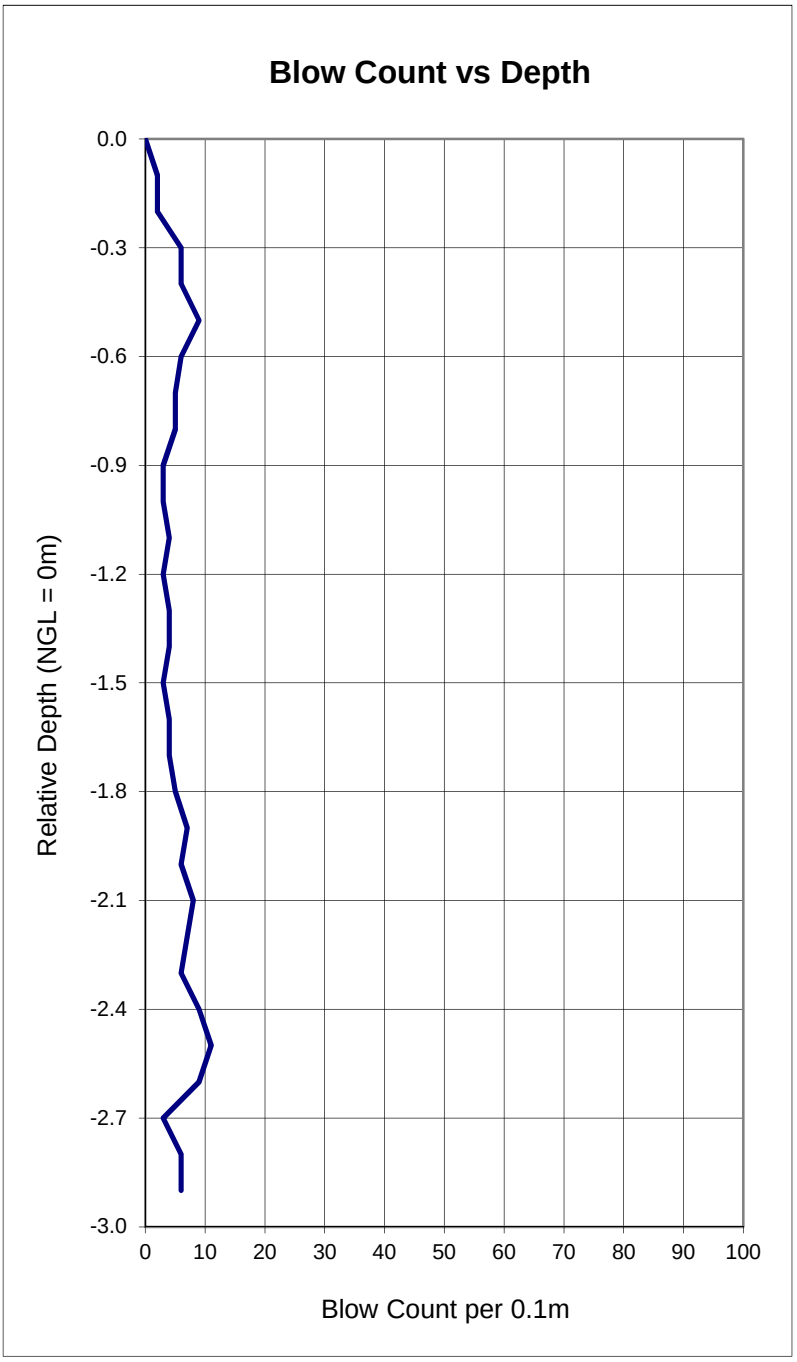


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC04

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	2
-0.2	2
-0.3	6
-0.4	6
-0.5	9
-0.6	6
-0.7	5
-0.8	5
-0.9	3
-1.0	3
-1.1	4
-1.2	3
-1.3	4
-1.4	4
-1.5	3
-1.6	4
-1.7	4
-1.8	5
-1.9	7
-2.0	6
-2.1	8
-2.2	7
-2.3	6
-2.4	9
-2.5	11
-2.6	9
-2.7	3
-2.8	6
-2.9	6
-3.0	

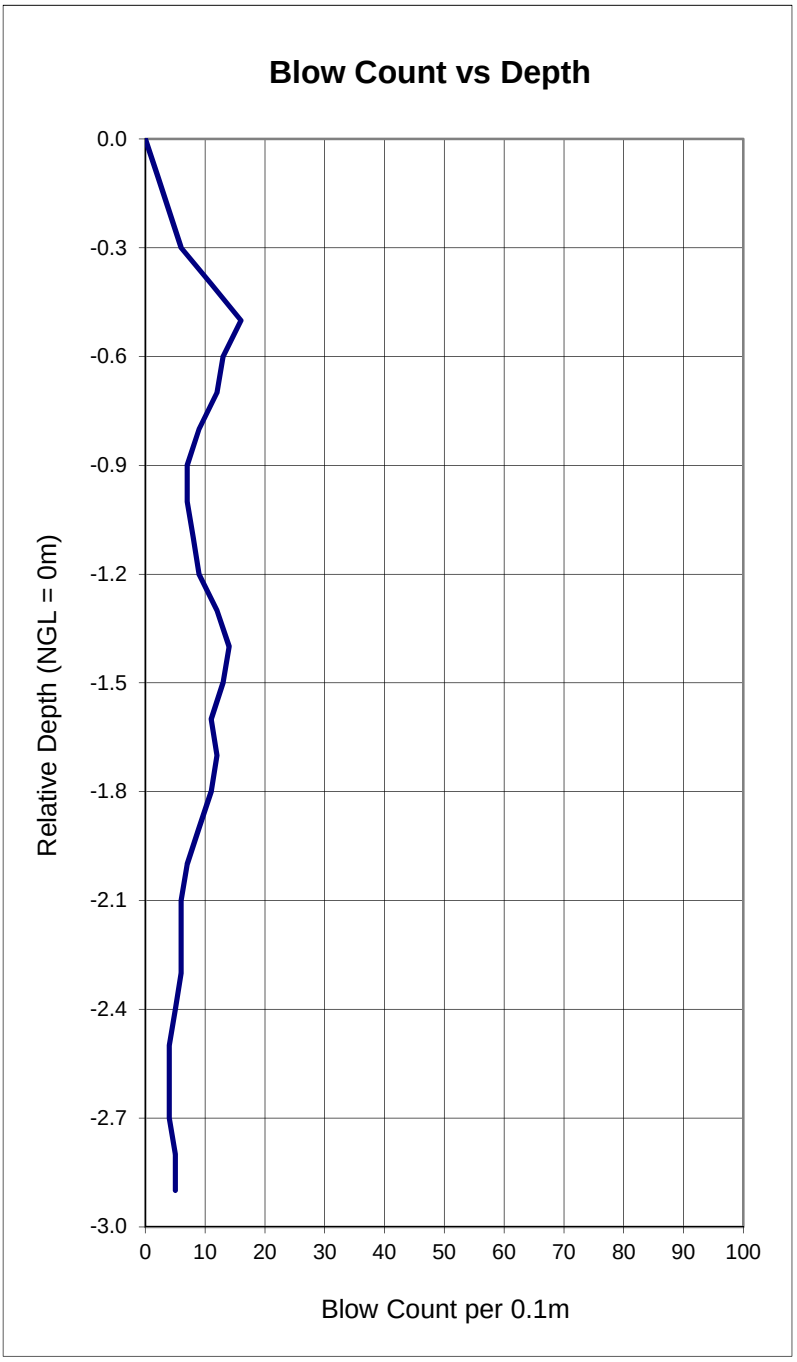


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC05

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	2
-0.2	4
-0.3	6
-0.4	11
-0.5	16
-0.6	13
-0.7	12
-0.8	9
-0.9	7
-1.0	7
-1.1	8
-1.2	9
-1.3	12
-1.4	14
-1.5	13
-1.6	11
-1.7	12
-1.8	11
-1.9	9
-2.0	7
-2.1	6
-2.2	6
-2.3	6
-2.4	5
-2.5	4
-2.6	4
-2.7	4
-2.8	5
-2.9	5
-3.0	

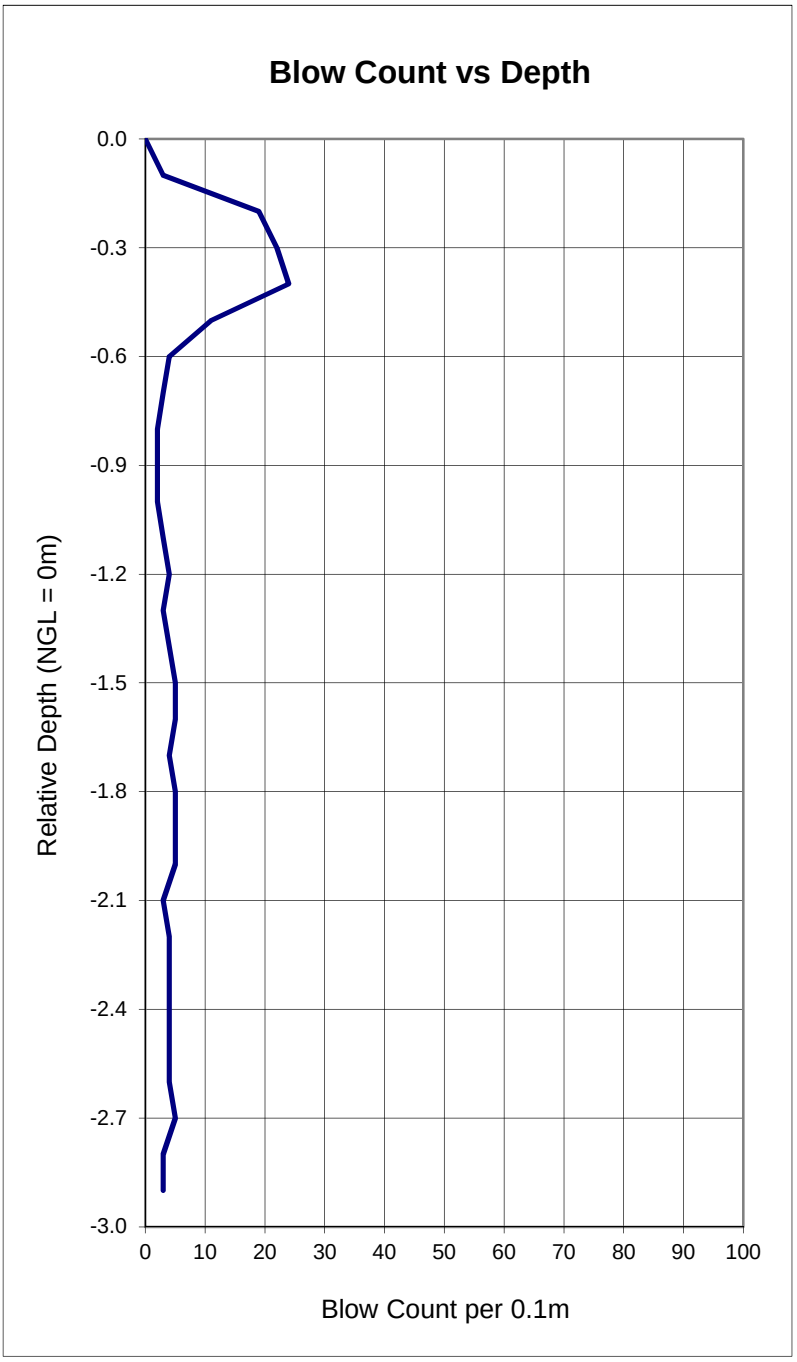


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC06

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	19
-0.3	22
-0.4	24
-0.5	11
-0.6	4
-0.7	3
-0.8	2
-0.9	2
-1.0	2
-1.1	3
-1.2	4
-1.3	3
-1.4	4
-1.5	5
-1.6	5
-1.7	4
-1.8	5
-1.9	5
-2.0	5
-2.1	3
-2.2	4
-2.3	4
-2.4	4
-2.5	4
-2.6	4
-2.7	5
-2.8	3
-2.9	3
-3.0	

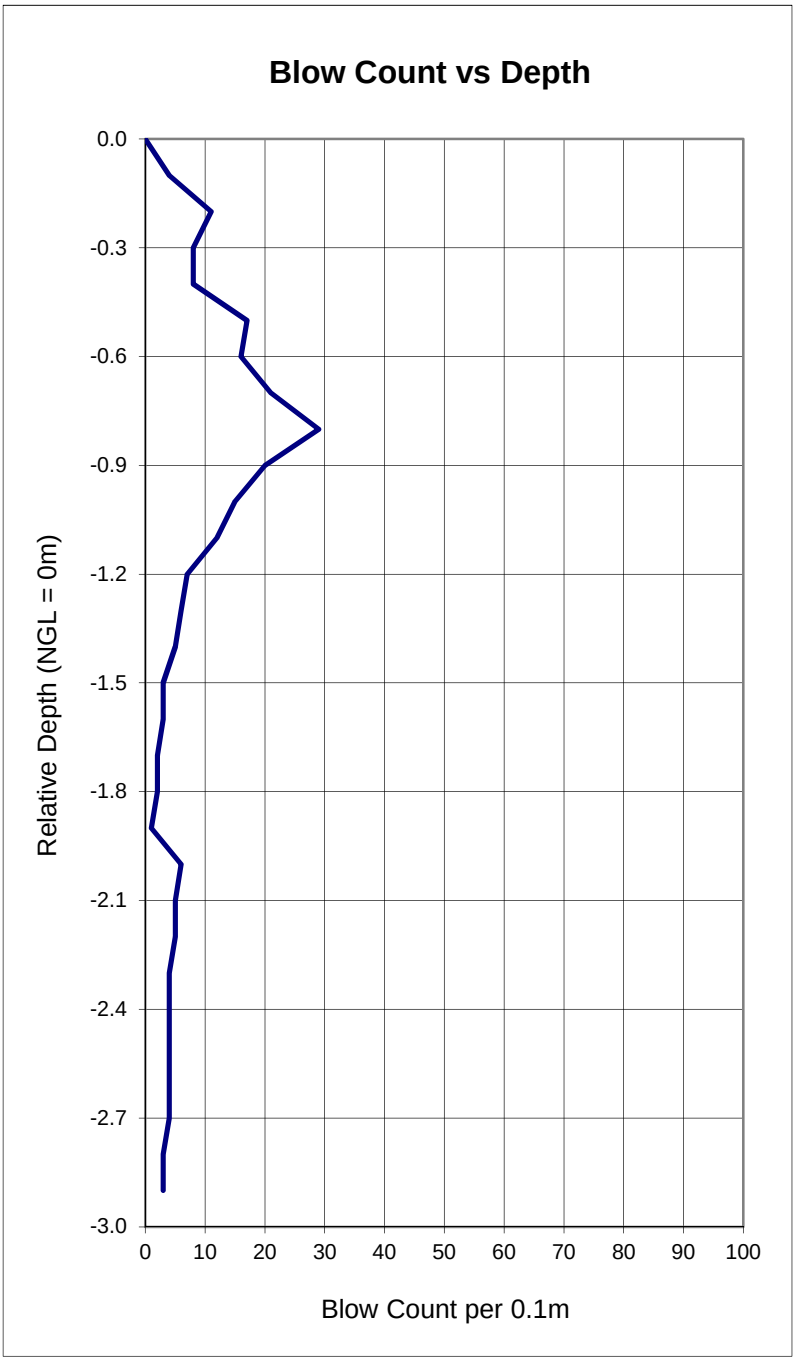


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC07

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	4
-0.2	11
-0.3	8
-0.4	8
-0.5	17
-0.6	16
-0.7	21
-0.8	29
-0.9	20
-1.0	15
-1.1	12
-1.2	7
-1.3	6
-1.4	5
-1.5	3
-1.6	3
-1.7	2
-1.8	2
-1.9	1
-2.0	6
-2.1	5
-2.2	5
-2.3	4
-2.4	4
-2.5	4
-2.6	4
-2.7	4
-2.8	3
-2.9	3
-3.0	

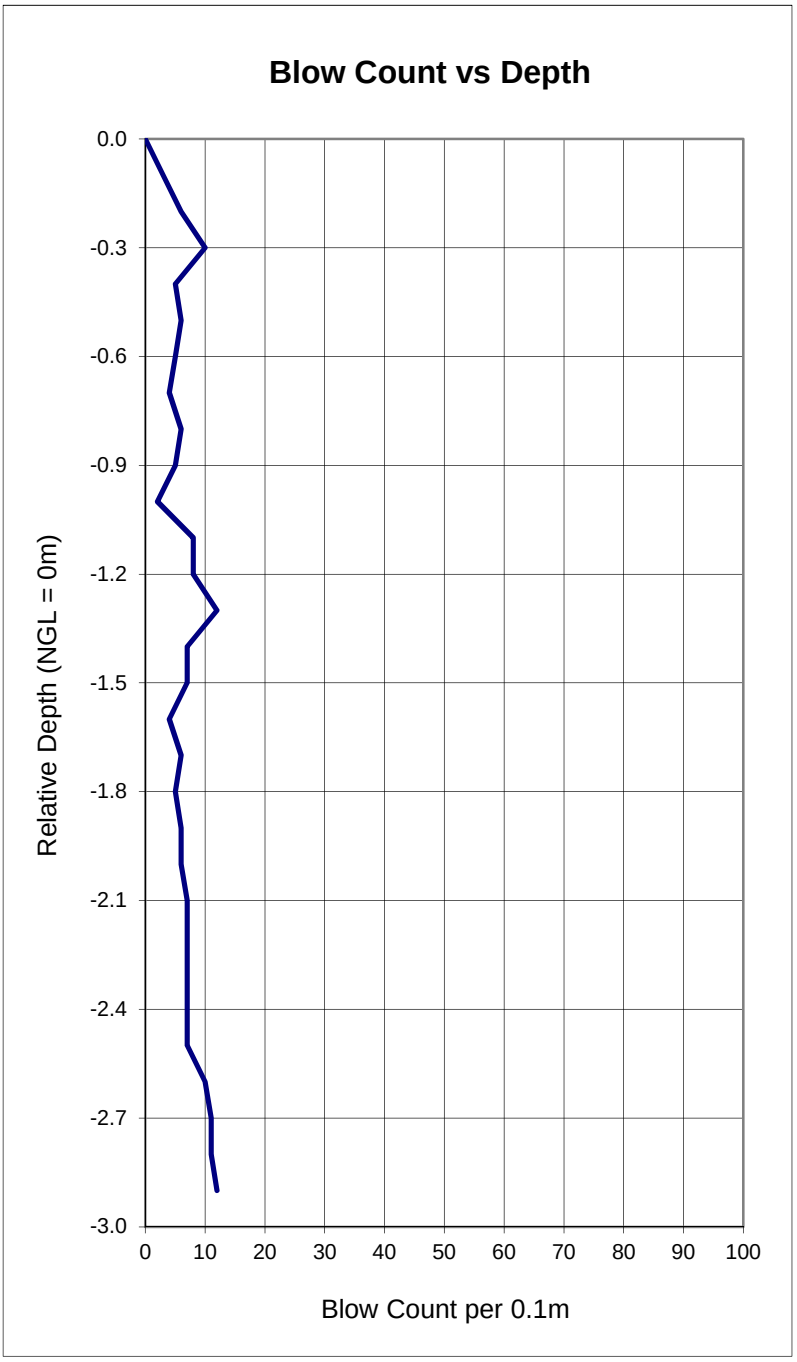


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC08

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	6
-0.3	10
-0.4	5
-0.5	6
-0.6	5
-0.7	4
-0.8	6
-0.9	5
-1.0	2
-1.1	8
-1.2	8
-1.3	12
-1.4	7
-1.5	7
-1.6	4
-1.7	6
-1.8	5
-1.9	6
-2.0	6
-2.1	7
-2.2	7
-2.3	7
-2.4	7
-2.5	7
-2.6	10
-2.7	11
-2.8	11
-2.9	12
-3.0	

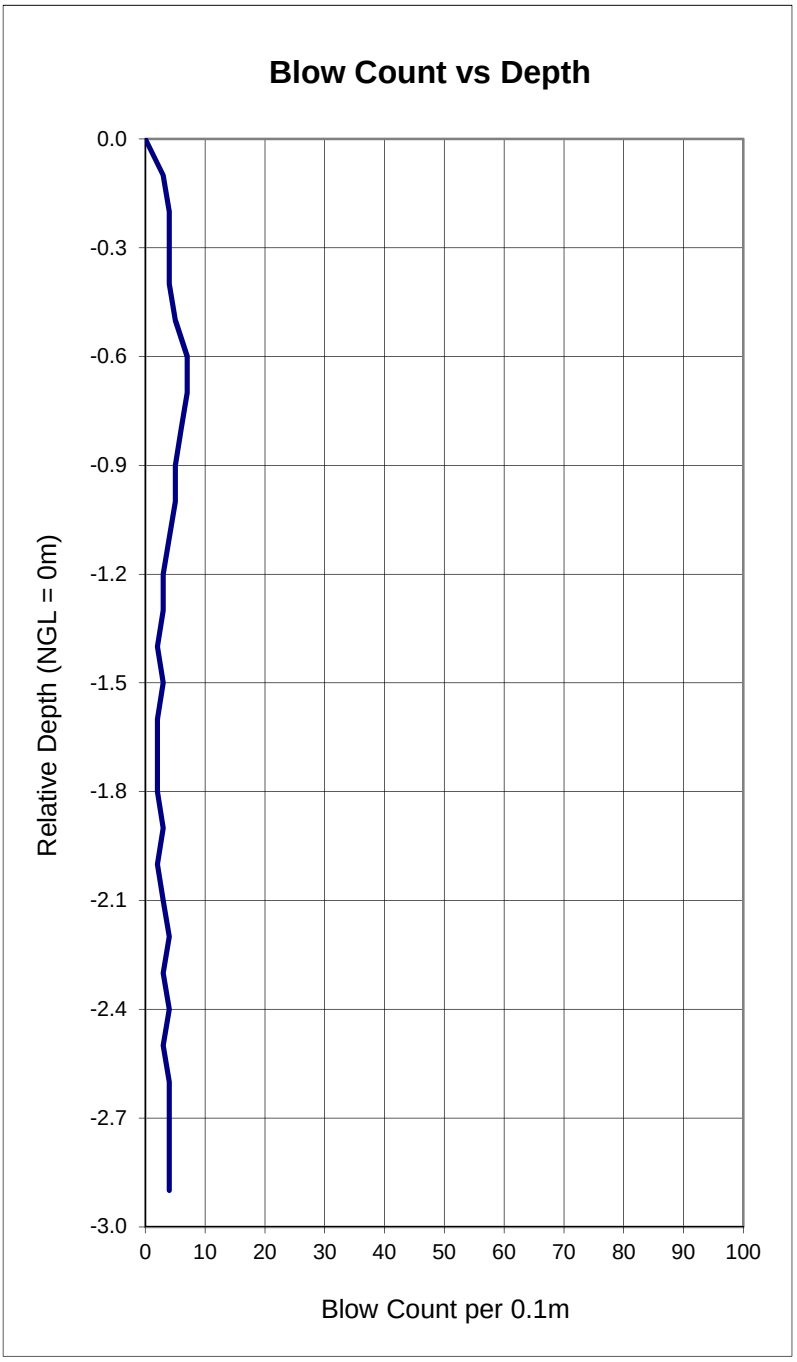


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC09

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	4
-0.3	4
-0.4	4
-0.5	5
-0.6	7
-0.7	7
-0.8	6
-0.9	5
-1.0	5
-1.1	4
-1.2	3
-1.3	3
-1.4	2
-1.5	3
-1.6	2
-1.7	2
-1.8	2
-1.9	3
-2.0	2
-2.1	3
-2.2	4
-2.3	3
-2.4	4
-2.5	3
-2.6	4
-2.7	4
-2.8	4
-2.9	4
-3.0	

