

PHETHOGO CONSULTING (BLOEMFONTEIN)

GEOTECHNICAL REPORT FOR THE PROPOSED TOWNSHIP DEVELOPMENT AT TSWELOPELE : BULTFONTEIN, PHAHAMENG, FREE STATE

GEOTECHNICAL INVESTIGATION

REFERENCE : SL / 1436

Document No.: 2013/265/Doc.

OCTOBER - 2013



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GEOTECHNICAL SERVICES

REG. No. 1987/004282/07

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Enquiries : BLOEMFONTEIN
Our ref. : SL / 1436
Your ref. : Tswelopele: Bultfontein,
Phahameng
File ref. : 2013/265/Doc.
Date : October- 2013

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GEOTECHNICAL INVESTIGATION

Offices: Bloemfontein, Cape Town, Kimberley, Kimberley (Water Division)

Directors: PJF Jacobs, D Lockey

Chief Executive Officer: J van Vuuren

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1. **INTRODUCTION**

1.1 **Terms of reference**

Phethogo Consulting (Bloemfontein) appointed Simlab (Pty) Limited - Geotechnical Services (Bloemfontein) to conduct a geotechnical investigation and compile a geotechnical report for the proposed township development at Tswelopele, Bultfontein (Phahameng) in the Free State.

This report contains the results of the geotechnical investigation done by Simlab (Pty) Limited Geotechnical Services (Bloemfontein).

Recommendations are made with regard to founding conditions for proposed buildings and other structures.

1.2 **Location**

Bultfontein is situated approximately 90km north of Bloemfontein.

Refer to Locality Plan (Appendix A) and Layout Plan (Appendix G) for more detail.

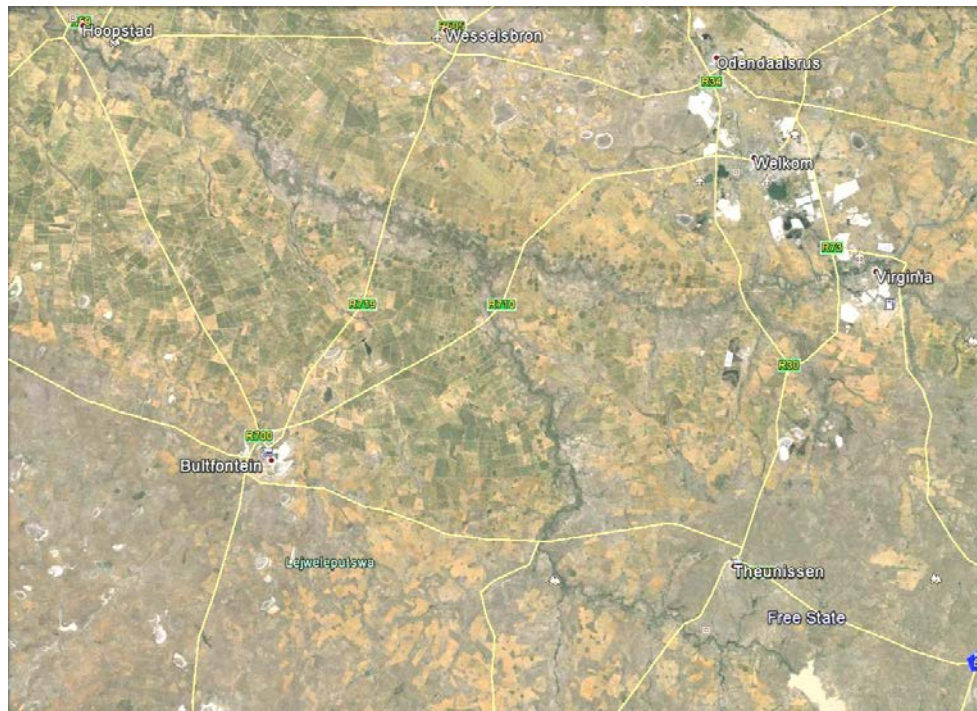


Figure 1 – Site Location : Tswelopele, Bultfontein (Google Earth)

2. INFORMATION USED IN THE STUDY

Jennings JE, Brink ABA, Williams AAB (1973), revised guide to soil profiling for Civil Engineering purposes in Southern Africa

Committee of Land Transport Officials (1998), Standard Specifications for Road and Bridge Works for State Road Authorities. South Africa: South African Institution of Civil Engineering.