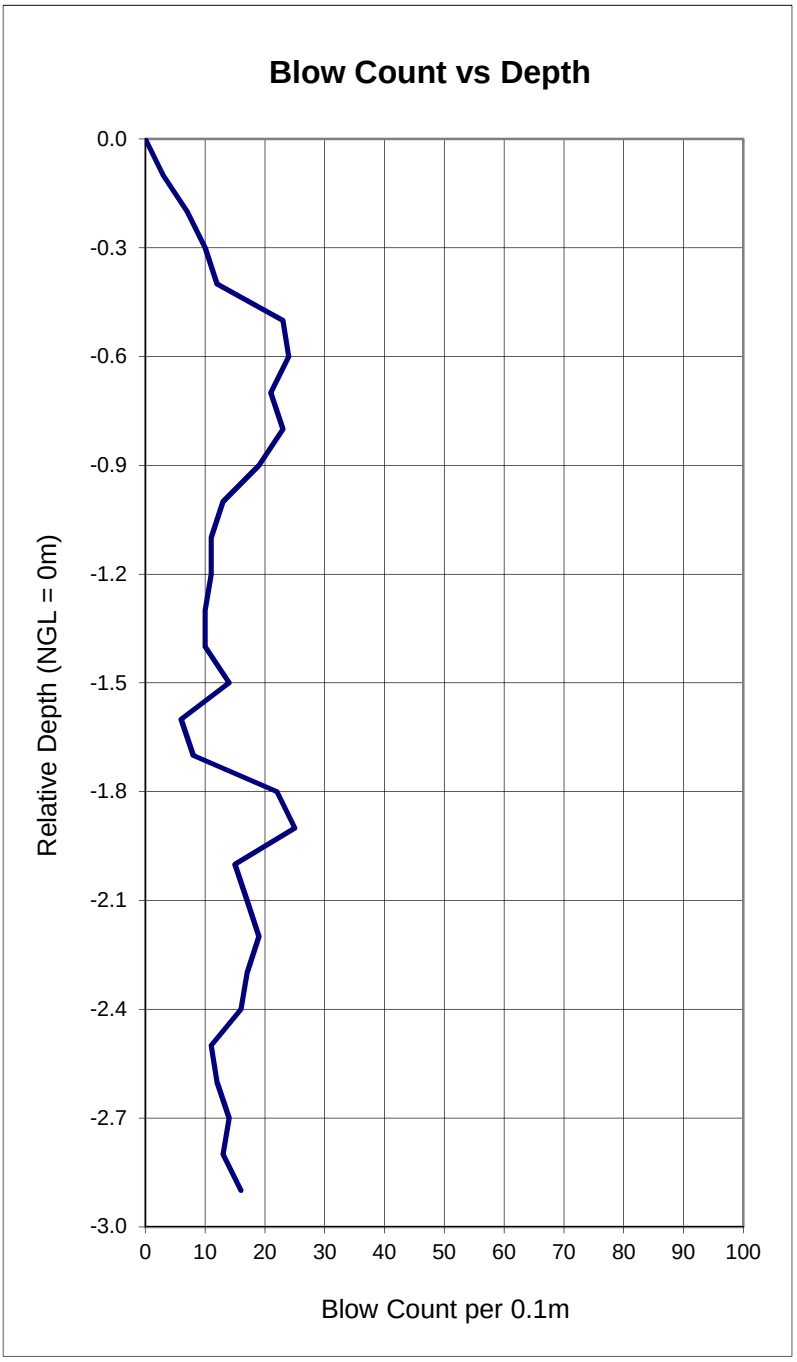


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC10

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	7
-0.3	10
-0.4	12
-0.5	23
-0.6	24
-0.7	21
-0.8	23
-0.9	19
-1.0	13
-1.1	11
-1.2	11
-1.3	10
-1.4	10
-1.5	14
-1.6	6
-1.7	8
-1.8	22
-1.9	25
-2.0	15
-2.1	17
-2.2	19
-2.3	17
-2.4	16
-2.5	11
-2.6	12
-2.7	14
-2.8	13
-2.9	16
-3.0	

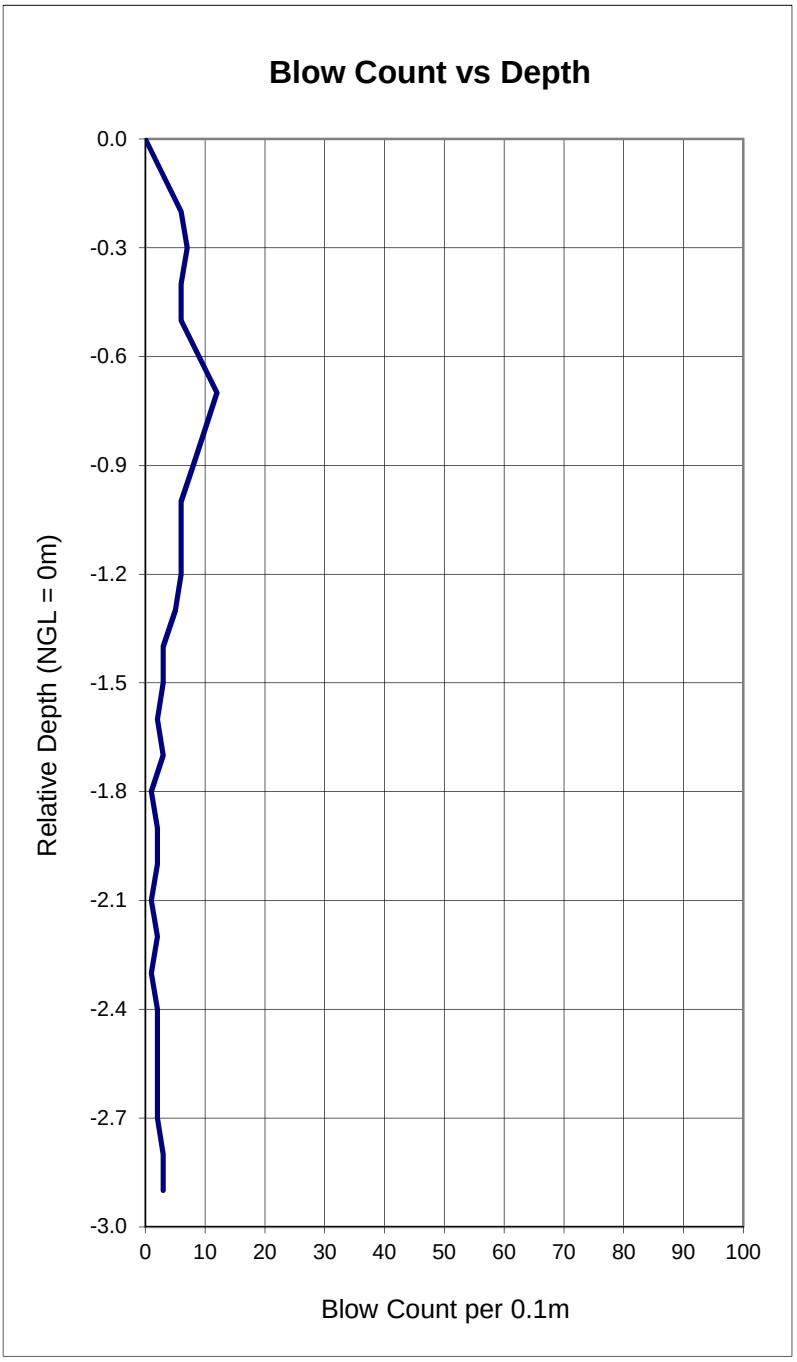


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC11

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	6
-0.3	7
-0.4	6
-0.5	6
-0.6	9
-0.7	12
-0.8	10
-0.9	8
-1.0	6
-1.1	6
-1.2	6
-1.3	5
-1.4	3
-1.5	3
-1.6	2
-1.7	3
-1.8	1
-1.9	2
-2.0	2
-2.1	1
-2.2	2
-2.3	1
-2.4	2
-2.5	2
-2.6	2
-2.7	2
-2.8	3
-2.9	3
-3.0	

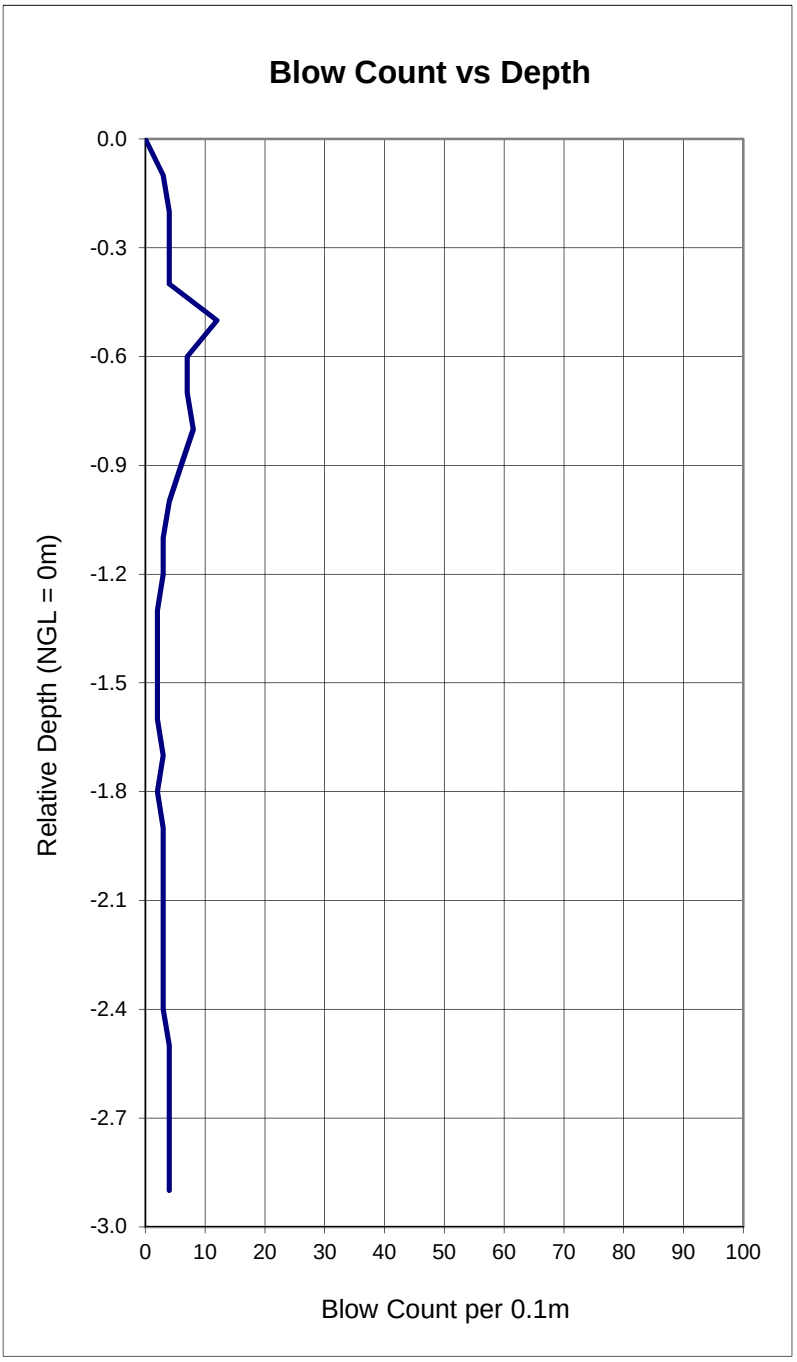


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC12

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	4
-0.3	4
-0.4	4
-0.5	12
-0.6	7
-0.7	7
-0.8	8
-0.9	6
-1.0	4
-1.1	3
-1.2	3
-1.3	2
-1.4	2
-1.5	2
-1.6	2
-1.7	3
-1.8	2
-1.9	3
-2.0	3
-2.1	3
-2.2	3
-2.3	3
-2.4	3
-2.5	4
-2.6	4
-2.7	4
-2.8	4
-2.9	4
-3.0	

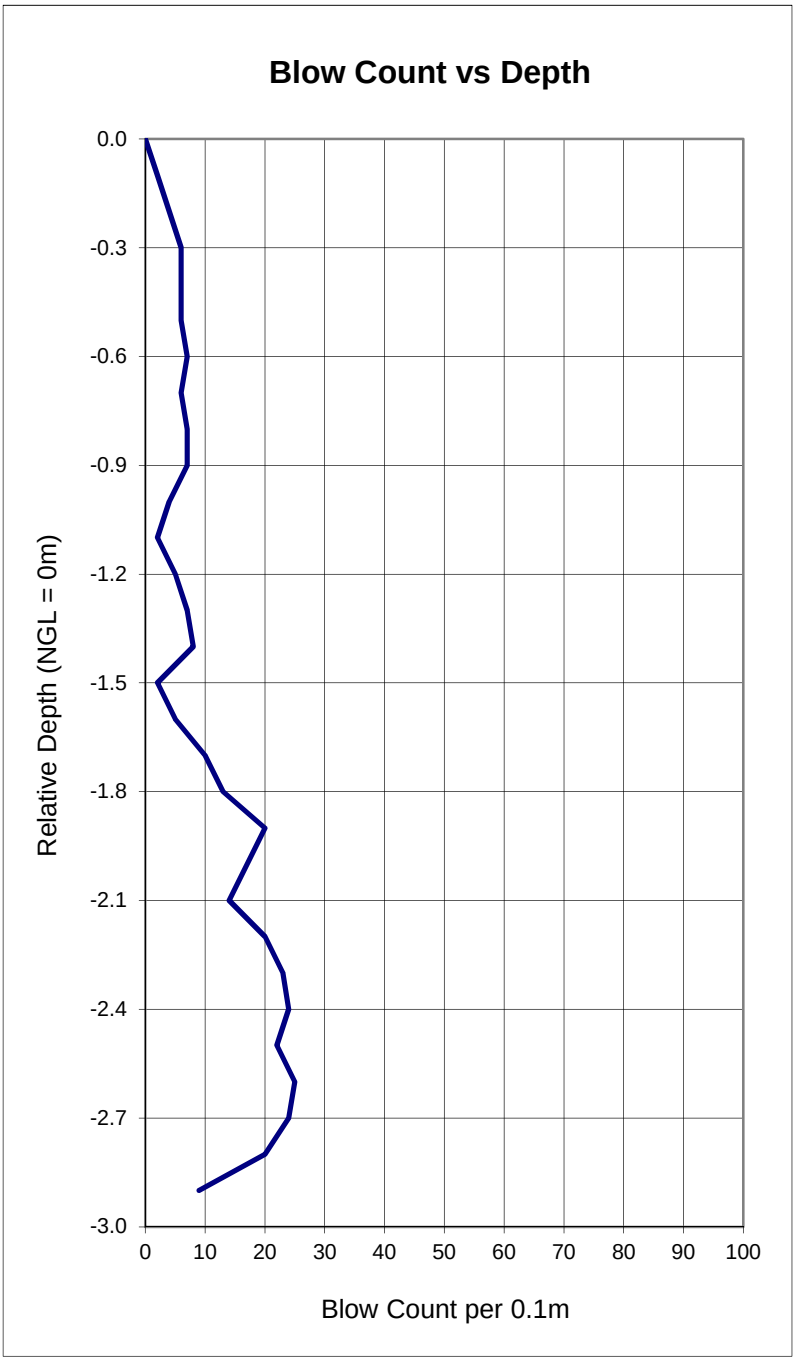


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC13

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	2
-0.2	4
-0.3	6
-0.4	6
-0.5	6
-0.6	7
-0.7	6
-0.8	7
-0.9	7
-1.0	4
-1.1	2
-1.2	5
-1.3	7
-1.4	8
-1.5	2
-1.6	5
-1.7	10
-1.8	13
-1.9	20
-2.0	17
-2.1	14
-2.2	20
-2.3	23
-2.4	24
-2.5	22
-2.6	25
-2.7	24
-2.8	20
-2.9	9
-3.0	

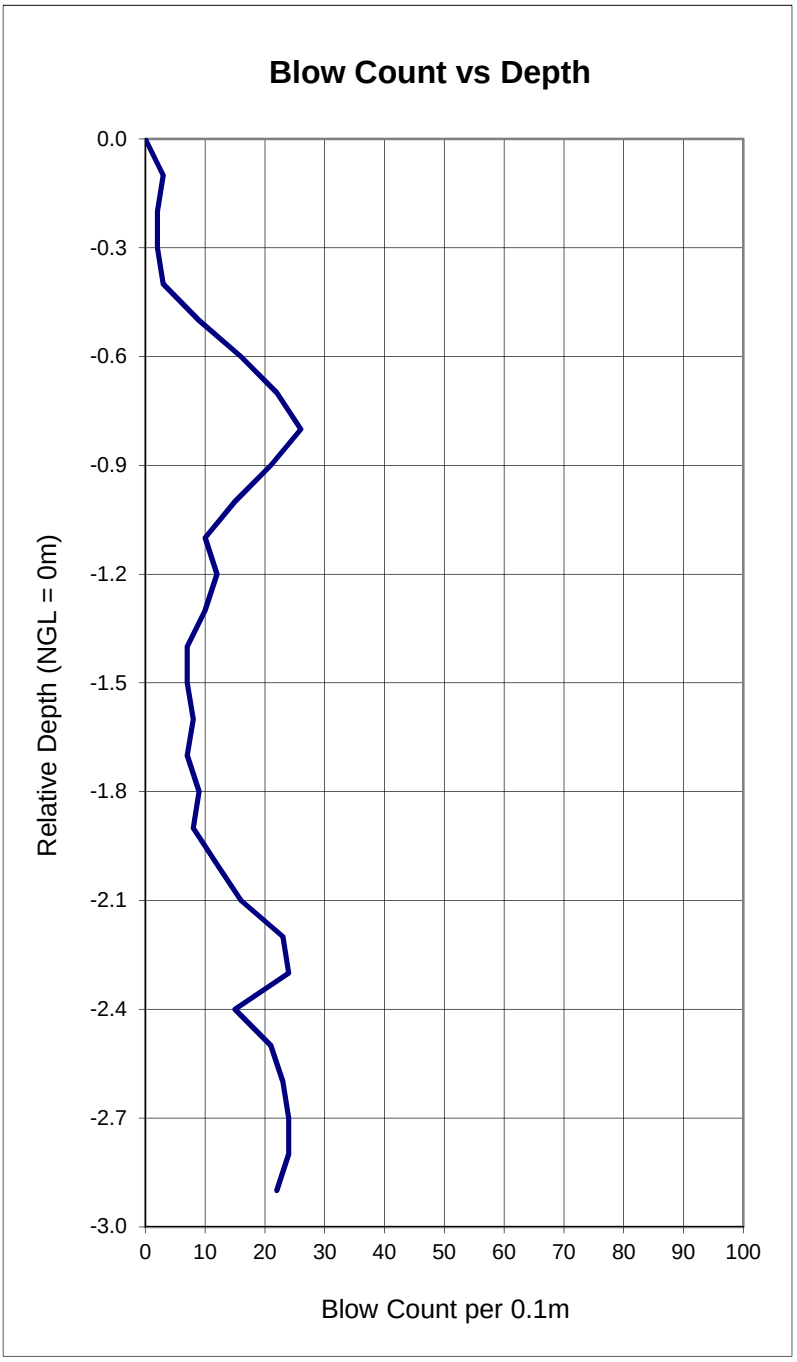


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC14

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	3
-0.2	2
-0.3	2
-0.4	3
-0.5	9
-0.6	16
-0.7	22
-0.8	26
-0.9	21
-1.0	15
-1.1	10
-1.2	12
-1.3	10
-1.4	7
-1.5	7
-1.6	8
-1.7	7
-1.8	9
-1.9	8
-2.0	12
-2.1	16
-2.2	23
-2.3	24
-2.4	15
-2.5	21
-2.6	23
-2.7	24
-2.8	24
-2.9	22
-3.0	

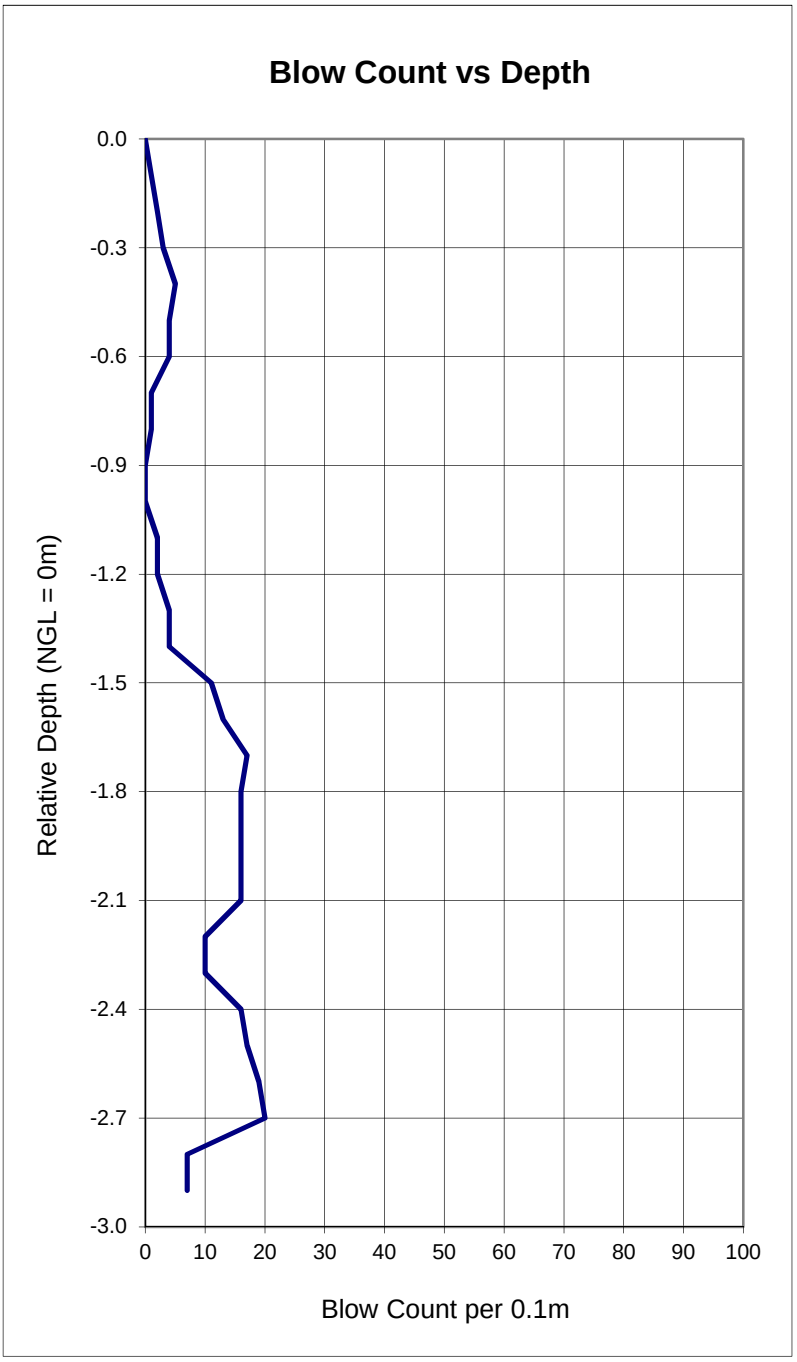


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC15

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	1
-0.2	2
-0.3	3
-0.4	5
-0.5	4
-0.6	4
-0.7	1
-0.8	1
-0.9	0
-1.0	0
-1.1	2
-1.2	2
-1.3	4
-1.4	4
-1.5	11
-1.6	13
-1.7	17
-1.8	16
-1.9	16
-2.0	16
-2.1	16
-2.2	10
-2.3	10
-2.4	16
-2.5	17
-2.6	19
-2.7	20
-2.8	7
-2.9	7
-3.0	

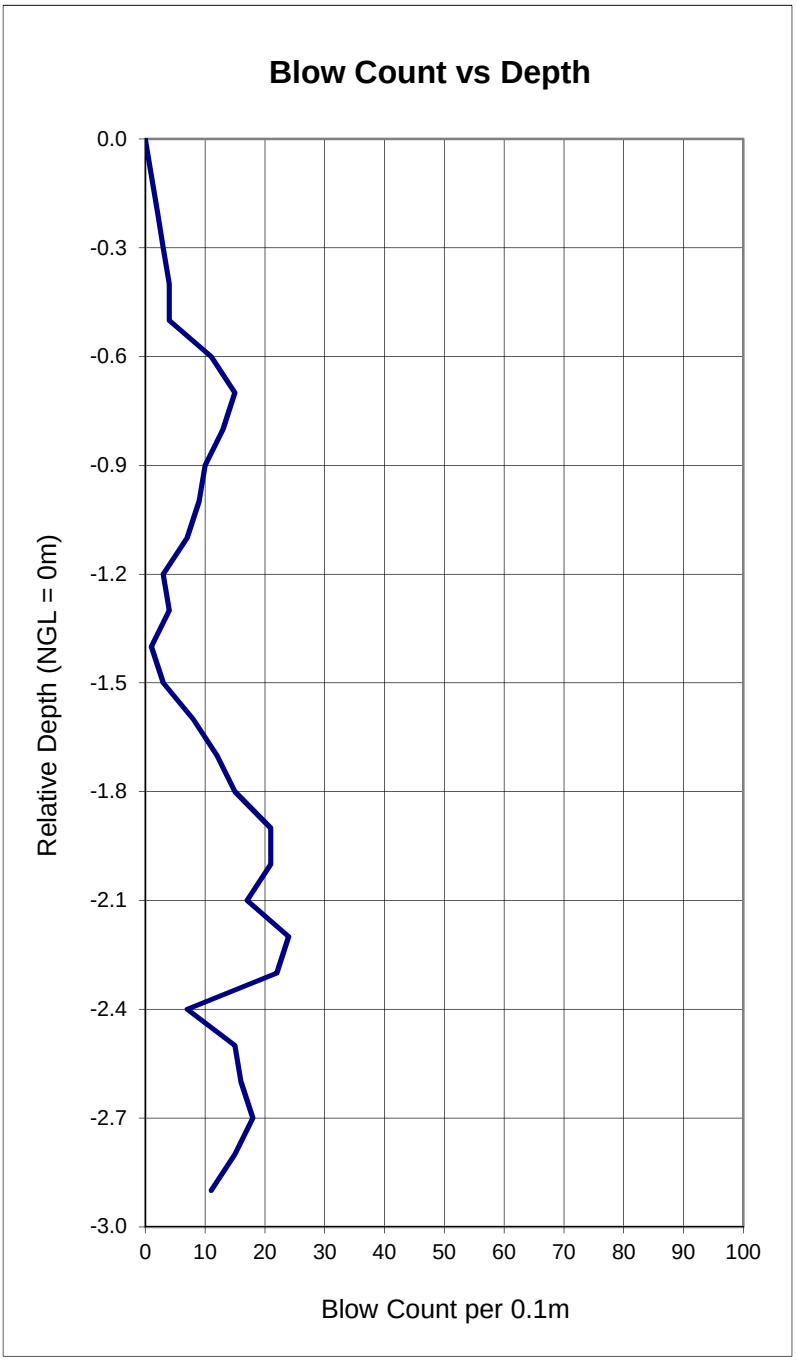


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC16

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	1
-0.2	2
-0.3	3
-0.4	4
-0.5	4
-0.6	11
-0.7	15
-0.8	13
-0.9	10
-1.0	9
-1.1	7
-1.2	3
-1.3	4
-1.4	1
-1.5	3
-1.6	8
-1.7	12
-1.8	15
-1.9	21
-2.0	21
-2.1	17
-2.2	24
-2.3	22
-2.4	7
-2.5	15
-2.6	16
-2.7	18
-2.8	15
-2.9	11
-3.0	

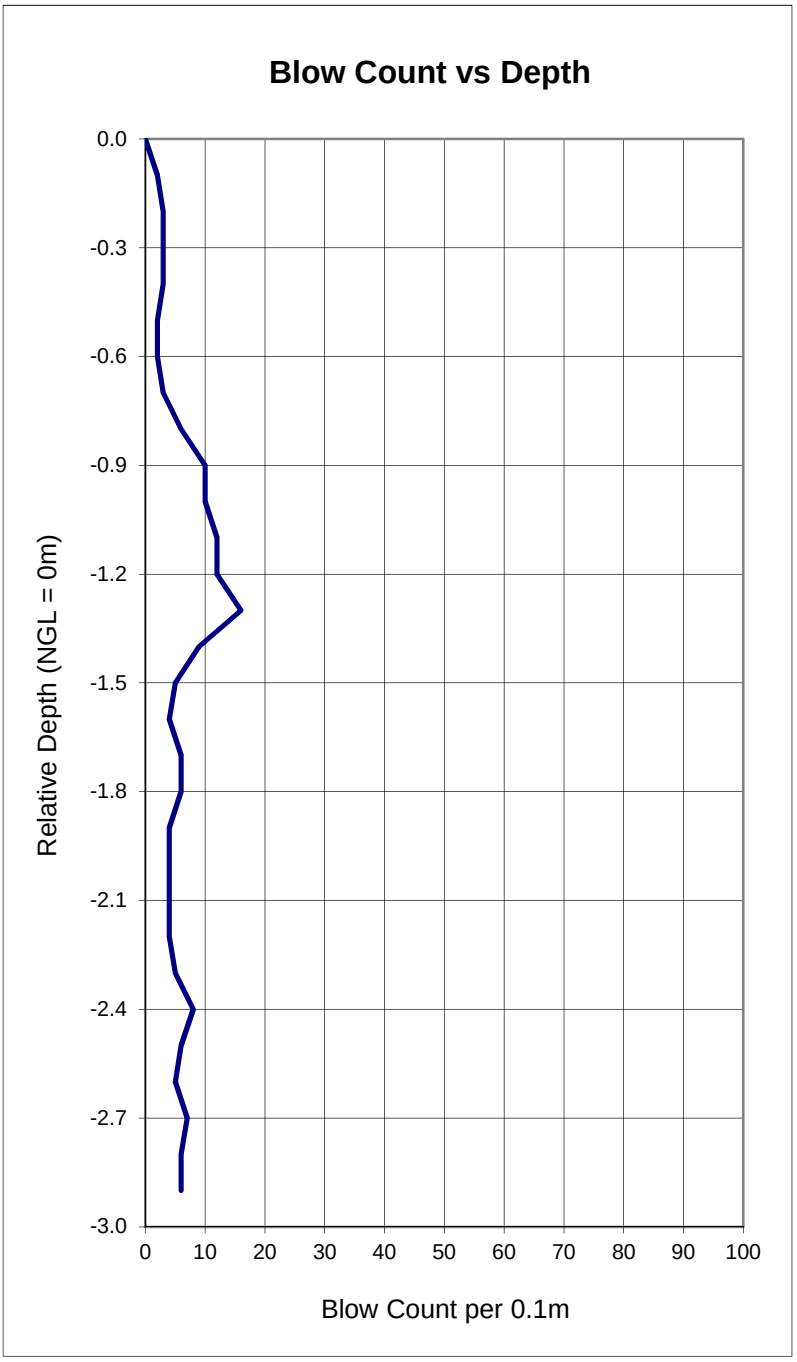


Dynamic Cone Penetrometer Test

PENETROMETER RESULTS: DC17

Proj. No. J01945
Project: Upgrade to SWWTW
Site: SWWTW
Date: 25/09/2014
Done by: R Naidoo
Client : Ethekwini Municipality

Depth (m)	Blows (per 0.1m)
0.0	0
-0.1	2
-0.2	3
-0.3	3
-0.4	3
-0.5	2
-0.6	2
-0.7	3
-0.8	6
-0.9	10
-1.0	10
-1.1	12
-1.2	12
-1.3	16
-1.4	9
-1.5	5
-1.6	4
-1.7	6
-1.8	6
-1.9	4
-2.0	4
-2.1	4
-2.2	4
-2.3	5
-2.4	8
-2.5	6
-2.6	5
-2.7	7
-2.8	6
-2.9	6
-3.0	



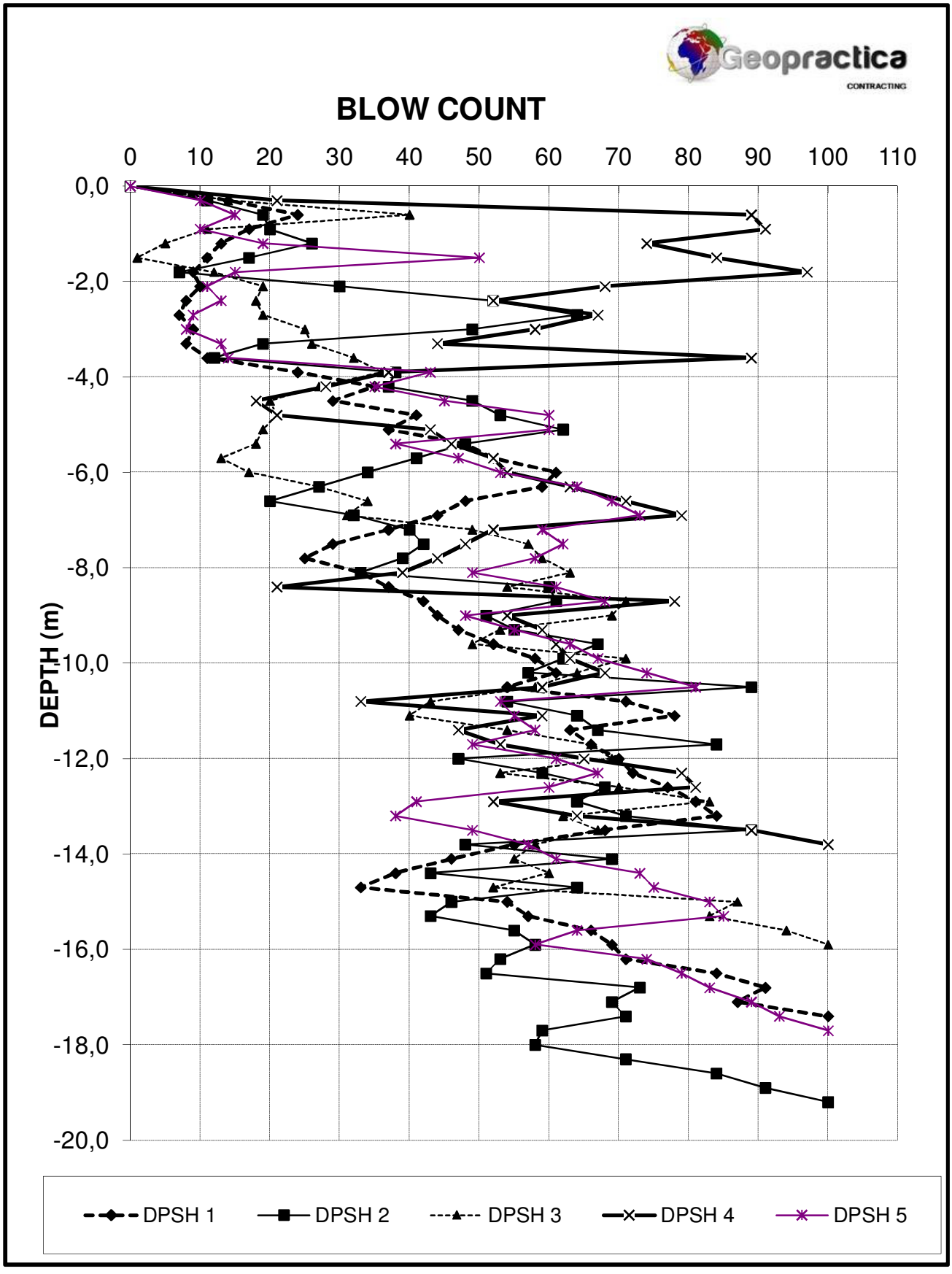
DPSH RESULTS

DPSH BLOW COUNT REPORT

Client AECOM
Project SWWTW
Site SWWTW

Engineer Rannel
Job no 693
Date 10-Jun-14

Depth	DPSH 1	DPSH 2	DPSH 3	DPSH 4	DPSH 5		Depth	DPSH 1	DPSH 2	DPSH 3	DPSH 4	DPSH 5
							13,2	84	71	62	64	38
0,3	14	11	14	21	10		13,5	68	89	67	89	49
0,6	24	19	40	89	15		13,8	55	48	58	100	57
0,9	17	20	11	91	10		14,1	46	69	55		61
1,2	13	26	5	74	19		14,4	38	43	60		73
1,5	11	17	1	84	50		14,7	33	64	52		75
1,8	9	7	12	97	15		15,0	54	46	87		83
2,1	10	30	19	68	11		15,3	57	43	83		85
2,4	8	52	18	52	13		15,6	66	55	94		64
2,7	7	64	19	67	9		15,9	69	58	100		58
3,0	9	49	25	58	8		16,2	71	53			74
3,3	8	19	26	44	13		16,5	84	51			79
3,6	11	12	32	89	14		16,8	91	73			83
3,9	24	38	36	37	43		17,1	87	69			89
4,2	35	37	27	28	35		17,4	100	71			93
4,5	29	49	20	18	45		17,7		59			100
4,8	41	53	21	21	60		18,0		58			
5,1	37	62	19	43	60		18,3		71			
5,4	48	48	18	46	38		18,6		84			
5,7	52	41	13	52	47		18,9		91			
6,0	61	34	17	54	53		19,2		100			
6,3	59	27	27	63	64		19,5					
6,6	48	20	34	71	69		19,8					
6,9	44	32	31	79	73		20,1					
7,2	37	40	49	52	59		20,4					
7,5	29	42	57	48	62		20,7					
7,8	25	39	59	44	58		21,0					
8,1	33	33	63	39	49		21,3					
8,4	37	60	54	21	61		21,6					
8,7	42	61	71	78	68		21,9					
9,0	44	51	69	54	48		22,2					
9,3	47	55	53	59	55		22,5					
9,6	52	67	49	61	63		22,8					
9,9	58	62	71	63	67		23,1					
10,2	61	57	64	68	74		23,4					
10,5	54	89	58	59	81		23,7					
10,8	71	54	43	33	53		24,0					
11,1	78	64	40	59	55		24,3					
11,4	63	67	54	47	58		24,6					
11,7	66	84	66	53	49		24,9					
12,0	70	47	69	65	61		25,2					
12,3	72	59	53	79	67		**Rem:**					
12,6	77	68	70	81	60							
12,9	81	64	83	52	41							
Re-Drive												
0,3	1	2	2	1	2							
0,6		1	1	1	1							

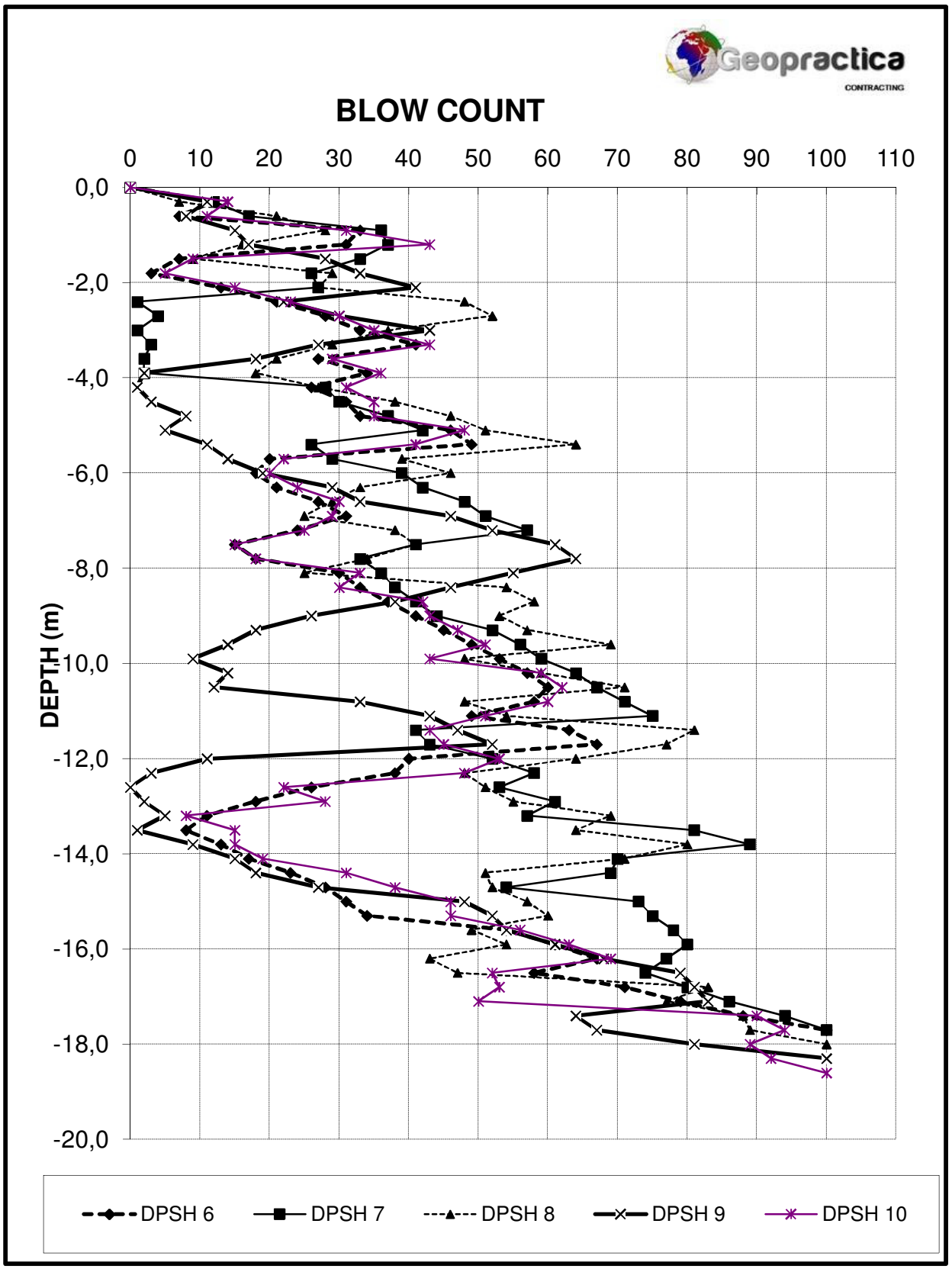

Geopractica
CONTRACTING
BLOW COUNT
0
10
20
30
40
50
60
70
80
90
100
110
0,0
-2,0
-4,0
-6,0
-8,0
-10,0
-12,0
-14,0
-16,0
-18,0
-20,0
DEPTH (m)
DPSH 1
DPSH 2
DPSH 3
DPSH 4
DPSH 5

DPSH BLOW COUNT REPORT

Client AECOM
Project SWWTW
Site SWWTW

Engineer Rannel
Job no 693
Date 10-Jun-14

Depth	DPSH 6	DPSH 7	DPSH 8	DPSH 9	DPSH 10		Depth	DPSH 6	DPSH 7	DPSH 8	DPSH 9	DPSH 10
							13,2	11	57	69	5	8
0,3	12	12	7	11	14		13,5	8	81	64	1	15
0,6	7	17	21	8	11		13,8	13	89	80	9	15
0,9	33	36	28	15	31		14,1	17	70	71	15	19
1,2	31	37	16	17	43		14,4	23	69	51	18	31
1,5	7	33	9	28	9		14,7	28	54	52	27	38
1,8	3	26	29	33	5		15,0	31	73	57	48	46
2,1	13	27	27	41	15		15,3	34	75	60	52	46
2,4	21	1	48	22	23		15,6	54	78	49	54	56
2,7	28	4	52	30	30		15,9	61	80	54	61	63
3,0	33	1	37	43	35		16,2	67	77	43	68	69
3,3	41	3	29	27	43		16,5	58	74	47	79	52
3,6	27	2	21	18	29		16,8	71	80	83	81	53
3,9	34	2	18	2	36		17,1	79	86	77	83	50
4,2	26	28	27	1	31		17,4	88	94	88	64	90
4,5	31	30	38	3	35		17,7	100	100	89	67	94
4,8	33	37	46	8	35		18,0			100	81	89
5,1	46	42	51	5	48		18,3				100	92
5,4	49	26	64	11	41		18,6					100
5,7	20	29	39	14	22		18,9					
6,0	18	39	46	19	20		19,2					
6,3	21	42	33	29	24		19,5					
6,6	27	48	29	33	30		19,8					
6,9	31	51	25	46	29		20,1					
7,2	24	57	38	52	25		20,4					
7,5	15	41	41	61	15		20,7					
7,8	18	33	34	64	18		21,0					
8,1	30	36	25	55	33		21,3					
8,4	33	38	54	46	30		21,6					
8,7	37	41	58	38	42		21,9					
9,0	41	44	53	26	43		22,2					
9,3	45	52	57	18	47		22,5					
9,6	49	56	69	14	51		22,8					
9,9	53	59	48	9	43		23,1					
10,2	57	64	59	14	59		23,4					
10,5	60	67	71	12	62		23,7					
10,8	58	71	48	33	60		24,0					
11,1	49	75	54	43	51		24,3					
11,4	63	41	81	47	43		24,6					
11,7	67	43	77	52	45		24,9					
12,0	40	52	64	11	53		25,2					
12,3	38	58	48	3	48		**Rem:**					
12,6	26	53	51		22							
12,9	18	61	55	2	28							
Re-Drive												
0,3	1	1	2	1	2							
0,6	1	1		1	2							

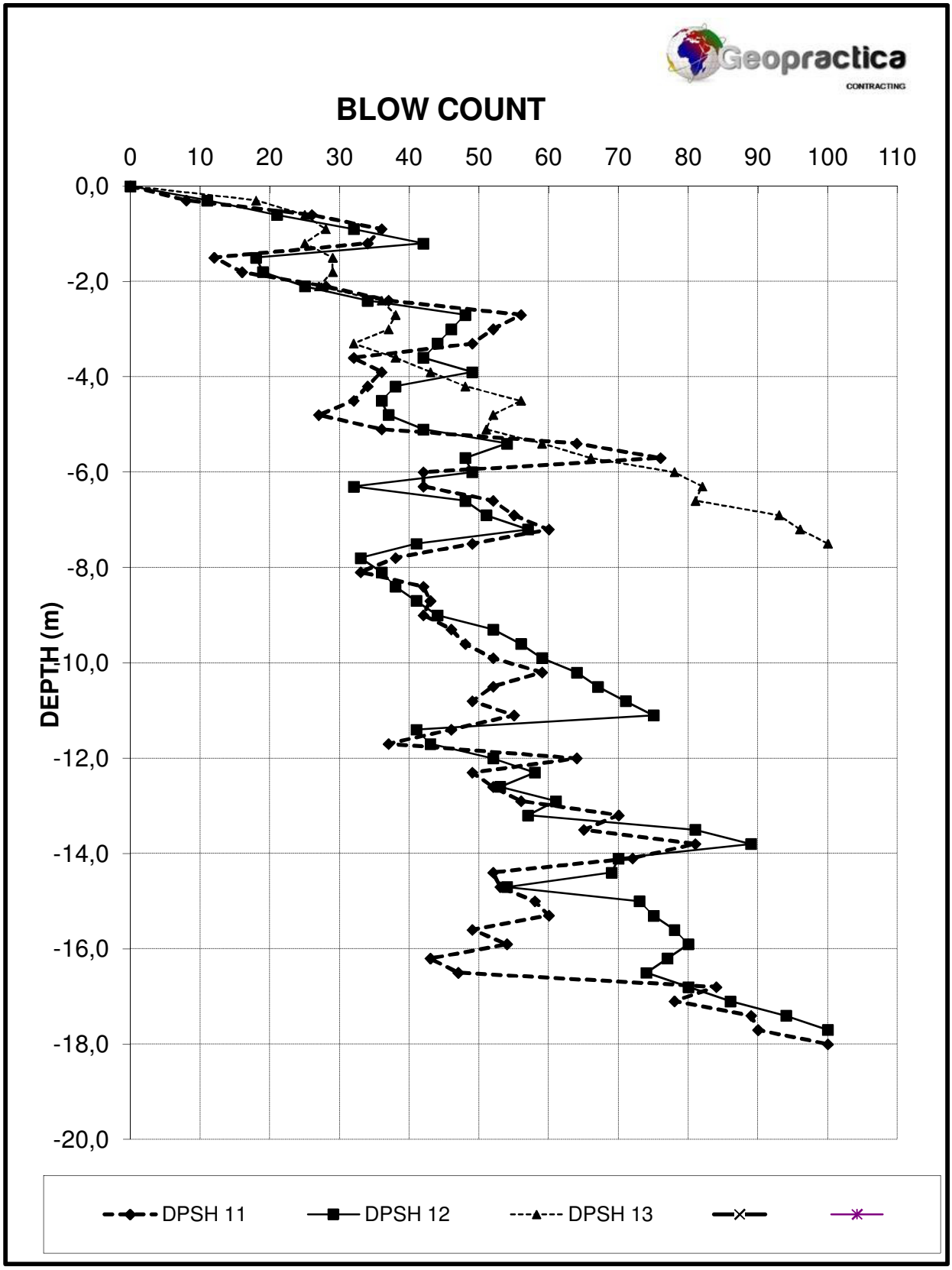

Geopractica
CONTRACTING
BLOW COUNT
0
10
20
30
40
50
60
70
80
90
100
110
0,0
-2,0
-4,0
-6,0
-8,0
-10,0
-12,0
-14,0
-16,0
-18,0
-20,0
DEPTH (m)
DPSH 6
DPSH 7
DPSH 8
DPSH 9
DPSH 10

DPSH BLOW COUNT REPORT

Client AECOM
Project SWWTW
Site SWWTW

Engineer Rannel
Job no 693
Date 10-Jun-14

Depth	DPSH 11	DPSH 12	DPSH 13				Depth	DPSH 11	DPSH 12	DPSH 13		
							13,2	70	57			
0,3	8	11	18				13,5	65	81			
0,6	26	21	25				13,8	81	89			
0,9	36	32	28				14,1	72	70			
1,2	34	42	25				14,4	52	69			
1,5	12	18	29				14,7	53	54			
1,8	16	19	29				15,0	58	73			
2,1	28	25	27				15,3	60	75			
2,4	37	34	36				15,6	49	78			
2,7	56	48	38				15,9	54	80			
3,0	52	46	37				16,2	43	77			
3,3	49	44	32				16,5	47	74			
3,6	32	42	38				16,8	84	80			
3,9	36	49	43				17,1	78	86			
4,2	34	38	48				17,4	89	94			
4,5	32	36	56				17,7	90	100			
4,8	27	37	52				18,0	100				
5,1	36	42	51				18,3					
5,4	64	54	59				18,6					
5,7	76	48	66				18,9					
6,0	42	49	78				19,2					
6,3	42	32	82				19,5					
6,6	52	48	81				19,8					
6,9	55	51	93				20,1					
7,2	60	57	96				20,4					
7,5	49	41	100				20,7					
7,8	38	33					21,0					
8,1	33	36					21,3					
8,4	42	38					21,6					
8,7	43	41					21,9					
9,0	42	44					22,2					
9,3	46	52					22,5					
9,6	48	56					22,8					
9,9	52	59					23,1					
10,2	59	64					23,4					
10,5	52	67					23,7					
10,8	49	71					24,0					
11,1	55	75					24,3					
11,4	46	41					24,6					
11,7	37	43					24,9					
12,0	64	52					25,2					
12,3	49	58					**Rem:**					
12,6	52	53										
12,9	56	61										
Re-Drive												
0,3	1	1	1									
0,6	1	1	1									


Geopractica
CONTRACTING
BLOW COUNT
0
10
20
30
40
50
60
70
80
90
100
110
0,0
-2,0
-4,0
-6,0
-8,0
-10,0
-12,0
-14,0
-16,0
-18,0
-20,0
DEPTH (m)
DPSH 11
DPSH 12
DPSH 13

ANNEXURE D
LABORATORY RESULTS

FOUNDATION INDICATOR RESULT

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists

GEOSURE (Pty) Ltd

sanas Testing Laboratory T0483

CLIENT : Aecom
ADDRESS : 1st Floor, 17 The Boulevard
Westway Office Park
Westville
3630
ATTENTION : Mr R. Naidoo
PROJECT : Southern Waste Water Treatment

TEST REPORT REFERENCE NUMBER: 19213

Dear Sir/Madam,

Enclosed herewith, please find the original reports pertaining to the above-mentioned project.