Committee of State Road Authorities (1986), Technical Methods for Highways 1: Standard Methods of Testing Road Construction Materials. Pretoria: Department of Transport.

National Home Builders Registration Council (1999), Home Building Manual Part 1 & 2. Revision No: 1. South Africa: National Home Builders Registration.

National Department of Housing (2002), Geotechnical Site Investigations for Housing Developments. South Africa: Greenfield Subsidy Project Developments.

Van Der Merwe D H. (1964), The prediction of heave from the plasticity index and percentage clay fraction of soil. South Africa: South African Institution of Civil Engineering.

Geological Map of the South Africa and the Kingdoms of Lesotho and Swaziland (1997), Council for Geoscience.

State-of-the-art review of Collapsible Soils, Department of Civil Engineering, College of Engineering, Sultan Qaboos, 2000

Bultfontein Climate : www.saexplorer.co.za

Software : GoogleEarth® 6.2.2. 6613, Google Inc. 2013,
MapSource® 6.16.3, Garmin™, 2010
dotPLOT® 2.4.0, Software Africa®, 2010

3. **PROJECT DETAIL**

CLIENT:

Phethogo Consulting (Bloemfontein)

CLIENT REPRESENTATIVE:

Mr P De Bie

CLIENT ADDRESS:

PO Box 43284

Heuwelsig

BLOEMFONTEIN

9332

Tel: 051 448 6006/7/8

Fax: 051 448 6728

PROJECT:

REPORT ON THE GEOTECHNICAL INVESTIGATION FOR THE PROPOSED
TOWNSHIP DEVELOPMENT AT TSWELOPELE : BULTFONTEIN,
PHAHAMENG , FREE STATE.

TESTING LABORATORY:

Simlab (Pty) Limited – Geotechnical Services (Bloemfontein)

LABORATORY ADDRESS:

Cnr. Grey Street and Lunn Road, Hilton, **BLOEMFONTEIN**, 9301.

Tel: 051 447 0224, Cell: 082 821 9435, Fax: 051 448 8329.

E-mail: simbfn@simlab.co.za or frank.holder@simlab.co.za

SAMPLE DETAIL:

Sampled by: Mr. Frank Holder

Date Sampled: 6 August 2013

Date Tested: 12 August – 26 September 2013

Report Date: 30 October 2013

SAMPLING AND TESTING:

Sampled according to the TMH5 : 1981, and specifications of the client.

Sampling was done by means of a Case, 75Kw TLB. Tested according to the TMH1 : 1986 specifications.

The test methods used include the following SANAS accredited methods:

- TMH1: 1986, A1 (a) – The wet preparation and sieve analysis of gravel, sand and soil samples.
- TMH1: 1986, A2 – The determination of the liquid limit of soils by means of the flow curve method.
- TMH1: 1986, A3 – The determination of the plastic limit and plasticity index of soils.
- TMH1: 1986, A4 – The determination of the linear shrinkage of soils.
- TMH1: 1986, A5 – The determination of the percentage of material passing a 0.075mm sieve in a soil sample.
- *TMH1: 1986, A6 – The determination of the grain size distribution in soils by means of a hydrometer. (Particle Size Distribution of Samples)
- TMH1 : 1986, method A7 - The determination of the maximum dry density and optimum moisture content of gravel, soil and sand.
- TMH1 : 1986, method A8 -The determination of the California Bearing Ratio of untreated soils and gravels.
- *TMH1: 1986, method A17 – The determination of the moisture content of soils.
- *TMH1 1986: method A20 - The electrometric determination of the pH value of a soil suspension.
- *TMH1 1896: methodA21T - Tentative method for the determination of the conductivity of a saturated soil paste and water
- *Colto Classification of Material Properties.
- *Potential Expansiveness of the Material – van der Merwe’s method.
- *Classification of Site – NHBRC Home Building Manual, Part 1, Section 2, Table: Residential Site Class Designations.

Tests marked - * “Not SANAS Accredited” in this report are not in the SANAS Schedule of Accreditation for this laboratory”

Opinions and interpretations expressed in the report are outside the scope of SANAS Accreditation of Simlab (Pty) Limited – Geotechnical Services.

SECTION/POSITION SAMPLED:

Simlab (Pty) Limited – Geotechnical Services (Bloemfontein) sampled and tested at positions shown on the Layout Plan (Appendix G).