Date Received	**08.10.2014**
Date Tested	08.10.2014 to 28.10.2014
Sample Location	Refer to Report
Sampling Method	N/A
Sample Condition	Moist
Sampling Environmental Condition	N/A
Sampler(s) Name	Client
Total Number of Pages	30

Test Carried Out			
TMH1 Method A1, B4, A5	✓	TMH1 Method C3	
TMH1 Method A2, A3, A4	✓	TMH1 Method C4a	
TMH1 Method A7	✓	TMH1 Method B6	
TMH1 Method A8, A9	✓	Hydrometer Analysis - ASTM D422	✓
TMH1 Method A10(b)		SANS 5863	
TMH1 Method A13T + A14app		SANS 5862-1	
TMH1 Method A15d		SANS 5860, 5861-1, 5861-2, 5861-3	
TMH1 Method A13T + A16T		TMH1 Method B9	

✓ - Tick denotes tests that were carried out.

We would like to take this opportunity of thanking you for your continued support.
Should you have any queries please do not hesitate to contact me.

Yours faithfully

K. Veeran

_____

Technical Signatory,
Kris Veeran for Geosure (Pty) Ltd.

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Mobile: +27 (0)82 784 0544
E-mail: geosure@iafrica.com

Civil Engineering Laboratory
122 Intersite Avenue, Umgeni Business Park, Durban, 4091, South Africa
PO Box 1461, Westville, 3630, South Africa
Tel: 031 701 9732
Fax: +27 (0) 86 684 9785
Mobile: 072 870 2621
E-mail: lab@geosure.co.za

Gauteng Branch
P. O. Box 32381, Kyalami 1684
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Mobile: 083 377 6559
Email: gauteng@geosure.co.za

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
GEOSURE (Pty) Ltd

sanas T0483

Reg.No.: 92/03145/07

LABORATORY AND HEAD OFFICE ADDRESS: 122 Intersite Avenue, Umgeni Business Park, Durban, 4091

LABORATORY CONTACT INFO.: Tel.: +27(0) 31 701 9732 Fax: 086 684 9785
Mobile: +27(0) 72 870 2621 e-mail: lab@geosure.co.za

HEAD OFFICE CONTACT INFO.: Tel.: +27(0) 31 266 0458 Fax: 086 689 5506
Mobile: +27(0) 82 784 0544 e-mail:geosure@iafrica.com

WEBSITE: www.geosure.co.za

Client : **Aecom** **Our Ref.** : **19213**

Project : **Southern Waste Water Treatment** **Your Ref.** : **-**

Date Tested : **17.10.2014**

Attention : **Ms R.Naidoo** **Date Reported** : **20.10.2014**

Sample No.			31242	31244	31245	31246	31247
Field No.			TP 01	TP 02	TP 02	TP 05	TP 07
Position in Field							
Depth (m)			1.3-1.9	0.6-1.6	1.6-2.9	2.6-2.7	1.5-2.8
Material Description			Grey Orange Brown Silty Sand	Orange Brown Silty Sand	Dark/Light Grey Slightly Clayey Sand	Dark/Light Grey Slightly Clayey Sand	Grey Slightly Silty Sand
Sieve Analysis (ASTM - D422)							
% Passing	**63.0**	**mm**	100	100	100	100	100
	53.0	**mm**	100	100	100	100	100
	37.5	**mm**	100	100	100	100	100
	26.5	**mm**	100	100	100	100	100
	19.0	**mm**	100	100	100	100	100
	13.2	**mm**	100	100	100	100	100
	4.75	**mm**	100	100	100	100	100
	2.00	**mm**	100	100	100	100	100
	0.425	**mm**	97	98	98	99	96
	0.075	**mm**	9	17	17	26	6
Hydrometer Analysis (ASTM - D422)							
% Passing	**0.060**	**mm**	7	13	14	23	5
	0.050	**mm**	5	11	11	21	4
	0.040	**mm**	5	11	11	21	4
	0.026	**mm**	5	11	11	21	4
	0.015	**mm**	5	11	11	21	4
	0.010	**mm**	5	11	9	21	4
	0.0074	**mm**	5	11	9	20	3
	0.0036	**mm**	5	9	9	20	3
	0.0020	**mm**	5	9	8	20	3
	0.0015	**mm**	4	7	8	18	2
Soil Mortar Analysis							
Coarse Sand		**%**	3	2	1	1	4
Coarse Fine Sand		**%**	30	29	23	20	26
Medium Fine Sand		**%**	53	47	52	47	56
Fine Fine Sand		**%**	6	6	6	7	8
Silt & Clay		**%**	9	17	17	26	6
Grading Modulus			0.9	0.9	0.9	0.7	1.0
Atterberg Limits and Classification							
Liquid Limit		**%**	NP	SP	SP	19	NP
Plasticity Index		**%**	NP	SP	SP	6	NP
Linear Shrinkage		**%**	0.0	0.5	0.5	3.5	0.0
AASHTO Classification (Group Index)*			A-3(0)	A-2-4(0)	A-2-4(0)	A-2-4(8)	A-3(0)
Unified Classification*			SP-SM	SM	SM	SM-SC	SP-SM
Moisture Content		**%**	25.1	12.1	25.4	18.0	19.0

Remarks:

Date Received: 08.10.2014.

Sampled by Client.

Deviation from ASTMD422 - Material passing 0.425mm analysed by hydrometer

*Opinions expressed herein fall outside the scope of SANAS accreditation.

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
GEOSURE (Pty) Ltd

sanas T0483

Reg.No.: 92/03145/07

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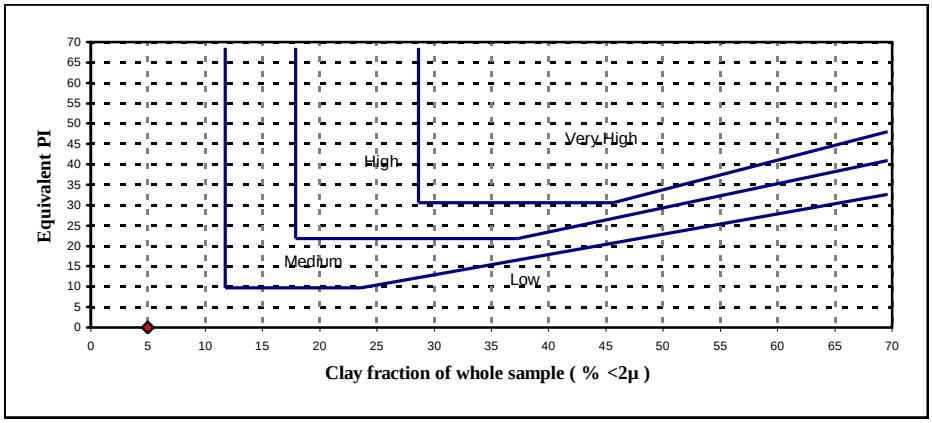
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

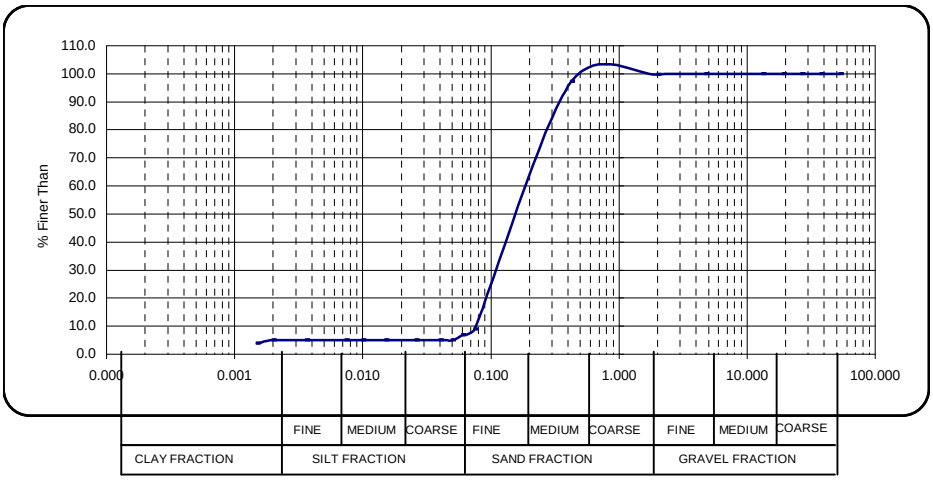
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31242
Field No. : TP 01
Sample Description : Grey Orange Brown Silty Sand
Equivalent PI : NP **Clay fraction of whole sample (% <2µ)** : 5

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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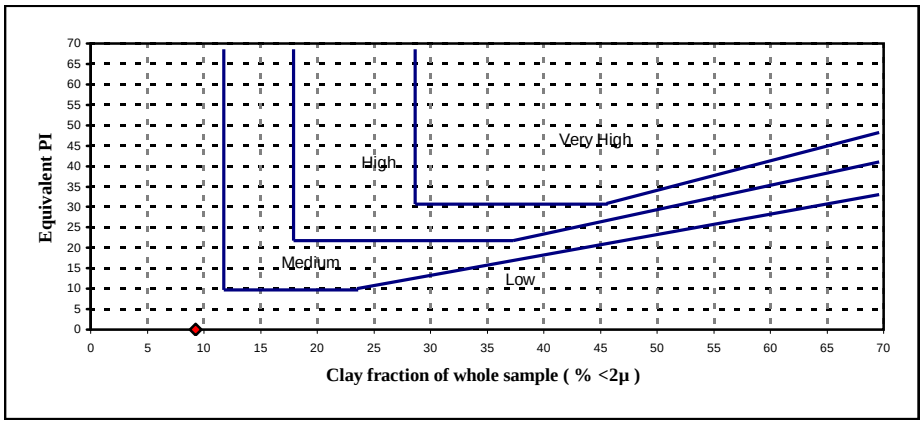
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

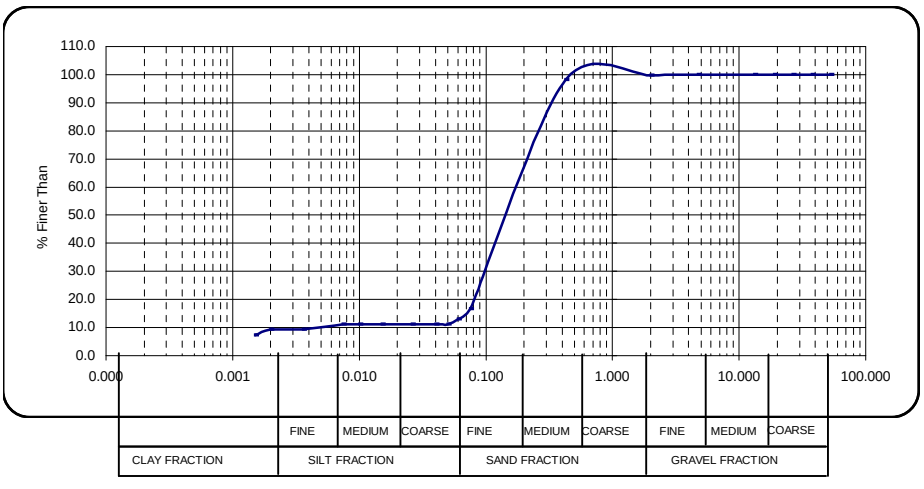
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31244
Field No. : TP 02
Sample Description : Orange Brown Silty Sand
Equivalent PI :
Clay fraction of whole sample (% <2µ) : 9

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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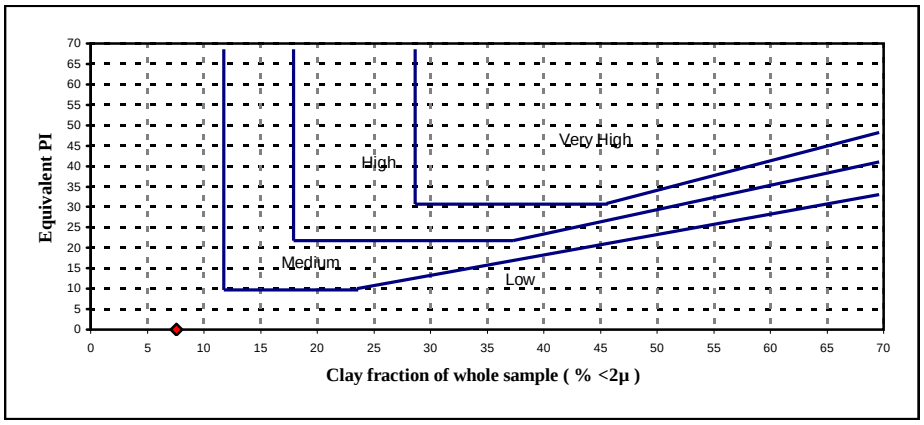
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

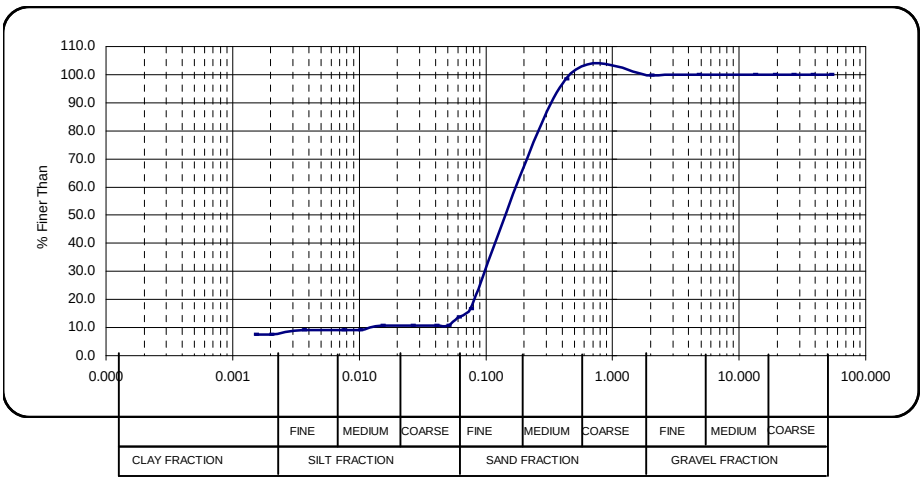
Job No. :
Your Ref.No. :
Date Tested :
Date Reported :

Sample Number : 31245
Field No. : TP 02
Sample Description : Dark/Light Grey Slightly Clayey Sand
Equivalent PI :
Clay fraction of whole sample (% <2µ) : 8

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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WEBSITE: www.geosure.co.za

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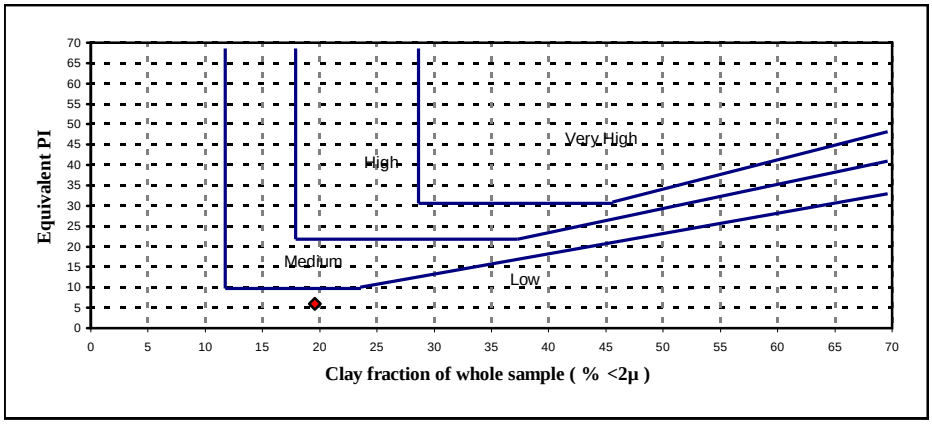
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

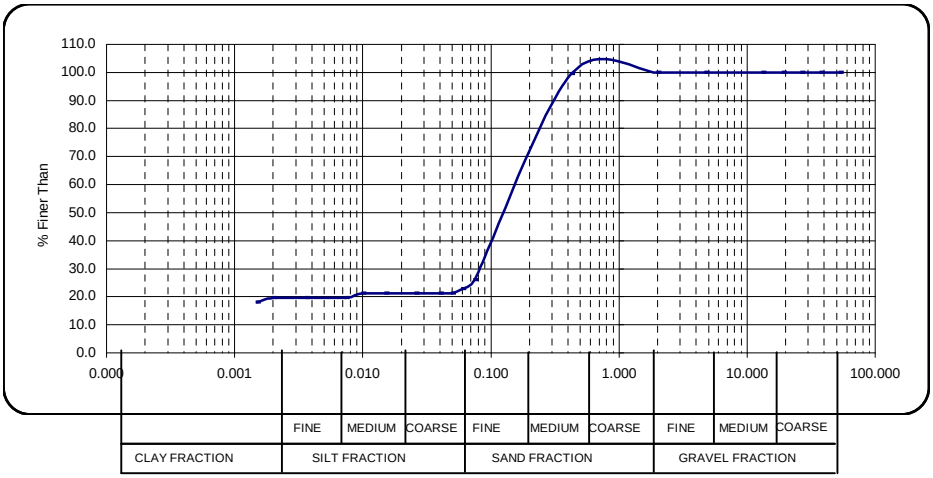
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31246
Field No. : TP 05
Sample Description : Dark/Light Grey Slightly Clayey Sand
Equivalent PI : 6 **Clay fraction of whole sample (% <2µ)** : 20

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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WEBSITE: www.geosure.co.za

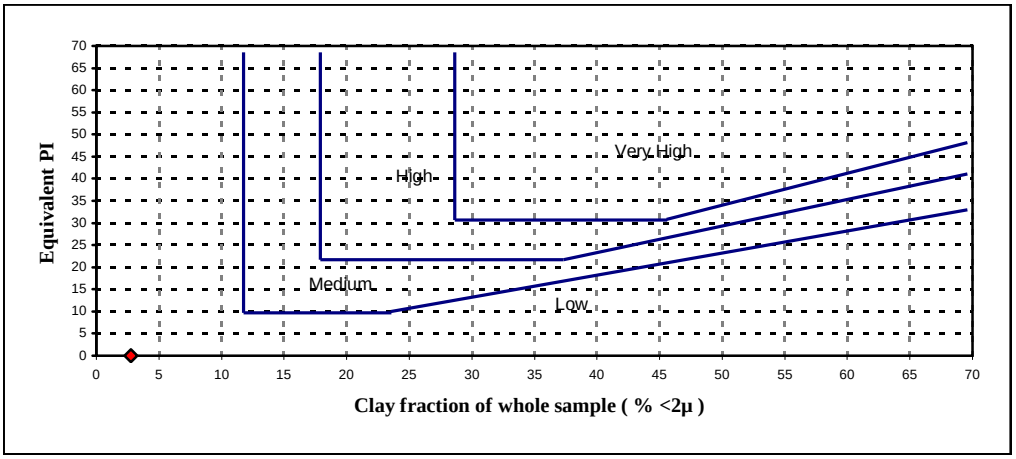
Sample Number : 31247

Field No. : TP 07

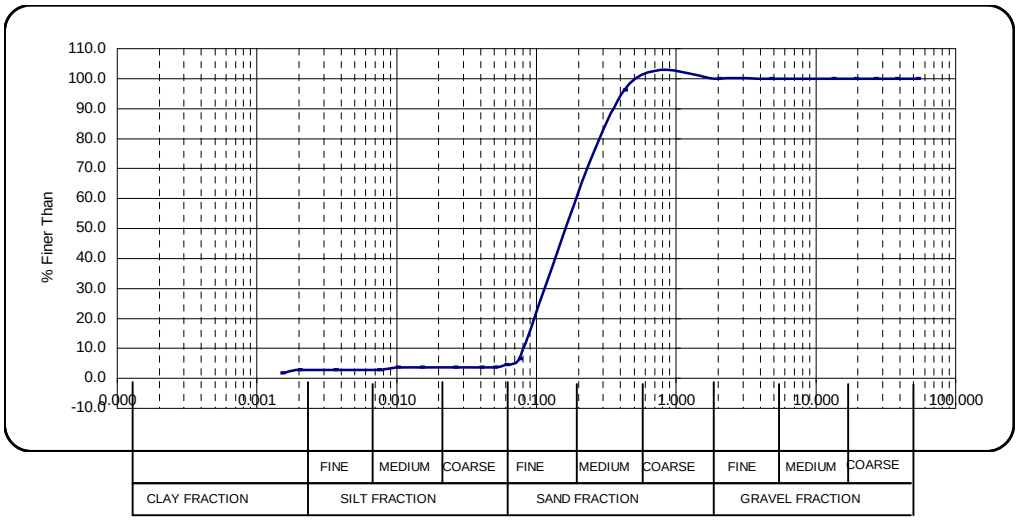
Sample Description : Grey Slightly Silty Sand

Equivalent PI : NP **Clay fraction of whole sample (% <2μ)** : 3

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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WEBSITE: www.geosure.co.za

Client : Aecom **Our Ref.** : 19213

Project : Southern Waste Water Treatment **Your Ref.** : -

Date Tested : 17.10.2014

Attention : Ms R.Naidoo **Date Reported** : 20.10.2014

Sample No.			31248	31249	31250	31251	31252
Field No.			TP 08	TP 09	TP 10	TP 12	TP 13
Position in Field							
Depth (m)			1.3-2.8	1.8-3.0	2.4-2.8	2.4-2.5	1.7-3.0
Material Description			Orange Grey Brown Clayey Silty Sand	Red Brown Sandy Clayey Silt	Red Brown Sandy Clayey Silt	Black Clayey Silt	Greenish Brown Slightly Silty Sand
Sieve Analysis (ASTM - D422)							
% Passing	**63.0**	**mm**	100	100	100	100	100
	53.0	**mm**	100	100	100	100	100
	37.5	**mm**	100	100	100	100	100
	26.5	**mm**	100	100	100	100	100
	19.0	**mm**	100	100	100	100	100
	13.2	**mm**	100	100	100	100	100
	4.75	**mm**	100	100	99	100	100
	2.00	**mm**	100	100	98	100	100
	0.425	**mm**	96	99	98	91	97
	0.075	**mm**	34	36	38	60	7
Hydrometer Analysis (ASTM - D422)							
% Passing	**0.060**	**mm**	31	33	35	55	5
	0.050	**mm**	29	31	31	48	3
	0.040	**mm**	29	31	31	35	3
	0.026	**mm**	29	31	31	33	3
	0.015	**mm**	29	31	31	25	3
	0.010	**mm**	29	31	30	20	3
	0.0074	**mm**	28	31	30	18	3
	0.0036	**mm**	26	29	30	13	3
	0.0020	**mm**	26	27	28	10	3
	0.0015	**mm**	23	27	28	8	2
Soil Mortar Analysis							
Coarse Sand		**%**	4	1	1	9	2
Coarse Fine Sand		**%**	15	14	8	8	36
Medium Fine Sand		**%**	39	39	44	16	48
Fine Fine Sand		**%**	9	10	8	6	6
Silt & Clay		**%**	34	36	39	60	7
Grading Modulus			0.7	0.7	0.7	0.5	1.0
Atterberg Limits and Classification							
Liquid Limit		**%**	25	27	34	69	NP
Plasticity Index		**%**	11	11	17	16	NP
Linear Shrinkage		**%**	5.1	5.0	8.3	7.5	0.0
AASHTO Classification (Group Index)*			A-2-4(0)	A-6(0)	A-6(2)	A-7-5(11)	A-3(0)
Unified Classification*			SC	SC	SC	MH	SP-SM
Moisture Content		**%**	15.1	20.0	24.1	17.0	17.1

Remarks:

Date Received: 08.10.2014.