4. TOPOGRAPHY

The area of the proposed development is a relatively flat terrain that slopes from south to north.

The area is covered with short dense grass with thorn trees and bush.

At the position of test pit 6, to the south of the proposed development there is an existing borrow pit.

5. GEOLOGY

Bultfontein is underlain by the Beaufort group of the Karoo Supergroup and consists of mudstone and sandstone.

Post Karoo dolerite intrusions also occur.

6. CLIMATE

Bultfontein normally receives about 369mm of rain per year, with most rainfall occurring during mid-summer. It receives the lowest rainfall (1mm) in July and the highest (65mm) in January.

The average midday temperatures for Bultfontein range from 17°C in June to 30°C in January. The region is coldest during July when the mercury drops to 0°C on average during the night.

7. SITE INVESTIGATION

Nine (9) test pits were investigated by means of a Case, 75kw TLB.

The test pits were profiled in accordance with Brink, Jennings and Williams guidelines for geotechnical profiling. Profiles are given in Appendix B.

Typical samples from selected test pits were taken to conduct the required tests.

The test pit co-ordinates are given in Table 1.

Table 1: Test Pit Co-ordinates

Test Pit No.	Co-ordinates
TP1	27 Y0082683 X3131275
TP2	27 Y0082698 X3131432
TP3	27 Y0082735 X3131582
TP4	27 Y0082624 X3131643
TP5	27 Y0082624 X3131643
TP6	27 Y0082624 X3131643
TP7	27 Y0083067 X3131704
TP8	27 Y0083181 X3131637
TP9	27 Y0083049 X3131580
TP10	27 Y0082882 X3131513

Co-ordinate system – WGS 84 LO27

Bedrock levels are summarised in Table 2.

Table 2: Bedrock Levels

Test Pit No.	Bedrock Level (mm)	Description of Bedrock
TP1	-2100	Calcified mudstone
TP2	-1800	Calcified mudstone
TP3	-1100	Mudstone

Test Pit No.	Bedrock Level (mm)	Description of Bedrock
TP4	-900	Hard pan calcrete and dolerite
TP5	-800	Hard rock / Weathered dolerite
TP7	-1600	Mudstone
TP8	-400	Hard calcified weathered dolerite
TP9	-1200	Mudstone

8. GEOTECHNICAL EVALUATION

8.1 Potentially Collapsible Soils

For the purpose of identifying whether soils with a probability of collapse occur over the terrain in question, criteria proposed by Priklonki (1952) and Handy (1973) are used.

The evaluation is summarised in the following table.

Table 3: * Probable Collapsible Profiles

Test pit No.	Depth	Description
TP2	200 - 1800	Calcified mudstone
TP3	600 - 1100	Mudstone
TP9	800 - 1200	Calcified mudstone

If collapse potential is of concern to the design engineer it is suggested that a one-dimensional oedometer test be done for the specific structure and site.

8.2 Potentially Expansive Soils

The potential expansiveness of the soil profiles investigated, vary from low to medium based on van der Merwe's method for predicting potential heave.

The potential heave and corresponding NHBRC classification is summarised in Table 4.

Table 4: *Potential Heave and NHBRC Classification

Test Pit No.	Depth of Layer (mm)	Potential Heave (mm)	Classification (NHBRC)
TP1	0 - 400	7.0	H2
	400 - 2100	20.0	
		TOTAL: 27	
TP2	0 - 200	4.0	H2
	200 - 1800	20.0	
		TOTAL: 24.0	
TP3	0 - 600	9.5	H1
TP4	0 - 900	<7.5	H
TP5	0 - 800	13.0	H1
TP7	0 - 400	15.0	H2
	400 - 1600		
		TOTAL: 22.0	
TP8	0 - 400	<7.5	H
TP9	0 - 800	12.0	H1
TP10	400 – 1500	14.0	H2
	1500 - 1900	4.2	
		TOTAL: 18.2	

8.3 Potentially Compressible Soils

Given ideal conditions such as saturated moisture content and applied load the soil encountered over this area will be compressible to a degree. (By the process of consolidation)

8.4 Ground Water Seepage or Level

No ground water seepage or level was encountered in any of the test pits at the time of the investigation.

8.5 Slope Stability (Steep Slopes & Unstable Natural Slopes)

No steep fill or unstable natural slopes occur over the proposed development area.