Sampled by Client.

Deviation from ASTMD422 - Material passing 0.425mm analysed by hydrometer

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Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
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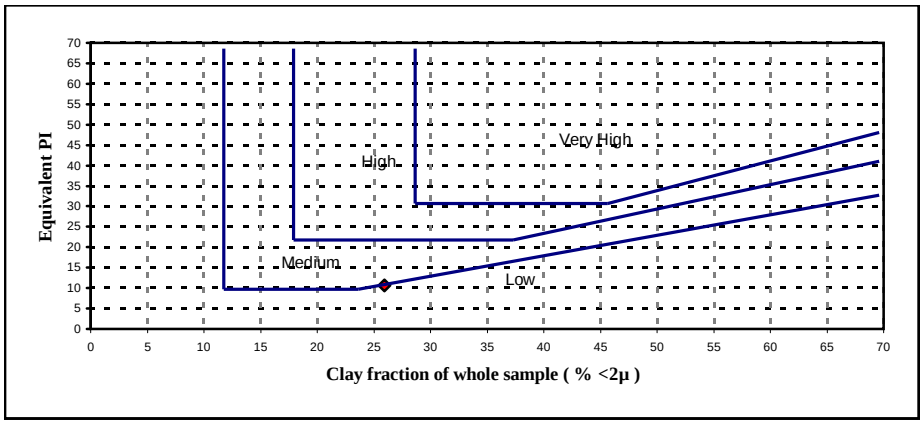
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

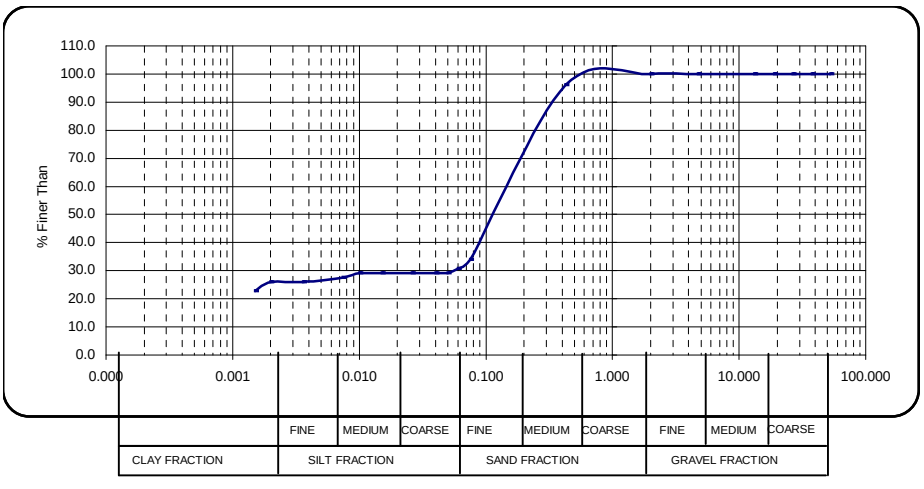
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31248
Field No. : TP 08
Sample Description : Orange Grey Brown Clayey Silty Sand
Equivalent PI : 11 **Clay fraction of whole sample (% <2µ)** : 26

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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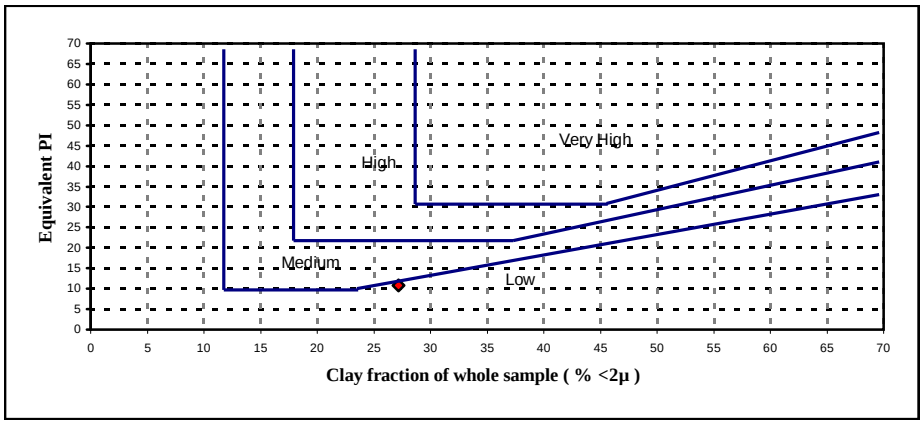
Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

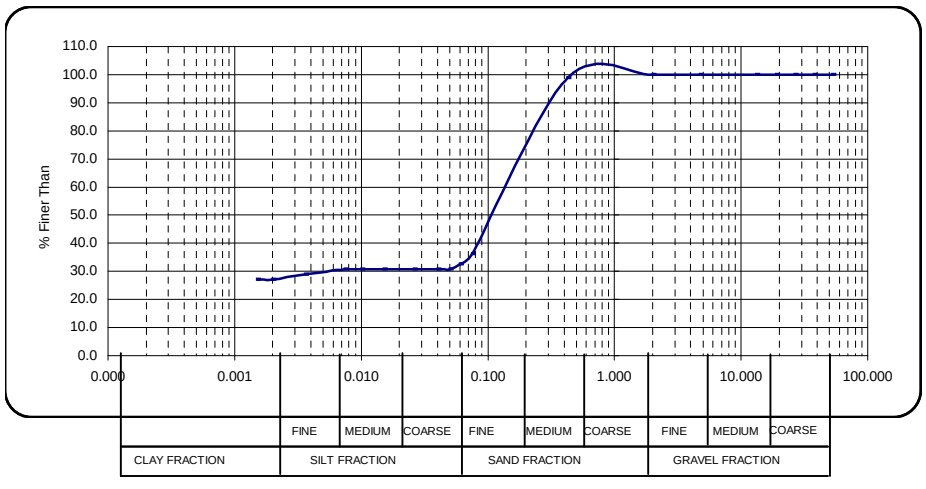
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31249
Field No. : TP 09
Sample Description : Red Brown Sandy Clayey Silt
Equivalent PI : 11 **Clay fraction of whole sample (% <2µ)** : 27

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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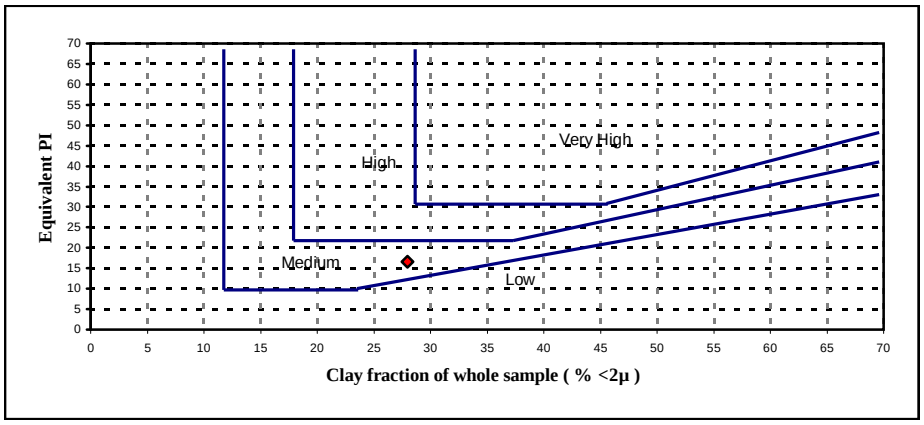
Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

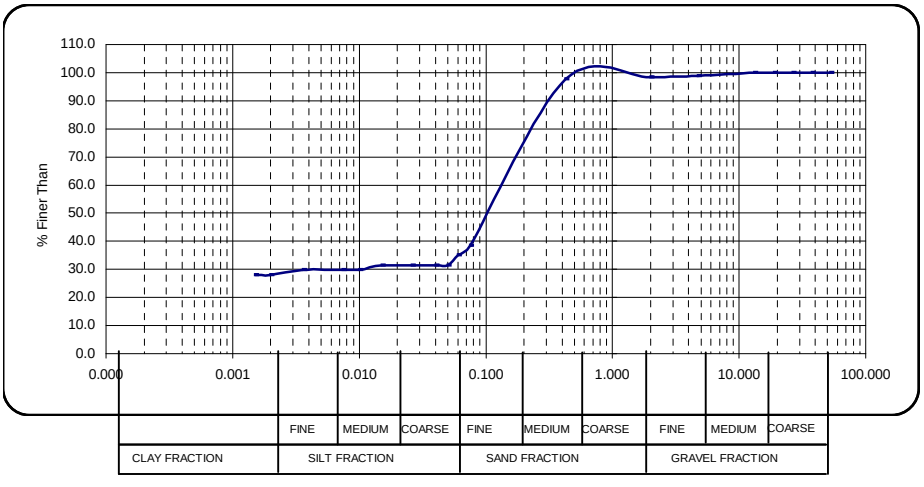
Job No. :
Your Ref.No. :
Date Tested :
Date Reported :

Sample Number : 31250
Field No. : TP 10
Sample Description : Red Brown Sandy Clayey Silt
Equivalent PI : 17 **Clay fraction of whole sample (% <2µ)** : 28

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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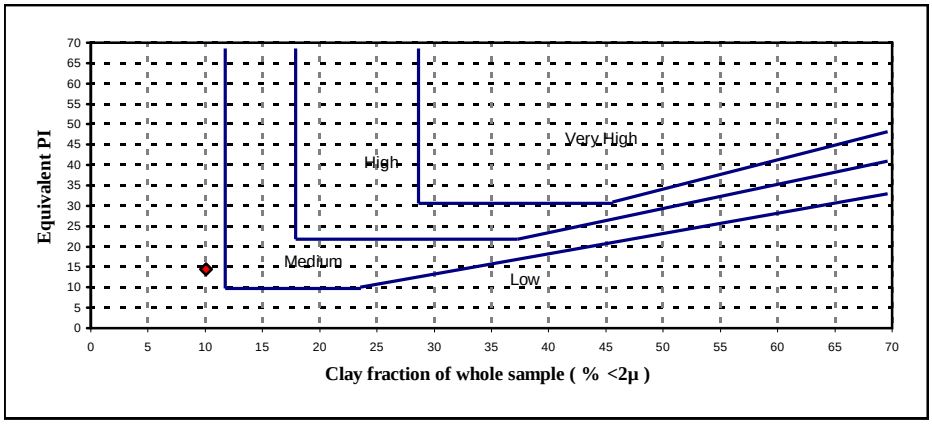
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

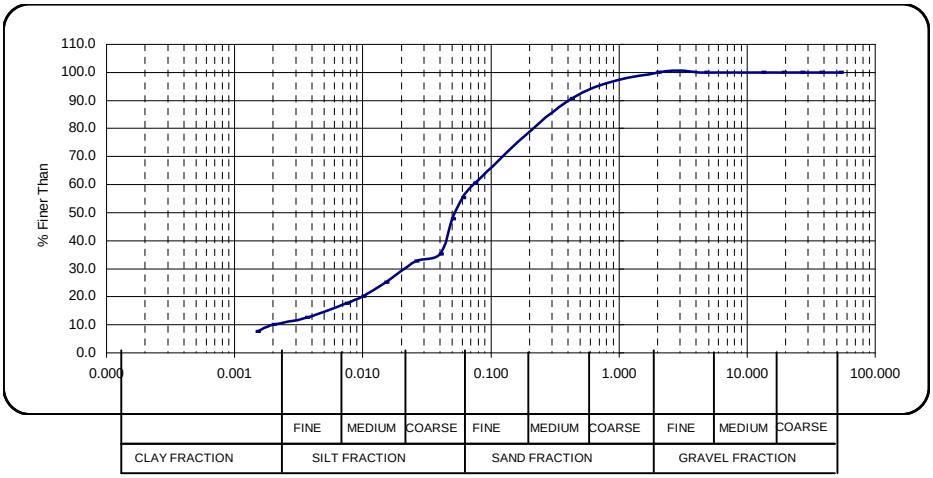
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31251
Field No. : TP 12
Sample Description : Black Clayey Silt
Equivalent PI : 14 **Clay fraction of whole sample (% <2µ)** : 10

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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Mobile: +27(0) 82 784 0544 e-mail:geosure@iafrica.com

WEBSITE: www.geosure.co.za

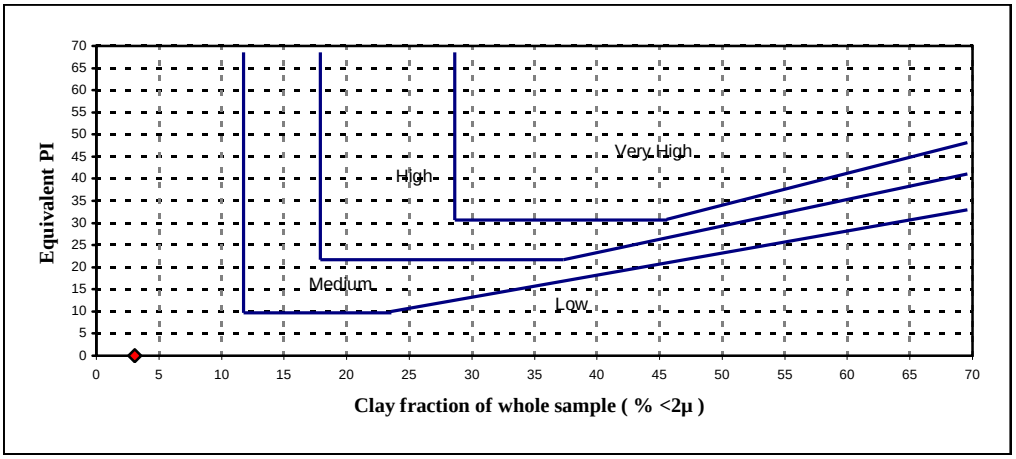
Sample Number : 31252

Field No. : TP 13

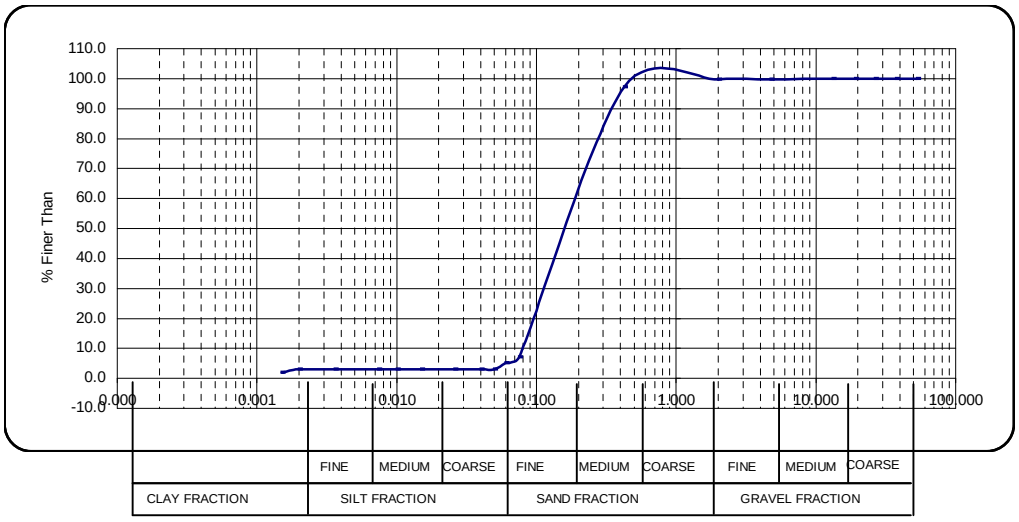
Sample Description : Greenish Brown Slightly Silty Sand

Equivalent PI : NP **Clay fraction of whole sample (% <2μ)** : 3

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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WEBSITE: www.geosure.co.za

Client : **Aecom** **Our Ref.** : **19213**

Project : **Southern Waste Water Treatment** **Your Ref.** : **-**

Date Tested : **17.10.2014**

Attention : **Ms R.Naidoo** **Date Reported** : **20.10.2014**

Sample No.			31253	31255	31256	31257	31258
Field No.			TP 15	TP 16	TP 16	TP 17	BH 01
Position in Field							
Depth (m)			1.6-2.5	3.0-3.2	2.4-3.0	2.6-3.0	8.05-8.6
Material Description			Orange Brown Silty Sand	Black Clayey Silty	Greenish Grey Brown Clayey Silty Clay	Grey Silty Sand	Grey Black Silty Clay
Sieve Analysis (ASTM - D422)							
% Passing	**63.0**	**mm**	100	100	100	100	100
	53.0	**mm**	100	100	100	100	100
	37.5	**mm**	100	100	100	100	100
	26.5	**mm**	100	100	100	100	100
	19.0	**mm**	100	100	100	100	100
	13.2	**mm**	97	100	100	100	100
	4.75	**mm**	97	100	100	100	100
	2.00	**mm**	97	100	100	100	100
	0.425	**mm**	95	100	98	97	100
	0.075	**mm**	4	97	20	13	83
Hydrometer Analysis (ASTM - D422)							
% Passing	**0.060**	**mm**	3	91	16	11	79
	0.050	**mm**	3	86	14	9	71
	0.040	**mm**	3	81	14	9	62
	0.026	**mm**	3	73	14	9	52
	0.015	**mm**	3	64	14	9	46
	0.010	**mm**	2	59	14	9	42
	0.0074	**mm**	2	51	14	9	35
	0.0036	**mm**	1	43	12	7	27
	0.0020	**mm**	1	38	10	5	25
	0.0015	**mm**	1	30	10	5	21
Soil Mortar Analysis							
Coarse Sand		**%**	3	0	2	2	0
Coarse Fine Sand		**%**	33	1	24	19	1
Medium Fine Sand		**%**	54	2	45	55	7
Fine Fine Sand		**%**	6	0	8	10	8
Silt & Clay		**%**	5	97	20	13	83
Grading Modulus			1.0	0.0	0.8	0.9	0.2
Atterberg Limits and Classification							
Liquid Limit		**%**	NP	57	SP	SP	46
Plasticity Index		**%**	NP	21	SP	SP	27
Linear Shrinkage		**%**	0.0	10.1	0.5	0.5	13.5
AASHTO Classification (Group Index)*			A-3(0)	A-7-5(27)	A-2-4(0)	A-2-4(0)	A-7-6(23)
Unified Classification*			SP	MH	SM	SM	CL
Moisture Content		**%**	17.0	86.0	16.1	19.1	46.0

Remarks:

Date Received: 08.10.2014.

Sampled by Client.

Deviation from ASTMD422 - Material passing 0.425mm analysed by hydrometer

*Opinions expressed herein fall outside the scope of SANAS accreditation.

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
GEOSURE (Pty) Ltd

sanas T0483

Reg.No.: 92/03145/07

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Mobile: +27(0) 82 784 0544 e-mail:geosure@iafrica.com

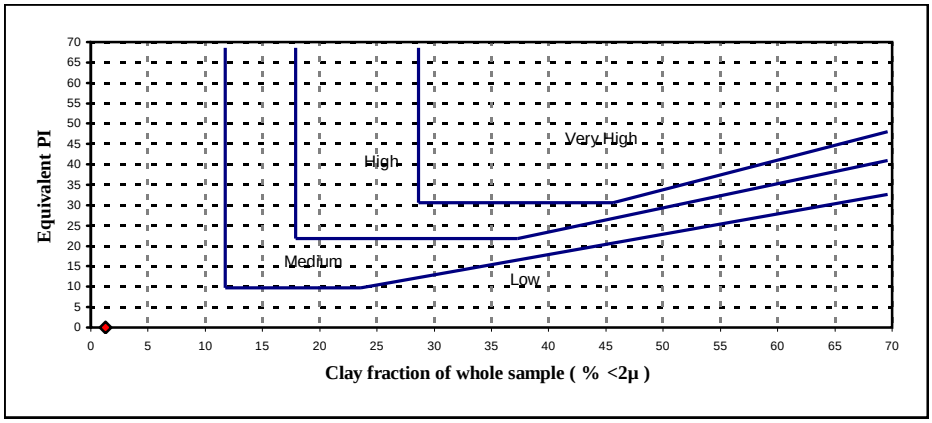
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

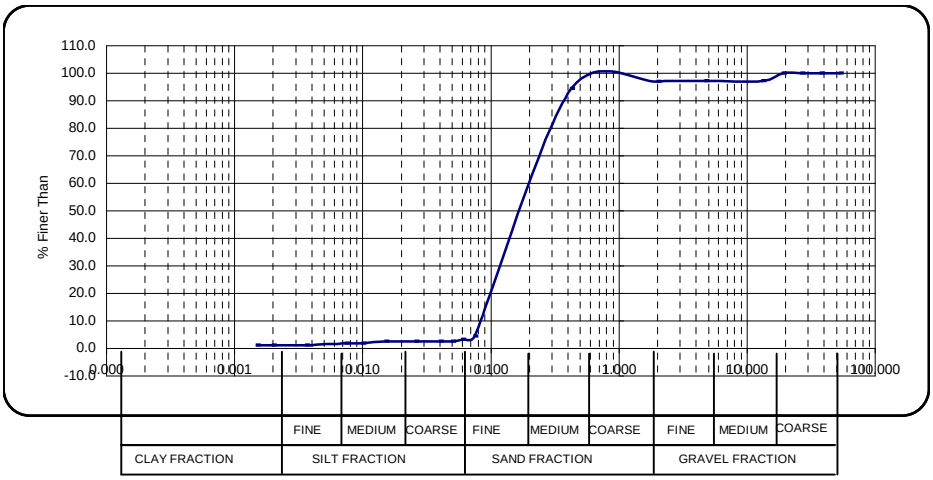
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31253
Field No. : TP 15
Sample Description : Orange Brown Silty Sand
Equivalent PI : NP **Clay fraction of whole sample (% <2µ)** : 1

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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GEOSURE (Pty) Ltd

sanas Testing Laboratory T9483

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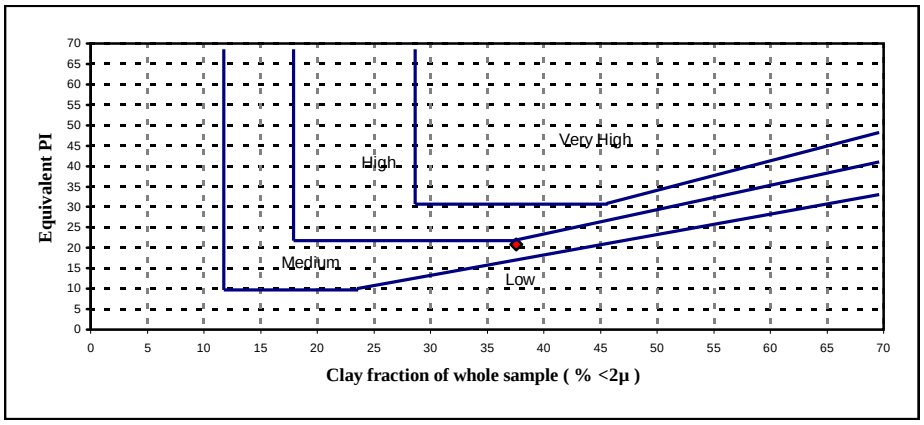
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

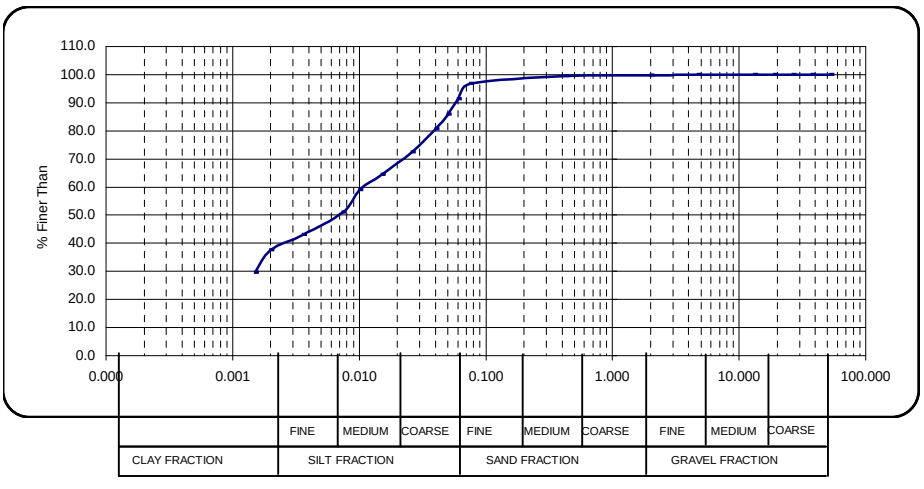
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31255
Field No. : TP 16
Sample Description : Black Clayey Silty
Equivalent PI : 21 **Clay fraction of whole sample (% <2µ)** : 38

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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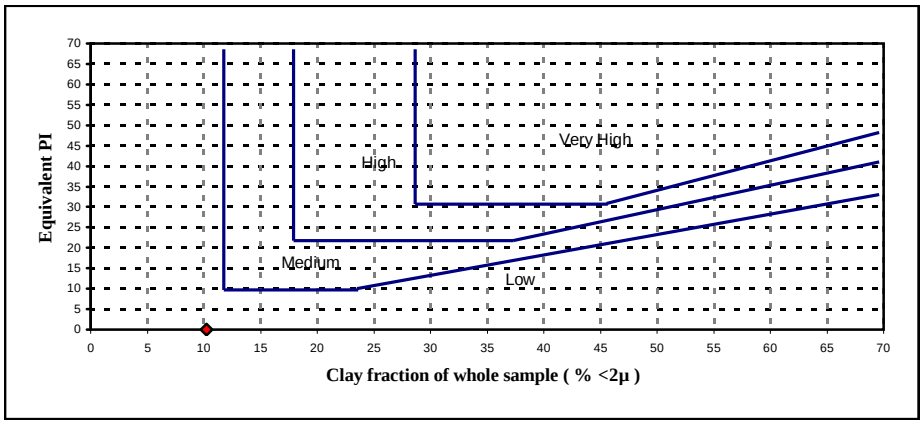
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

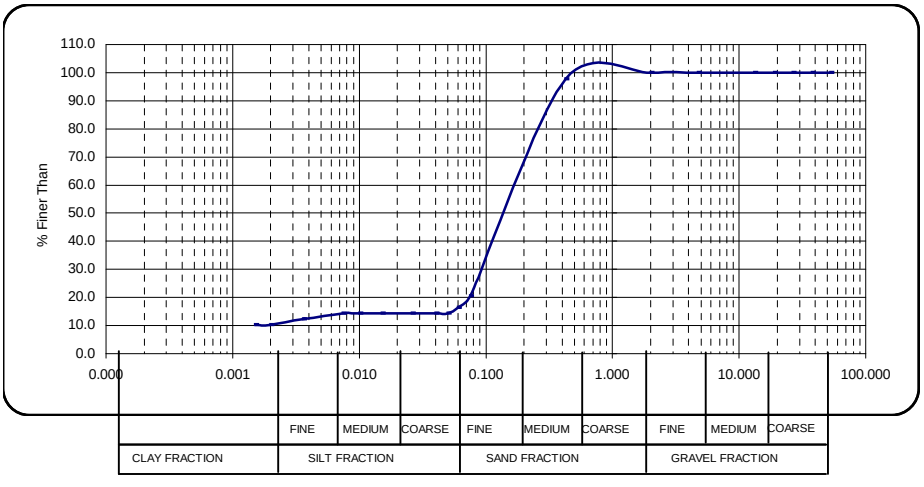
Job No. :
Your Ref.No. :
Date Tested :
Date Reported :

Sample Number : 31256
Field No. : TP 16
Sample Description : Greenish Grey Brown Clayey Silty Clay
Equivalent PI :
Clay fraction of whole sample (% <2µ) : 10

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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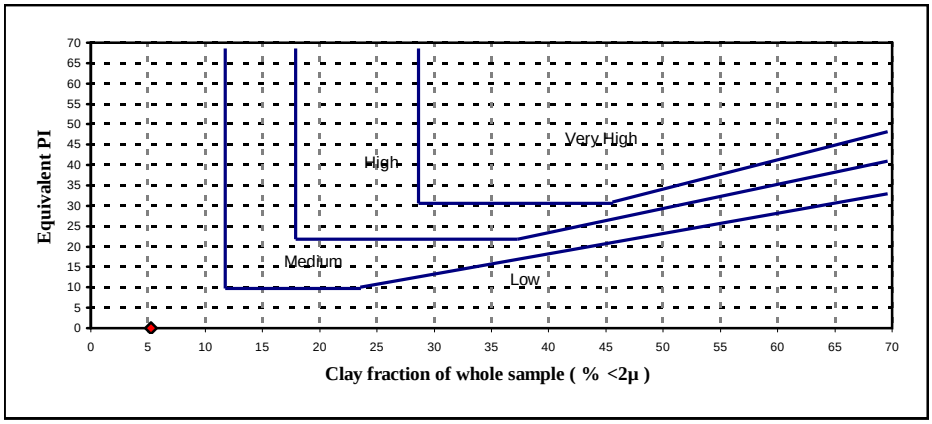
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

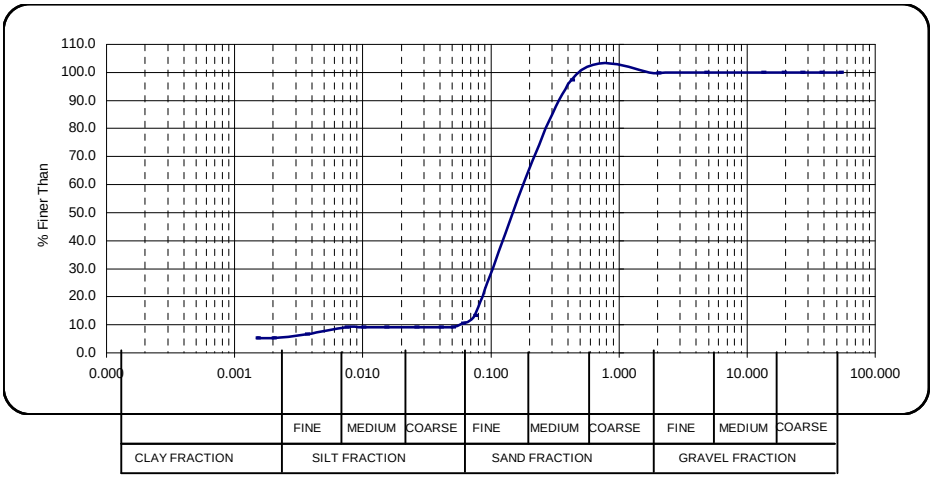
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31257
Field No. : TP 17
Sample Description : Grey Silty Sand
Equivalent PI : [ ] **Clay fraction of whole sample (% <2µ)** : [5]

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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WEBSITE: www.geosure.co.za

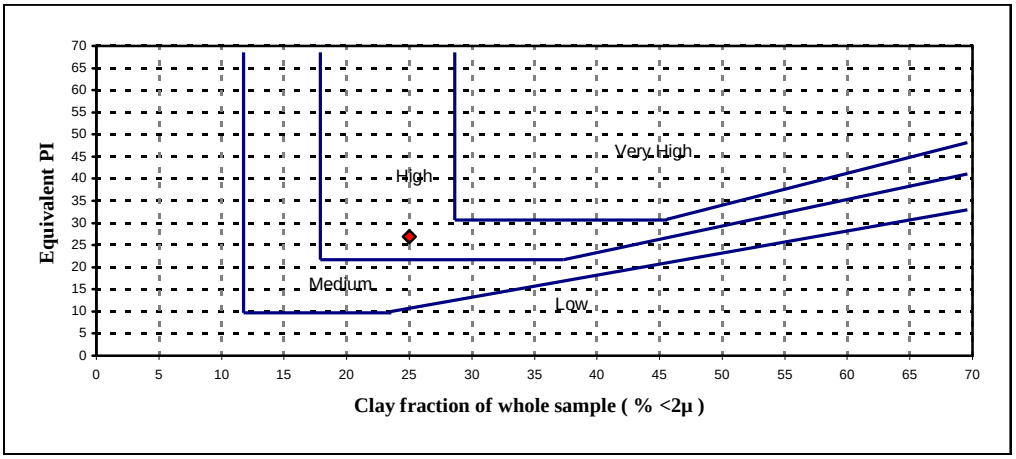
Sample Number : 31258

Field No. : BH 01

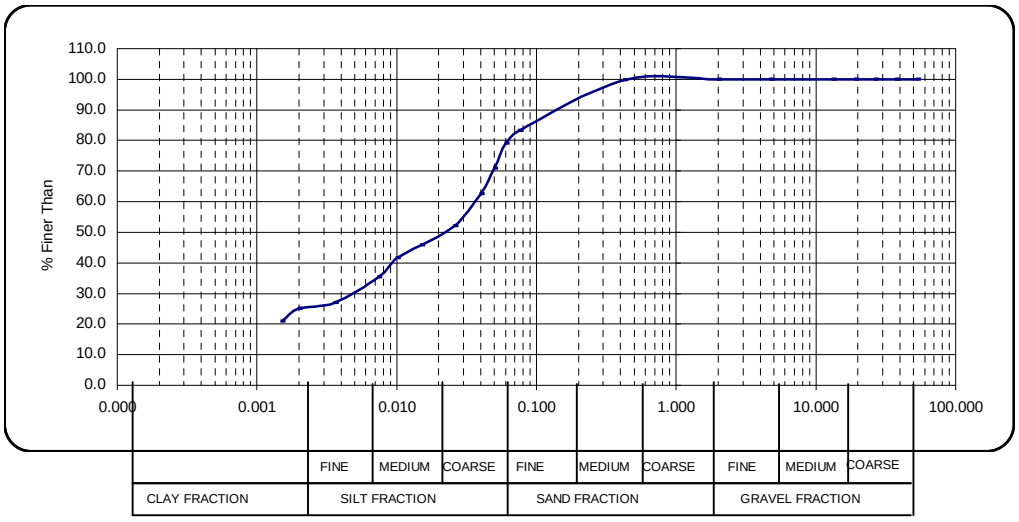
Sample Description : Grey Black Silty Clay

Equivalent PI : 27 **Clay fraction of whole sample (% <2μ)** : 25

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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WEBSITE: www.geosure.co.za

Client : Aecom **Our Ref.** : 19213

Project : Southern Waste Water Treatment **Your Ref.** : -

Date Tested : 17.10.2014

Attention : Ms R.Naidoo **Date Reported** : 20.10.2014

Sample No.			31259	31260	31261	31262	31269
Field No.			BH01	BH01	BH02A	BH02A	BH05
Position in Field							
Depth (m)			0.52-10.07	11.33-11.76	10.23-10.77	13.07-13.60	11.08-11.47
Material Description			Orange Brown Silty Sand	Black Clayey Silty	Greenish Grey Brown Clayey Silty Clay	Grey Silty Sand	Grey Slightly Clayey Silty Sand
Sieve Analysis (ASTM - D422)							
% Passing	63.0	mm	100	100	100	100	100
	53.0	mm	100	100	100	100	100
	37.5	mm	100	100	100	100	100
	26.5	mm	100	100	100	100	100
	19.0	mm	100	100	100	100	100
	13.2	mm	100	100	100	100	100
	4.75	mm	100	99	100	100	100
	2.00	mm	98	99	100	98	100
	0.425	mm	96	98	93	51	95
	0.075	mm	88	92	21	15	24
Hydrometer Analysis (ASTM - D422)							
% Passing	0.060	mm	84	87	18	13	21
	0.050	mm	72	79	15	12	19
	0.040	mm	62	66	14	11	19
	0.026	mm	53	59	14	11	19
	0.015	mm	45	50	14	11	19
	0.010	mm	43	48	14	11	19
	0.0074	mm	38	42	12	11	19
	0.0036	mm	29	31	11	10	19
	0.0020	mm	24	28	11	10	19
	0.0015	mm	22	26	11	10	17
Soil Mortar Analysis							
Coarse Sand		%	2	1	7	48	5
Coarse Fine Sand		%	2	1	23	15	27
Medium Fine Sand		%	2	1	38	18	38
Fine Fine Sand		%	4	4	11	4	6
Silt & Clay		%	90	93	21	15	24
Grading Modulus			0.2	0.1	0.9	1.4	0.8
Atterberg Limits and Classification							
Liquid Limit		%	56	53	SP	23	24
Plasticity Index		%	27	25	SP	8	9
Linear Shrinkage		%	12.9	11.4	0.5	3.2	4.9
AASHTO Classification (Group Index)*			A-7-6(27)	A-7-6(27)	A-2-4(0)	A-2-4(0)	A-2-4(0)
Unified Classification*			CH	CH	SM	SC	SC
Moisture Content		%	51.0	42.8	22.2	20.1	15.9

Remarks:
Date Received: 08.10.2014.
Sampled by Client.
Deviation from ASTMD422 - Material passing 0.425mm analysed by hydrometer
*Opinions expressed herein fall outside the scope of SANAS accreditation.

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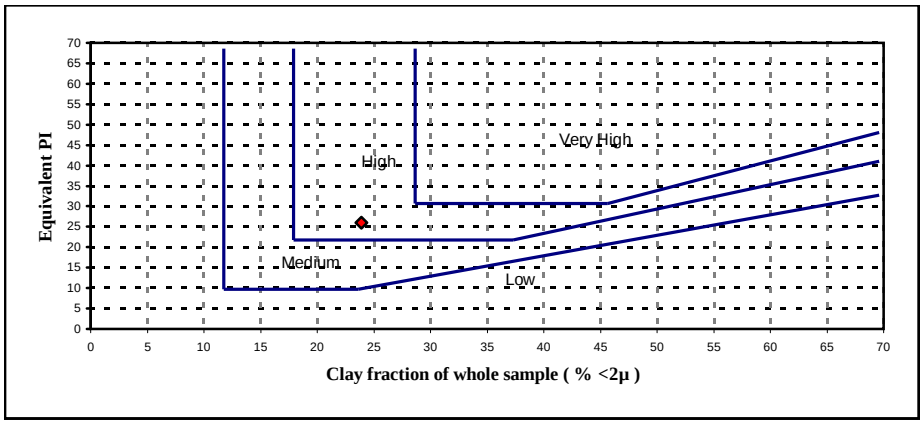
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

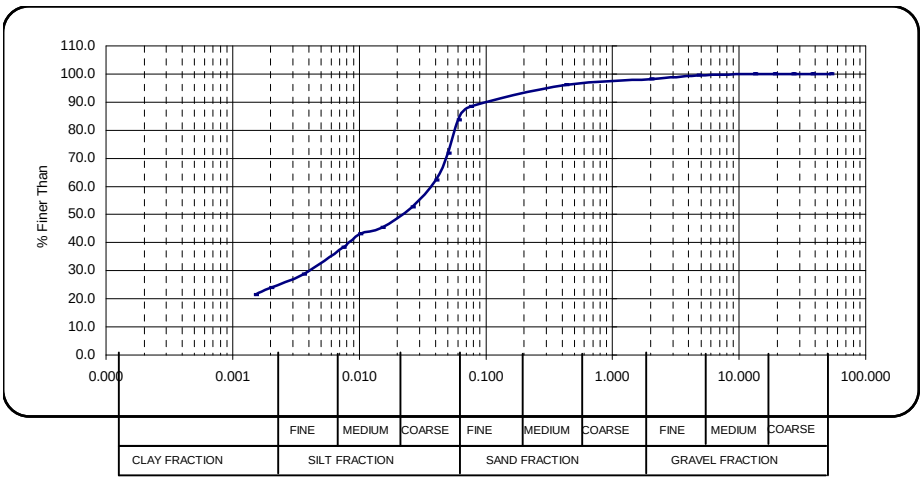
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31259
Field No. : BH01
Sample Description : Orange Brown Silty Sand
Equivalent PI : 26 **Clay fraction of whole sample (% <2µ)** : 24

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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GEOSURE (Pty) Ltd
sanas Testing laboratory T9483

Reg.No.: 92/03145/07

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Mobile: +27(0) 82 784 0544 e-mail:geosure@iafrica.com

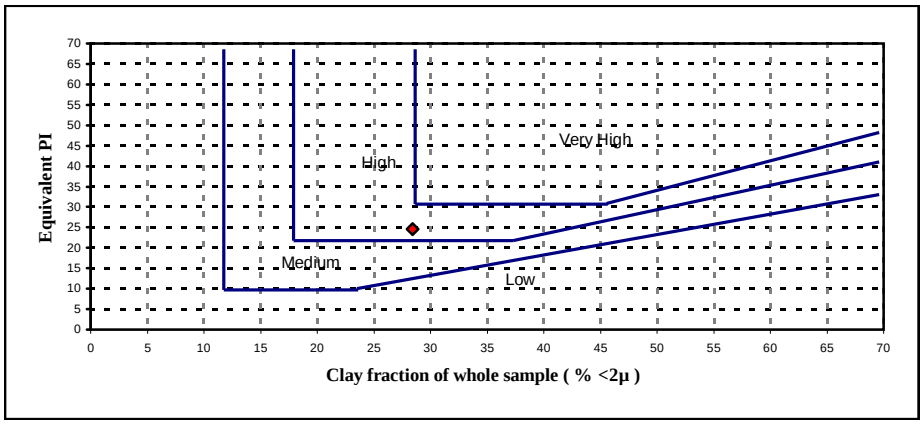
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

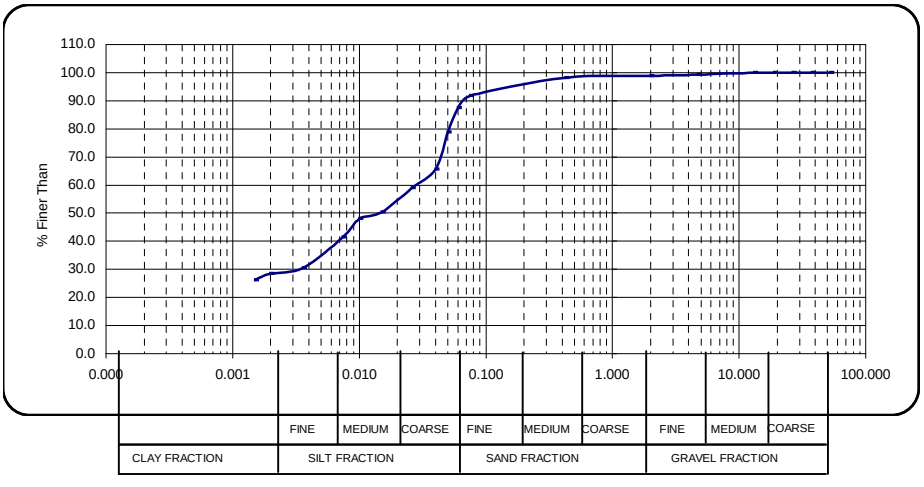
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31260
Field No. : BH01
Sample Description : Black Clayey Silty
Equivalent PI : 25 **Clay fraction of whole sample (% <2µ)** : 28

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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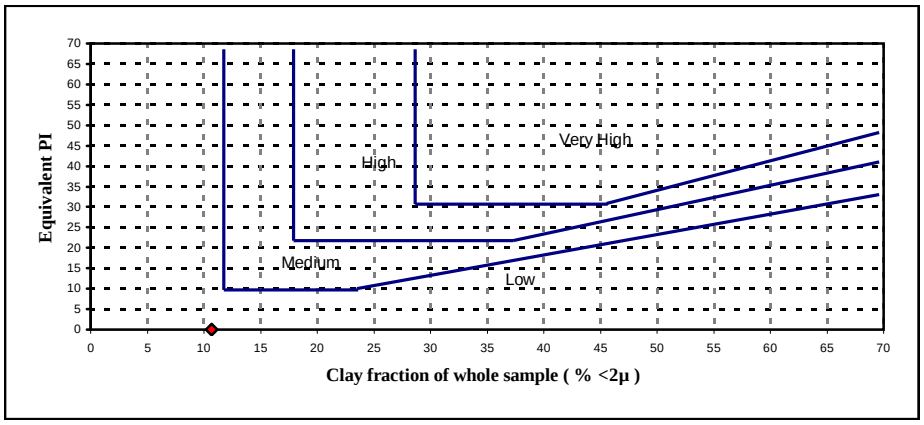
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

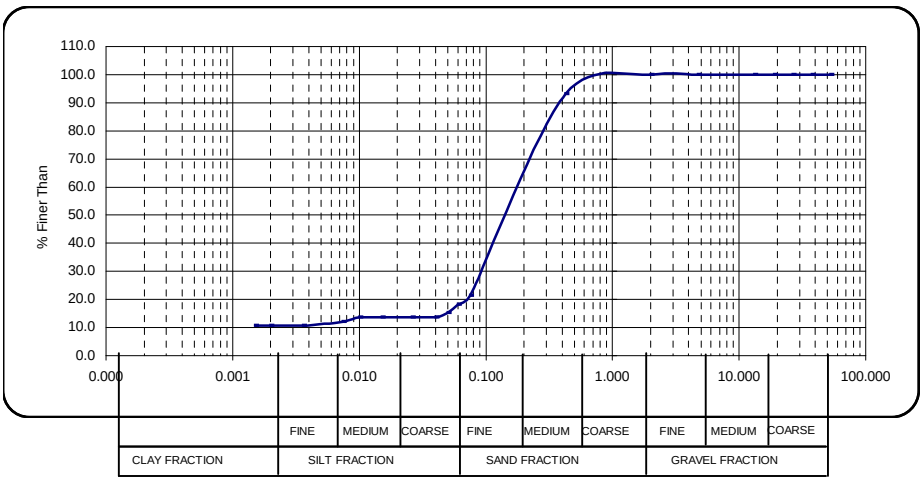
Job No. :
Your Ref.No. :
Date Tested :
Date Reported :

Sample Number : 31261
Field No. : BH02A
Sample Description : Greenish Grey Brown Clayey Silty Clay
Equivalent PI :
Clay fraction of whole sample (% <2µ) : 11