8.6 Erodibility of the Soil Profile

There is no evidence that erosion had taken place or is occurring at the time of the investigation.

8.7 Excavatibility

Excavations during the investigation showed that the soil found in the area down to bedrock level can be excavated with ease by means of pick and shovel or TLB excavator.

The soil can in general be excavated at a rate of approximately 0.5m³/min by means of a TLB.

8.8 Aggressiveness of Soil

The conductivity and pH of the soil types occurring over the area were measured to estimate the aggressiveness of the soil.

Based on the conductivity results the soil is very corrosive.

Precautionary measures may be necessary with regard to service materials

8.9 Infrastructure – Roads and Streets

With reference to TP8 (layer 0 – 400mm) the clayey sand has a Colto classification G7 which is suitable for selected subgrade in a road or street pavement.

The calcified mudstone is not suitable to be used in a road or street pavement.

9. **SITE ZONING**

Based on the laboratory results and van der Merwe's method of predicting the heave of soil profiles, the area can be classified as follows:

Zone 1 : (H) TP4 and TP8

Soil conditions with a potential heave of <7.5mm.

Zone 2 : (H1) TP3, TP5 and TP9,

Soil conditions with a potential heave of 7.5 - 15mm.

Zone 3 : (H2) TP1, TP2, TP7 and TP10

Soil conditions with a potential heave of 15 -30mm.

Site Class	Estimated Total Heave (mm)	Construction Type	Foundation Design and Building Procedures
H2	15-30mm	Piled construction	<ul style="list-style-type: none"> • Piled foundations with suspended floor slabs with or without ground beams. • Site drainage and plumbing/service precautions.
		Split construction	<ul style="list-style-type: none"> • Combination of reinforced masonry and full movement joints. • Suspended floors or fabric reinforced ground slabs acting independently from the building. • Site drainage and plumbing/service precautions.
		Soil raft	<ul style="list-style-type: none"> • Remove all or necessary parts of expansive horizon to 1.0m beyond the perimeter of the building and replace with inert backfill compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. • Normal construction with lightly reinforced strip footings and light reinforcement in masonry if residual movements are <7.5mm, or construction type appropriate to residual movements. • Site drainage and plumbing/service precautions.

The above is only a recommendation and the design should be done by a professional engineer.

F HOLDER (Senior Technician)
for : SIMLAB (PTY) LIMITED

J VAN VUUREN (Chief Executive Officer)
(Technical Signatory)

APPENDIX A LOCALITY PLAN

APPENDIX B IN SITU MATERIAL PROFILES



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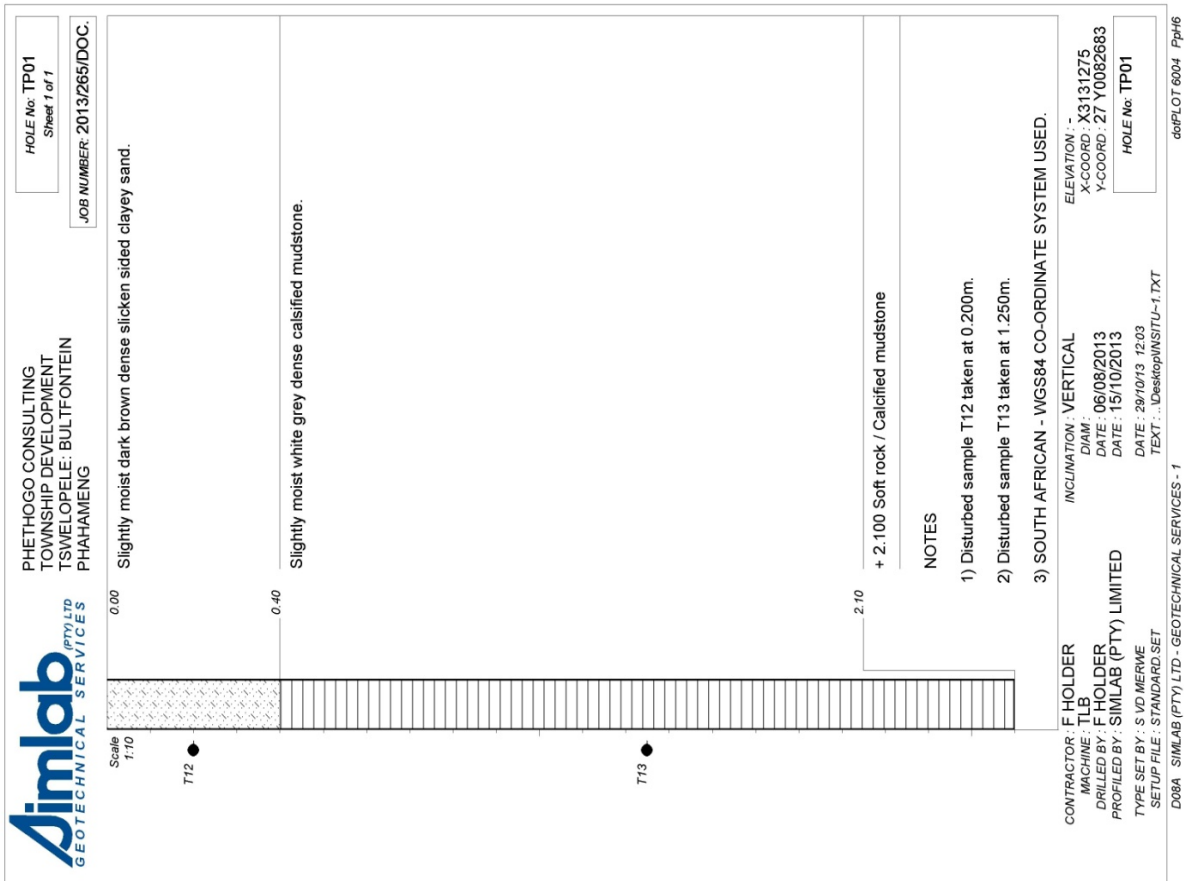
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TEST PIT No. : TP1