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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GEOSURE (Pty) Ltd

sanas T0483

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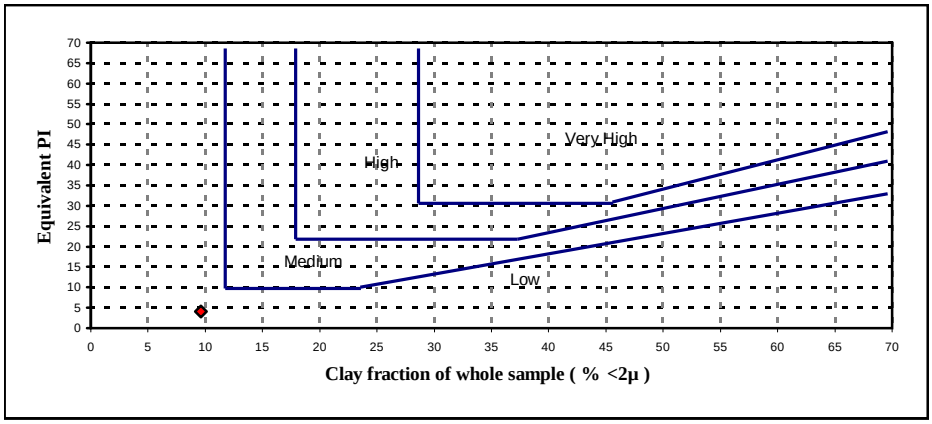
WEBSITE: www.geosure.co.za

Client : Aecom
Project : Southern Waste Water Treatment
Attention : Ms R.Naidoo

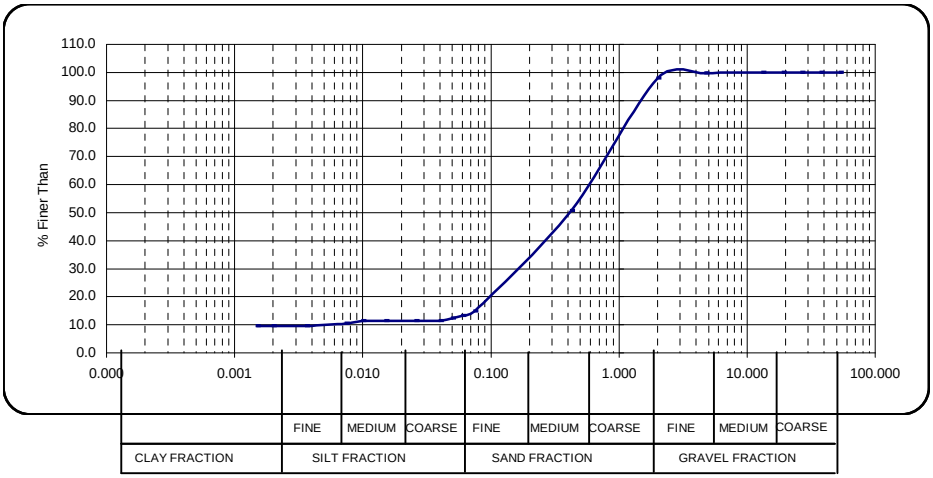
Job No. : 19213
Your Ref.No. : -
Date Tested : 17.10.2014
Date Reported : 20.10.2014

Sample Number : 31262
Field No. : BH02A
Sample Description : Grey Silty Sand
Equivalent PI : 4 **Clay fraction of whole sample (% <2µ)** : 10

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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GEOSURE (Pty) Ltd
sanas Testing Laboratory T0483

Reg.No.: 92/03145/07

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Mobile: +27(0) 82 784 0544 e-mail:geosure@iafrica.com

WEBSITE: www.geosure.co.za

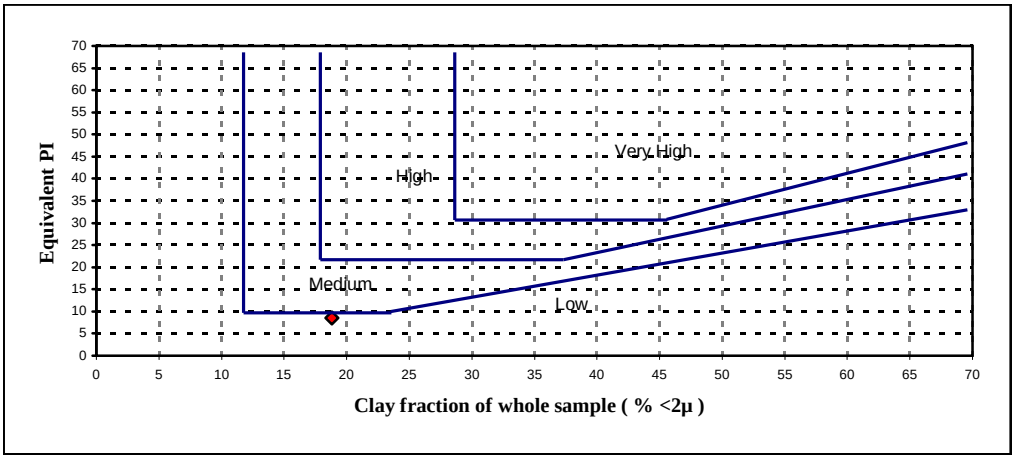
Sample Number : 31269

Field No. : BH05

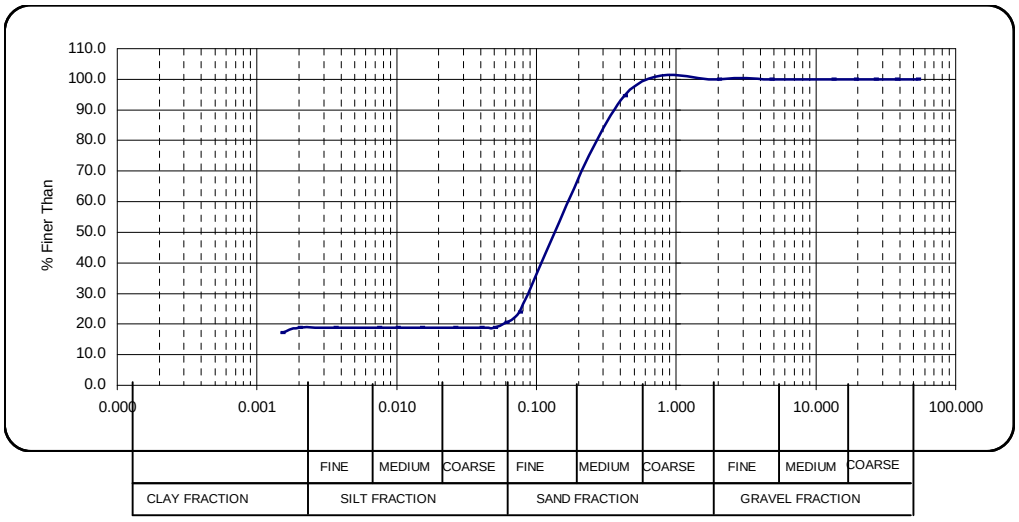
Sample Description : Grey Slightly Clayey Silty Sand

Equivalent PI : 9 **Clay fraction of whole sample (% <2μ)** : 19

POTENTIAL EXPANSIVENESS GRAPH



PARTICLE SIZE DISTRIBUTION CHART



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RESULTS

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
GEOSURE (Pty) Ltd

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Reg. No. : 92/03145/07
Fax: 086 684 9785
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HEAD OFFICE:
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Durban, 4091, KwaZulu Natal, South Africa.
Tel: +27 (0)31 266 0458 Fax: 086 689 5506
email: geosure@iafrica.com www.geosure.co.za

Client : **Aecom** — **Your Ref No. : -**
Project : **Southern Waste Water Treatment Works** — **Our Ref No. : 19213**
Attention : **Ms R.Naidoo** — **Date Reported : 21/10/2014**

Test Report

Sample No.		31243	31254			
Field No.		TP 01	TP 14			
Position						
Depth (m)		0.5-1.3	0.8-1.9			
Material Description		Orange Brown/Light Brown (Slightly) Silty Sand	Orange Brown/Light Brown (Slightly) Silty Sand			
Sieve Analysis (Wet Preparation) TMH1 - Method A1 (a) - Percent Passing Sieve Size						
Sieve Aperture (mm)	**75.00**					
	63.00					
	53.00					
	37.50					
	26.50					
	19.00					
	13.20					
	4.750	100	100			
	2.000	99	99			
	0.425	62	90			
	0.075	5	13			
Grading Modulus		1.33	0.98			
Mechanical analysis - TMH1 - Method A5 - Percent of Soil Mortar (<2 mm) for Grain Size range						
Coarse Sand	**2.000 - 0.425**	37	9			
Coarse-Fine Sand	**0.425 - 0.250**	25	30			
Medium-Fine Sand	**0.250 - 0.150**	30	42			
Fine-Fine Sand	**0.150 - 0.075**	3	5			
Silt and Clay	**< 0.075**	5	13			
Atterberg Limits TMH 1 - Methods A2, A3, A4 on <0.425 mm fraction						
Liquid Limit	% or symbol	NP	NP			
Plasticity Index	% or symbol	NP	NP			
Linear Shrinkage	%	0.0	0.0			
Maximum Dry Density and Optimum Moisture Content - TMH1 - Method A7						
Maximum Dry Density (kg/m³)		1856	1843			
Optimum moisture content (%)		9.6	8.8			
California Bearing Ratio - TMH1 - Method A8						
CBR @100% Compaction	%	20	37			
CBR @ 98% Compaction	%	18	32			
CBR @ 97% Compaction	%	17	30			
CBR @ 95% Compaction	%	17	23			
CBR @ 93% Compaction	%	16	17			
CBR @ 90% Compaction	%	15	11			
Swell @100% Compaction	%	0.0	0.0			
TRH 14 Classification (1985)**		G7	G7			
AASHTO Classification (Group Index)**		A-3 (0)	A-2-4 (0)			
Unified Classification **		SP-SM	SM			

Remarks: ***Subject to further testing as required by TRH14.**

** Opinions and interpretations expressed herein are outside the scope of SANAS accreditation

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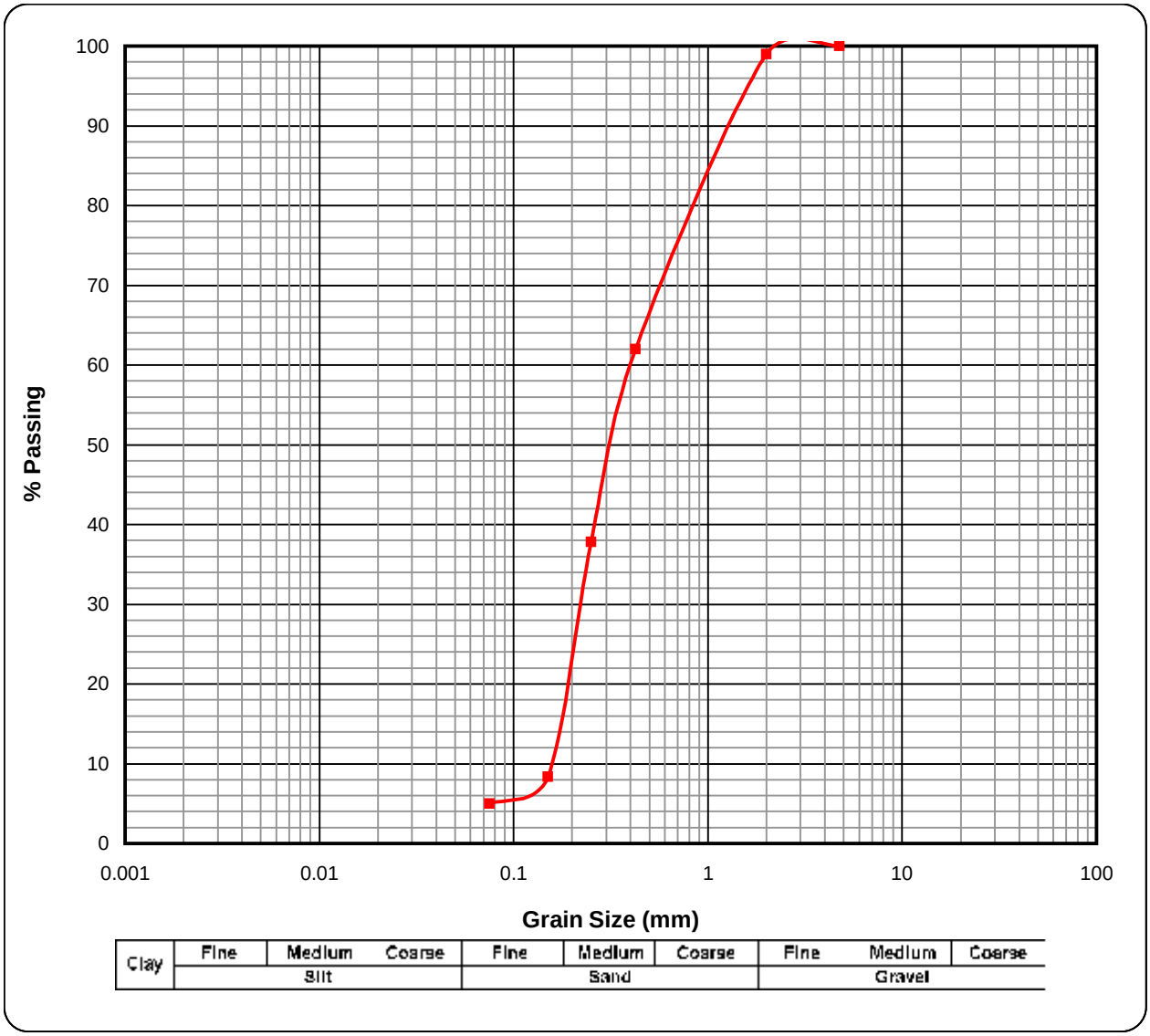
Client : **Aecom**
Project : **Southern Waste Water Treatment Works**
Attention : **Ms R.Naidoo**

Your Ref No.: **-**
Our Ref No. : **19213**
Date Reported : **21/10/2014**

Grading Curve for Sample 31243 – TMH1 Method A1 (a)



Thick Red Line is the Grading Curve (TRH 14 Classification = G7)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	13.2	19.0	26.5	37.5	53	63	75
Percentage Passing	5%	8%	38%	62%	99%	100%							

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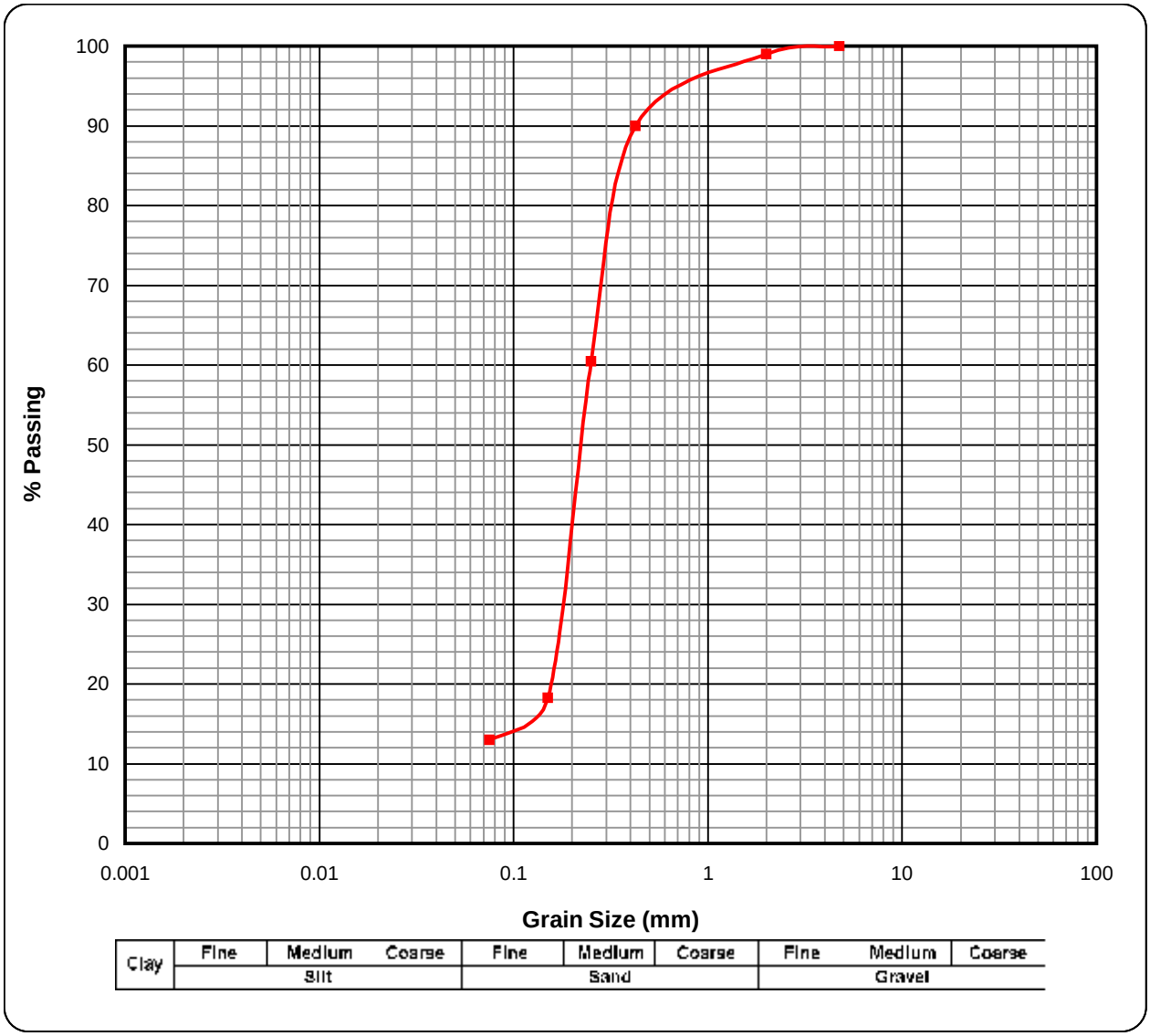
Project : **Southern Waste Water Treatment Works**
Attention : **Ms R.Naidoo**

Your Ref No.: **-**
Our Ref No. : **19213**
Date Reported : **21/10/2014**

Grading Curve for Sample 31254 – TMH1 Method A1 (a)



Thick Red Line is the Grading Curve (TRH 14 Classification = G7)

Sieve Aperture Size	0.075	0.150	0.250	0.425	2.00	4.75	13.2	19.0	26.5	37.5	53	63	75
Percentage Passing	13%	18%	60%	90%	99%	100%							

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Client : **Your Ref No. :**
Project : Southern Waste Water Treatment Works **Our Ref No. : 19213**
Attention : **Date Reported : 30 October 2012**

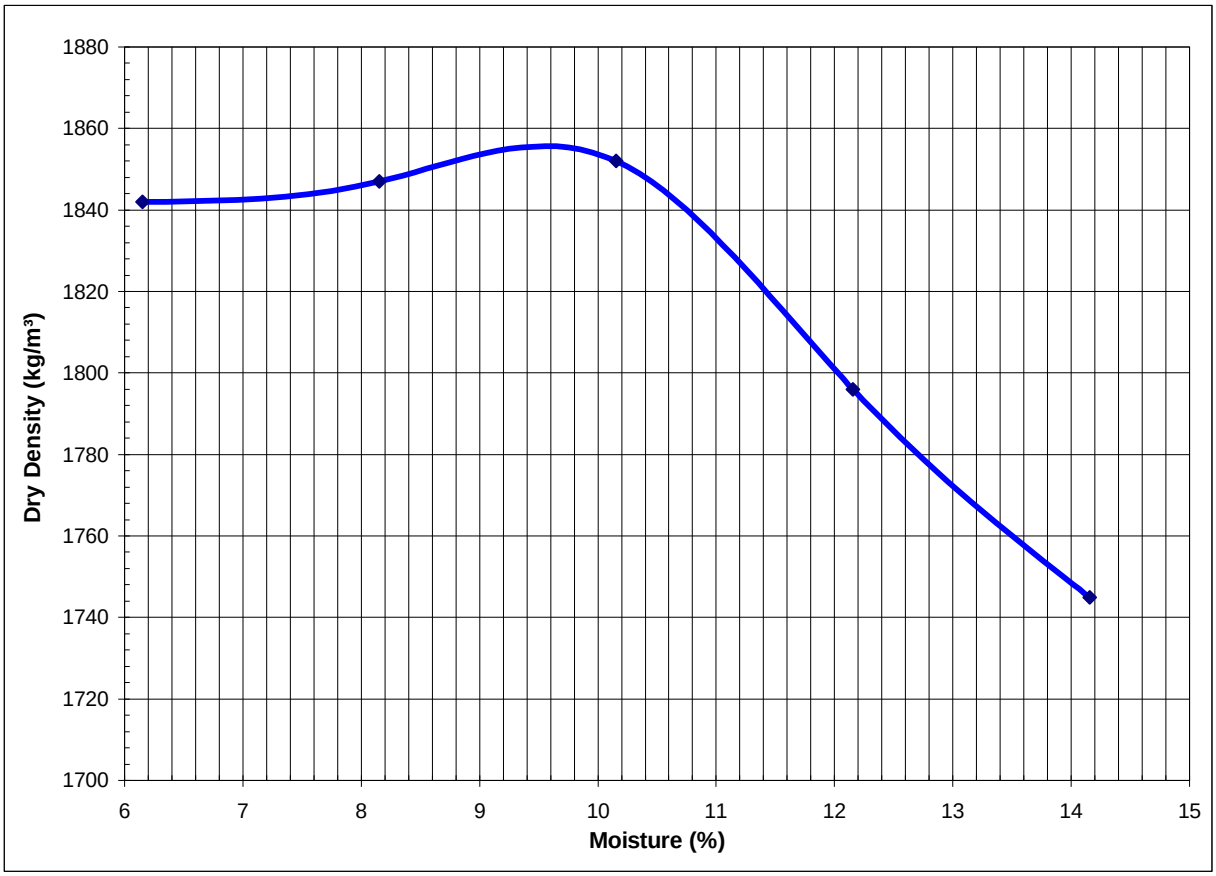
Moisture/Density Relationship (TMH1: Method A7)

Sample No. : 31243 Field No. :
Depth (m) :
Natural/Stabilised : Natural Origin :
Material Description : Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1856 **Optimum Moisture Content (%) 9.6**

Plotted Values:

Moisture (%)	6.2	8.2	10.2	12.2	14.2
Dry Density (kg/m³)	1842	1847	1852	1796	1745



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Project : Southern Waste Water Treatment Works **Our Ref No. : 19213**
Attention : **Date Reported : 30 October 2012**

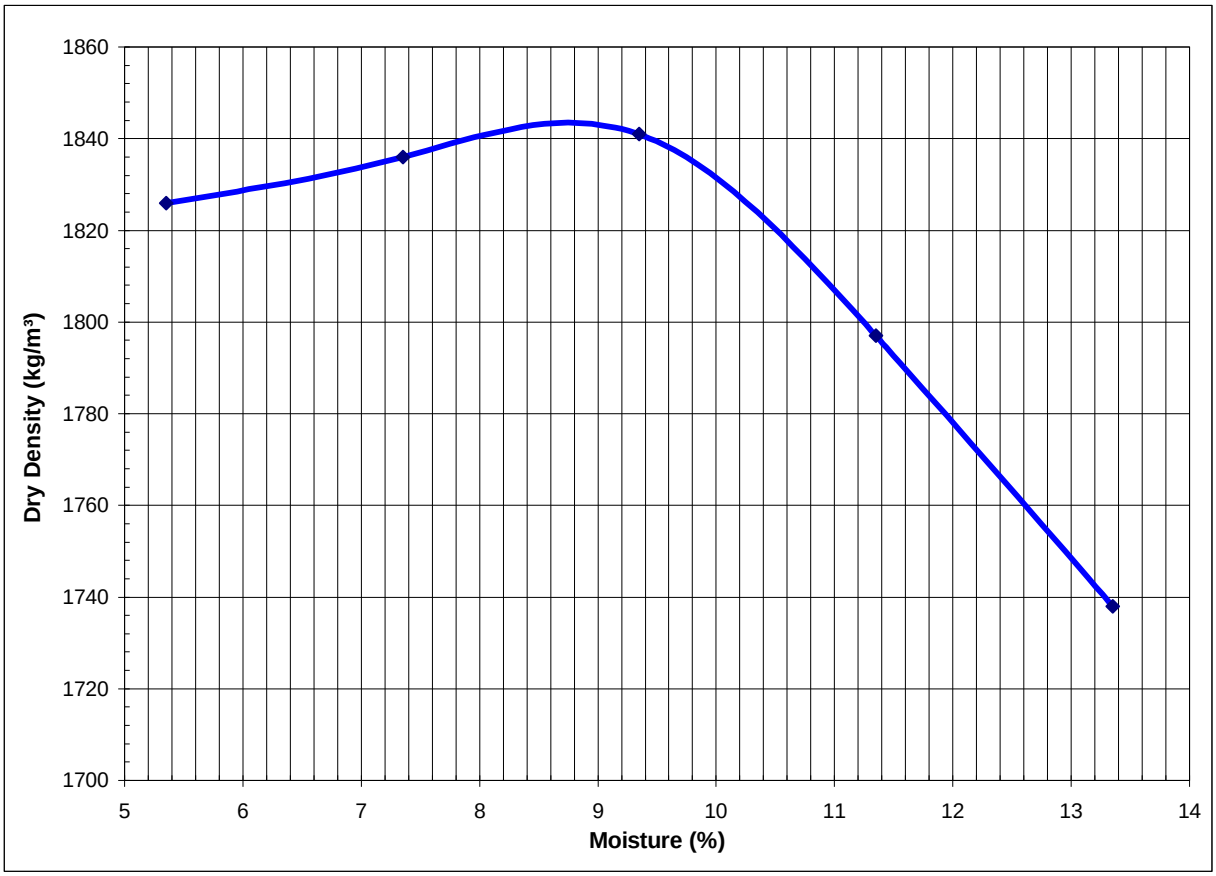
Moisture/Density Relationship (TMH1: Method A7)