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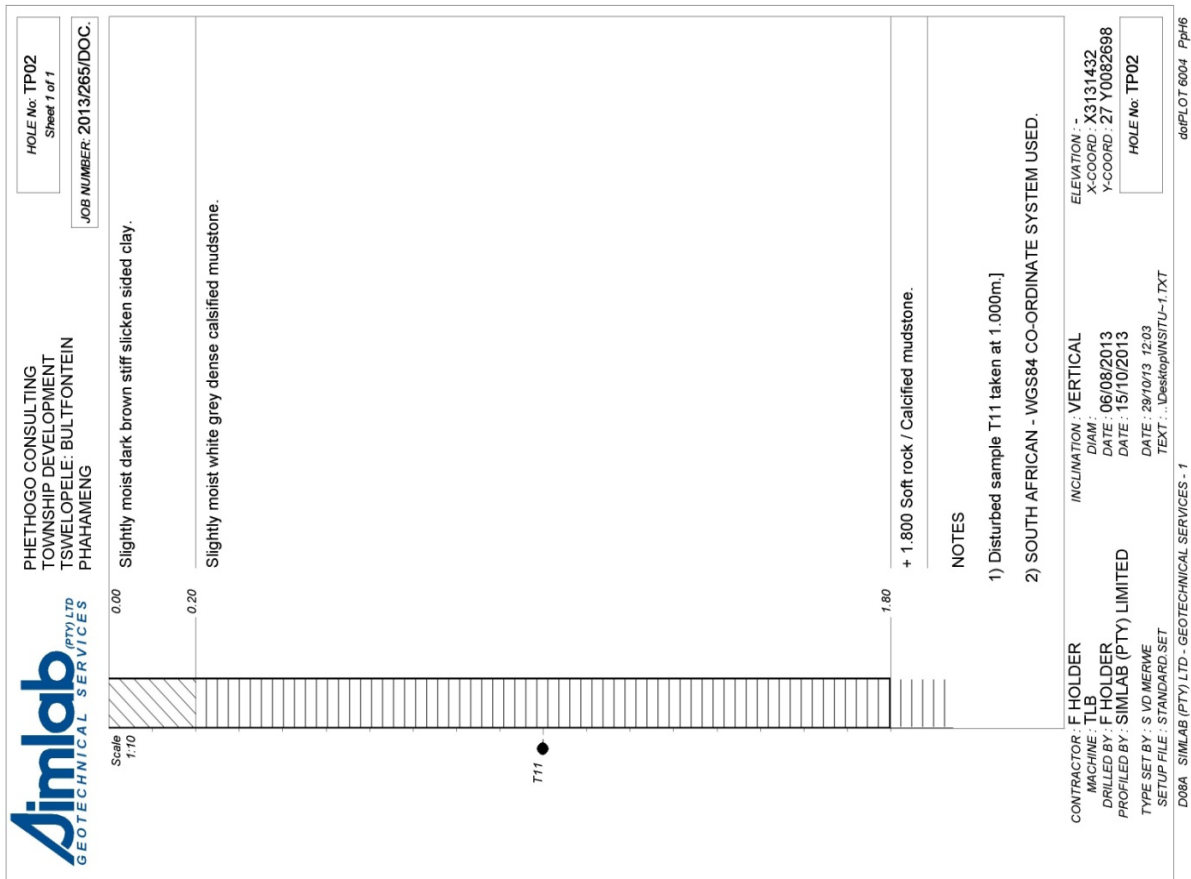
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TEST PIT No. : TP2