Sample No. : 31254 Field No. :
Depth (m) :
Natural/Stabilised : Natural Origin :
Material Description : Compaction Effort : Mod AASHTO

Maximum Dry Density (kg/m³) 1843 **Optimum Moisture Content (%) 8.8**

Plotted Values:

Moisture (%)	5.4	7.4	9.4	11.4	13.4
Dry Density (kg/m³)	1826	1836	1841	1797	1738



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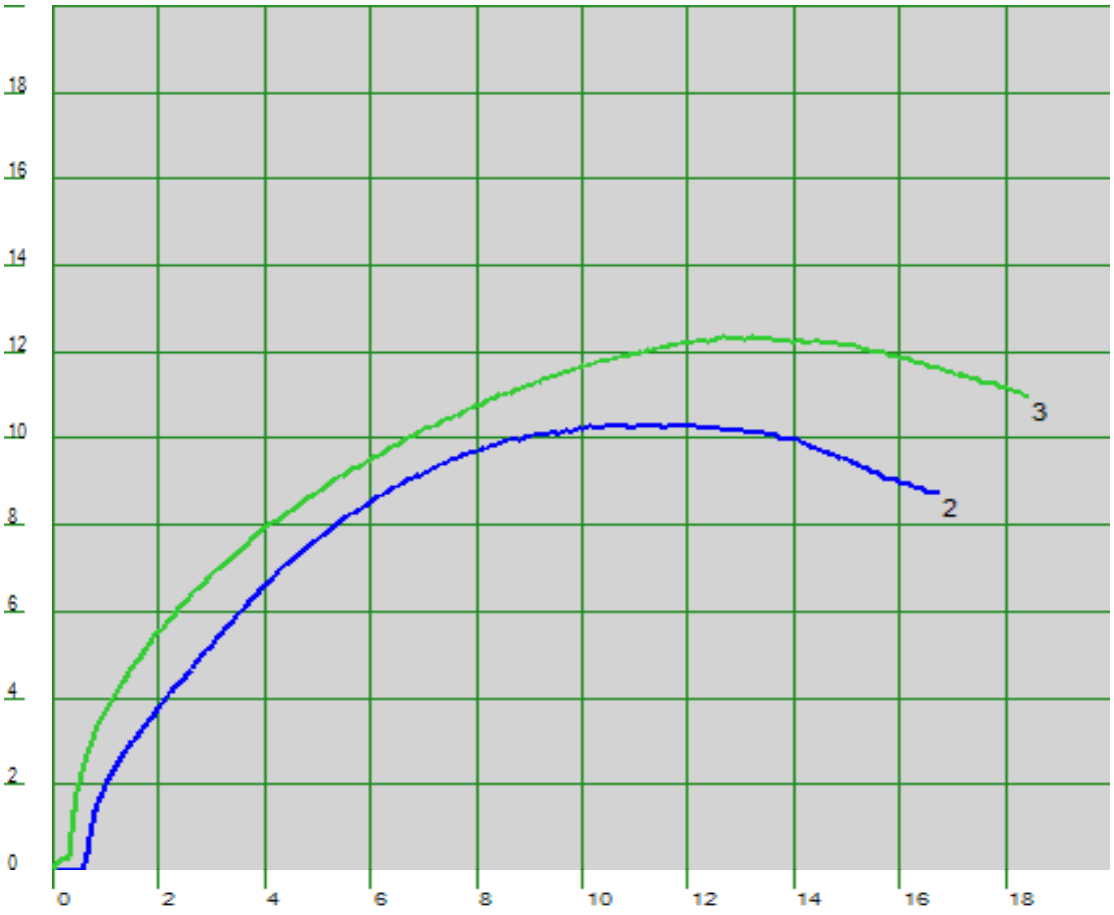
TRIAXIAL TESTS
RESULTS

Test Report

11/6/2014

Project Description

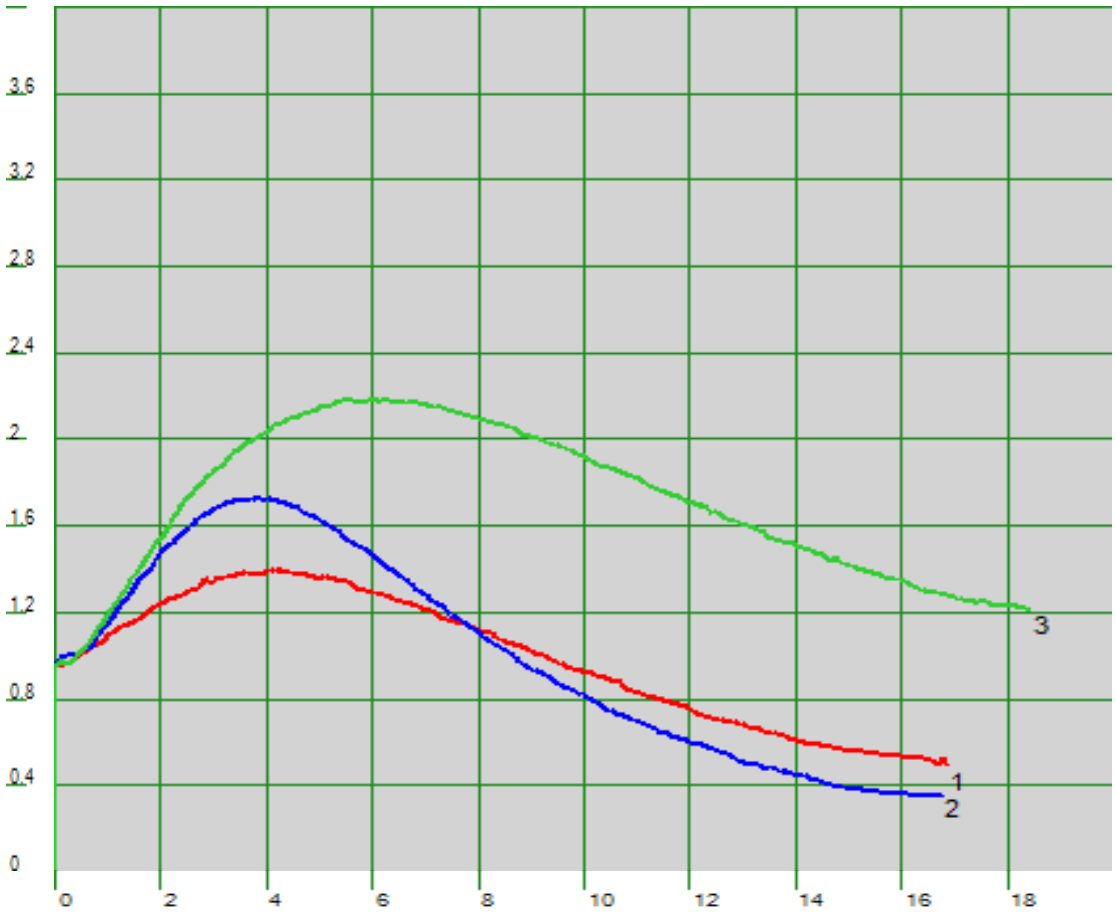
Test Type	CUBar Test
Project Id	Aecom
Project Site	(GEO-199) SWWTW
Soil Type	(910) Grey slightly clayey silty SAND-Estuarine
Remarks	BH5 (11.08-11.47m) Specimens were tested at 200, 400 & 600kPa



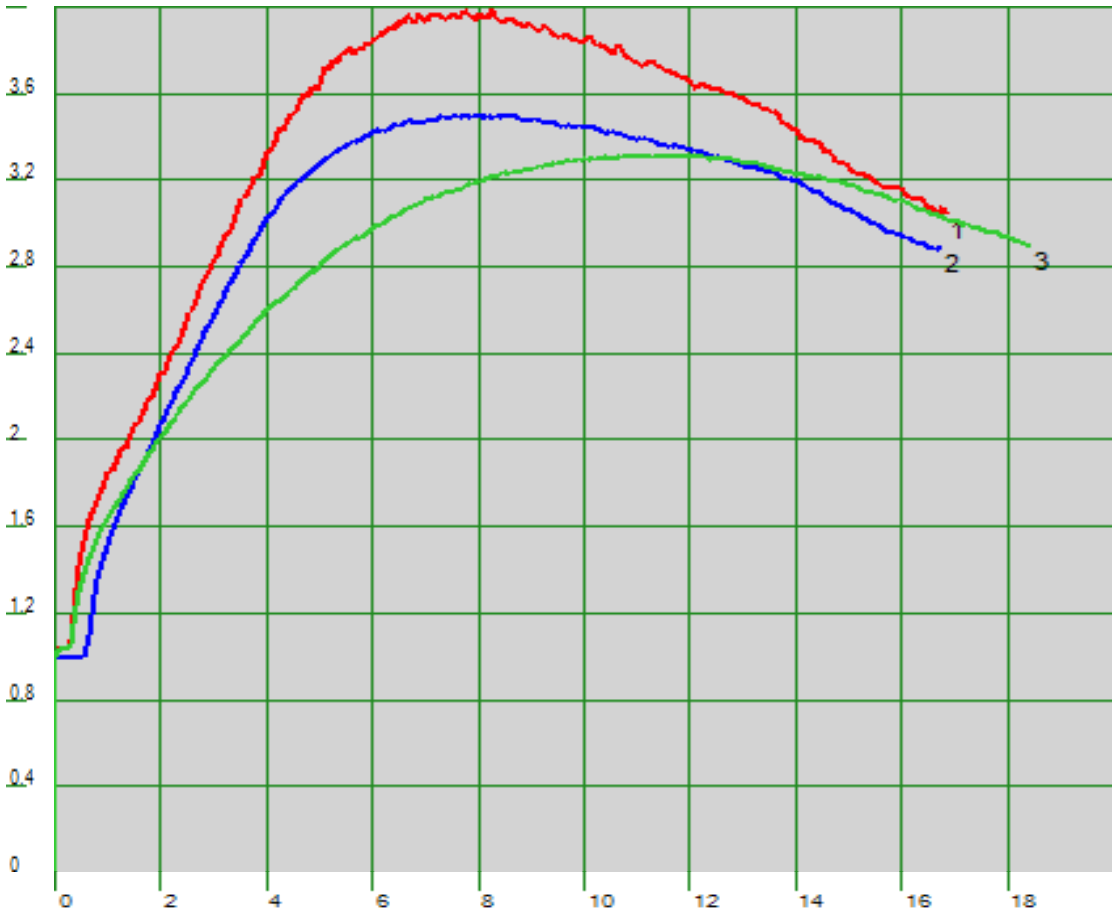
Deviatric Stress(kg/Sq.cm) vs Axial Strain(%)

Test Report

11/6/2014



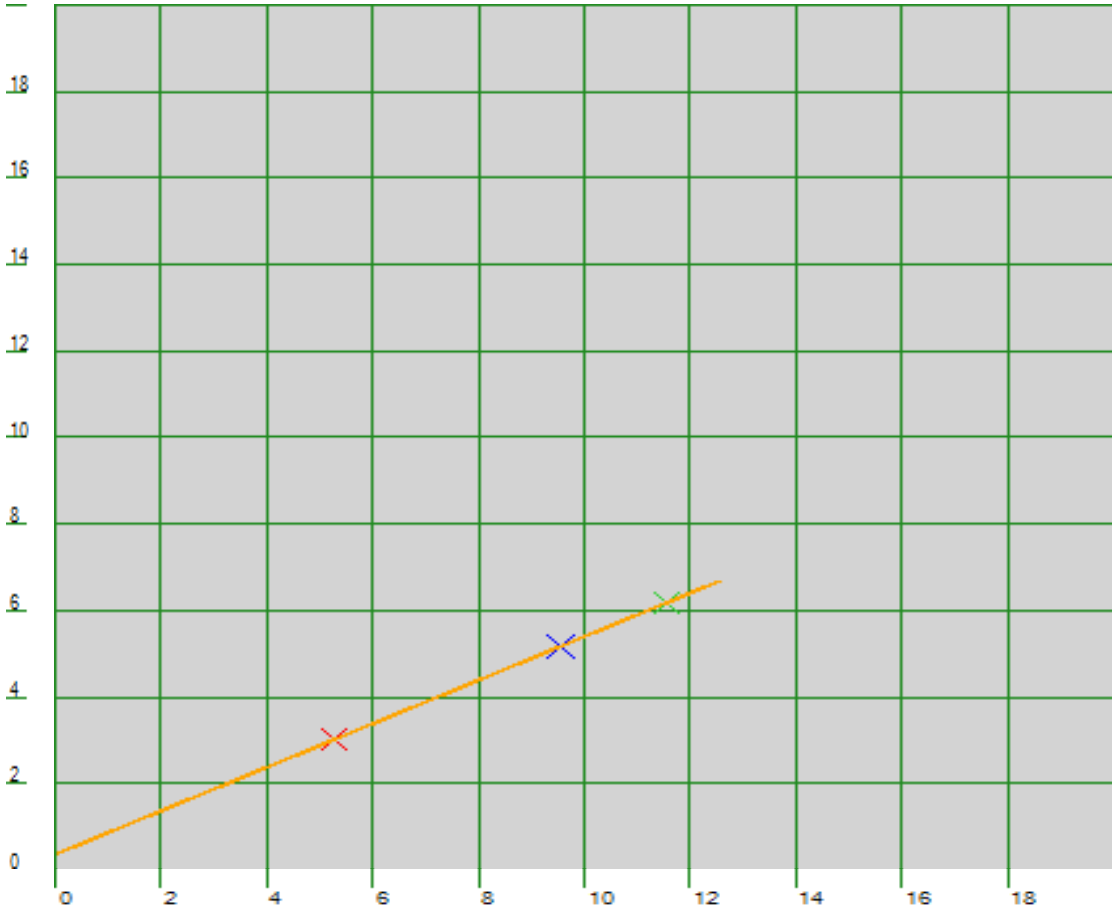
Pore Pr.(kg/sq.cm) vs Axial Strain(%)



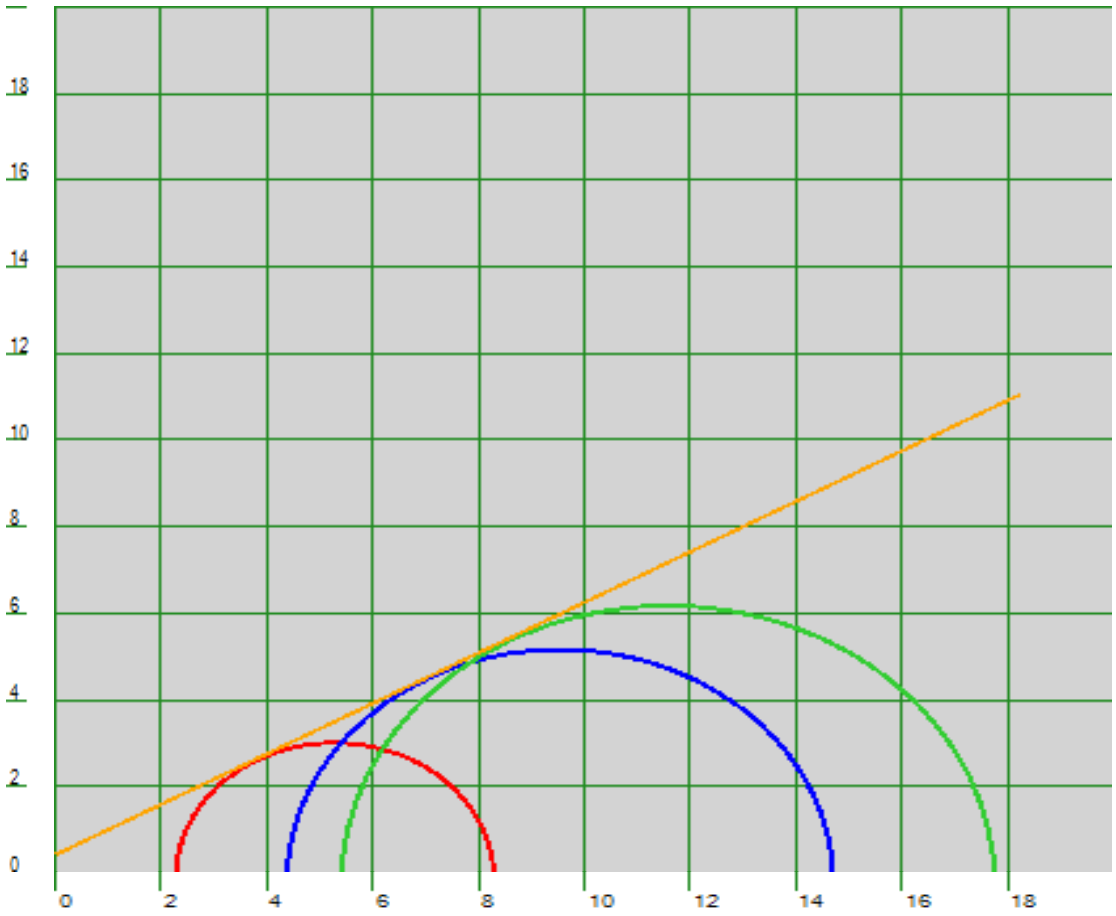
StressRatio vs Axial Strain(%)

Test Report

11/6/2014



mean stress vs shear stress [a=0.36(kg/sq.cm) alpha=26.7(deg)]



Mohr-Columb Plot [c=0.42(kg/sq.cm) Phi=30.2(deg)]

CONSOLIDATION TEST RESULTS

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Client:	Aecom	**Job No:**	GEO-199
Project:	SWWTW	**Sample No.:**	909
Attention:		**Date Reported :**	2014/12/18
Road / Section :	BH01	**Depth:**	11.3-11.76m
Data Processed By:	Mr D. Chetty	**Date Tested:**	14.10.2014

One Dimensional Consolidation

Sample Description:
Greyish black silty CLAY-Estuarine

Preparation of Specimen:
Test specimen was carved from a shelby tube sample.

Dimensions of Specimen:
60mm Diameter X 20mm Height

Bulk Density (kg/m^3):	1749
Moisture Content (%):	46.4
Dry Density (kg/m^3):	1194
Initial Void Ratio:	1.016
Degree of Saturation (assumed) (%):	100.0
Specific Gravity (measured):	2.41

Applied Pressure	Parameter						
	e	OCR	m_v (m^2/Kn)	c_v (m^2/year)	t_{50} (min)	t_{90} (min)	k (m/s)
0	1.016						
25	1.009	-	1.24E-04	3.388	3.06	14.06	1.31E-10
50	0.997	-	2.38E-04	5.037	2.04	9.00	3.73E-10
100	0.975	-	2.29E-04	2.525	4.00	16.00	1.79E-10
200	0.937	-	1.98E-04	2.985	3.28	11.90	1.84E-10
400	0.892	-	1.18E-04	5.550	1.69	6.25	2.04E-10
800	0.820	-	9.86E-05	3.278	2.69	12.53	1.00E-10
1600	0.658	-	1.22E-04	0.733	10.56	45.56	2.78E-11
800							
400							
200							

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Attention:		**Date Reported :**	2014/12/18
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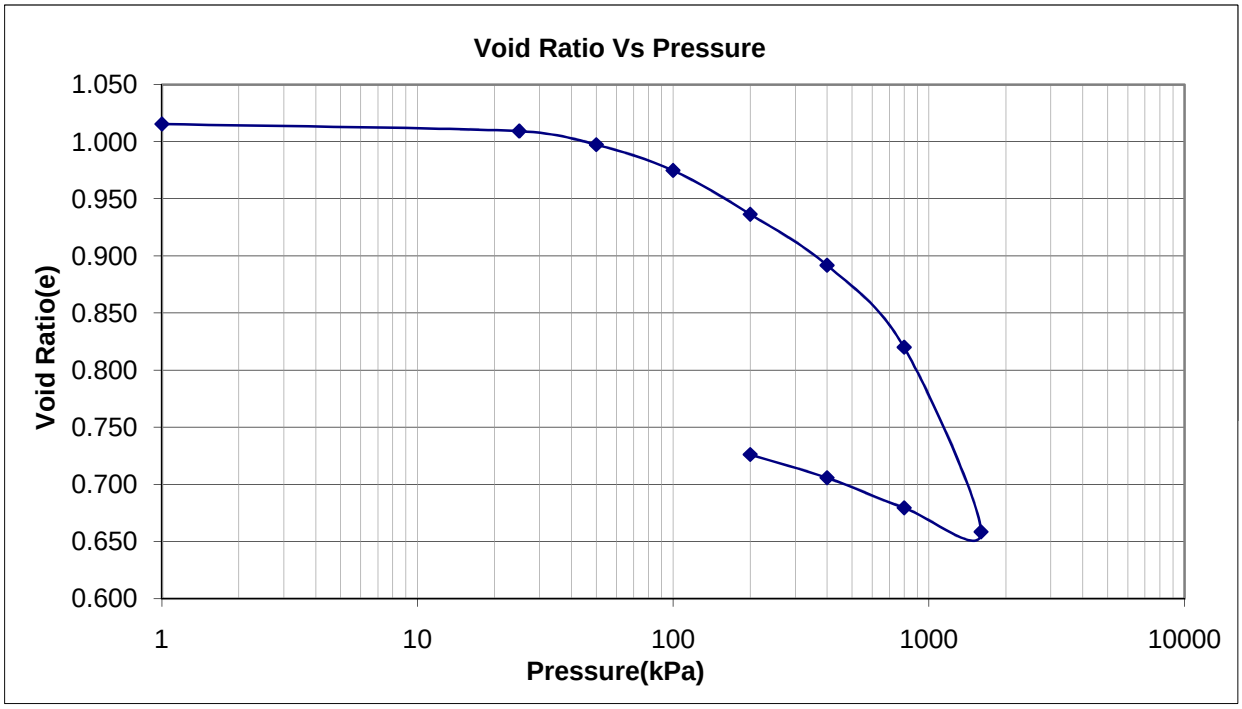

Notes:

Dhiven Chetty
Laboratory Technician

Consulting Engineering Geologists, Geotechnical Engineers, Geotechnicians & Geotechnical Quality Assurance Specialists
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Project:	SWWTW	**Sample No.**	909
Attention:		**Date Reported :**	2014/12/18
Road / Section :	BH01	**Depth:**	11.3-11.76m
Data Processed By:	Mr D. Chetty	**Date Tested:**	14.10.2014

Appendix

Definitions:

e	void ratio
OCR	overconsolidation ratio
m_v	coefficient of volume compressibilty
c_v	Coefficient of consolidation
t_{50}	time taken for 50% consolidation
t_{90}	time taken for 90% consolidation
k	coefficient of permeability
Cα	coefficient of secondary compression

Disclaimer: Please note that all values were done manually by hand calculation. All settlement graphs are available on request for own interpretation.