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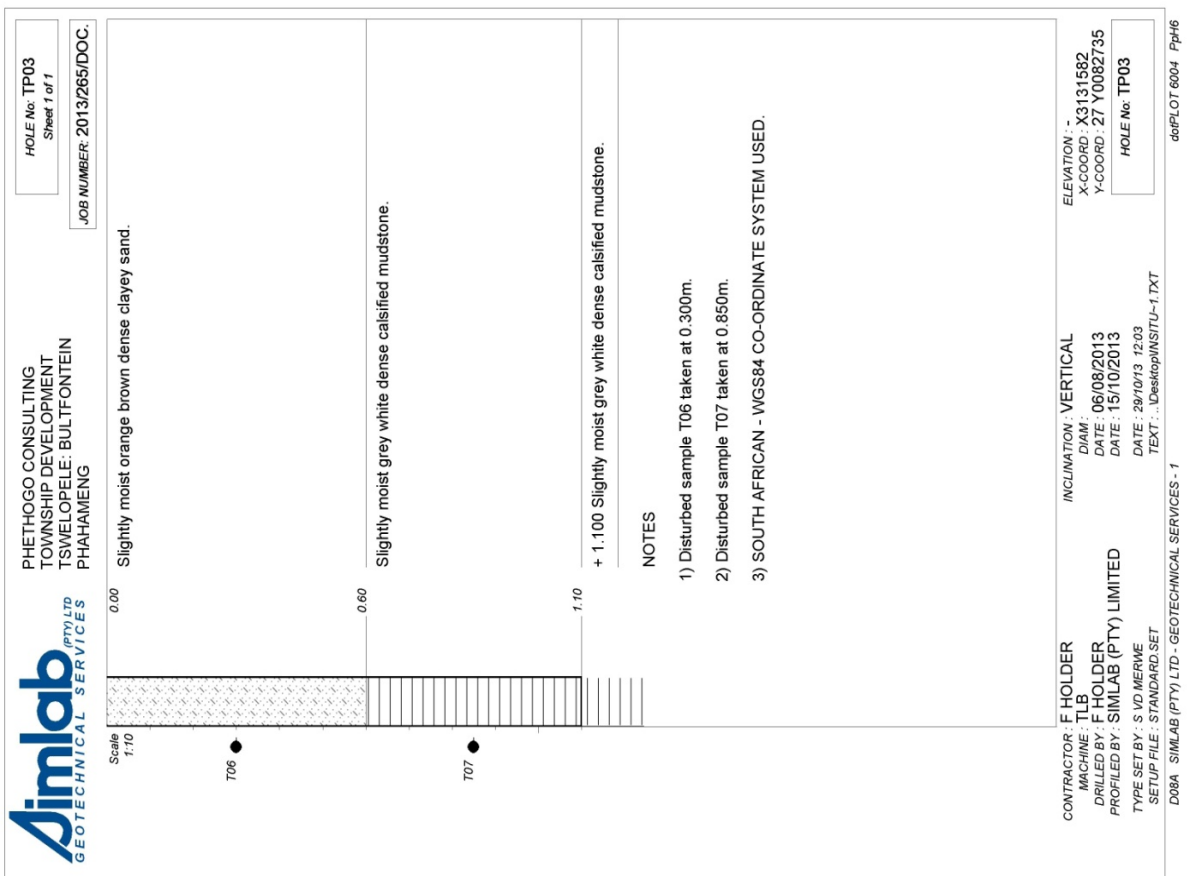
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TEST PIT No. : TP3



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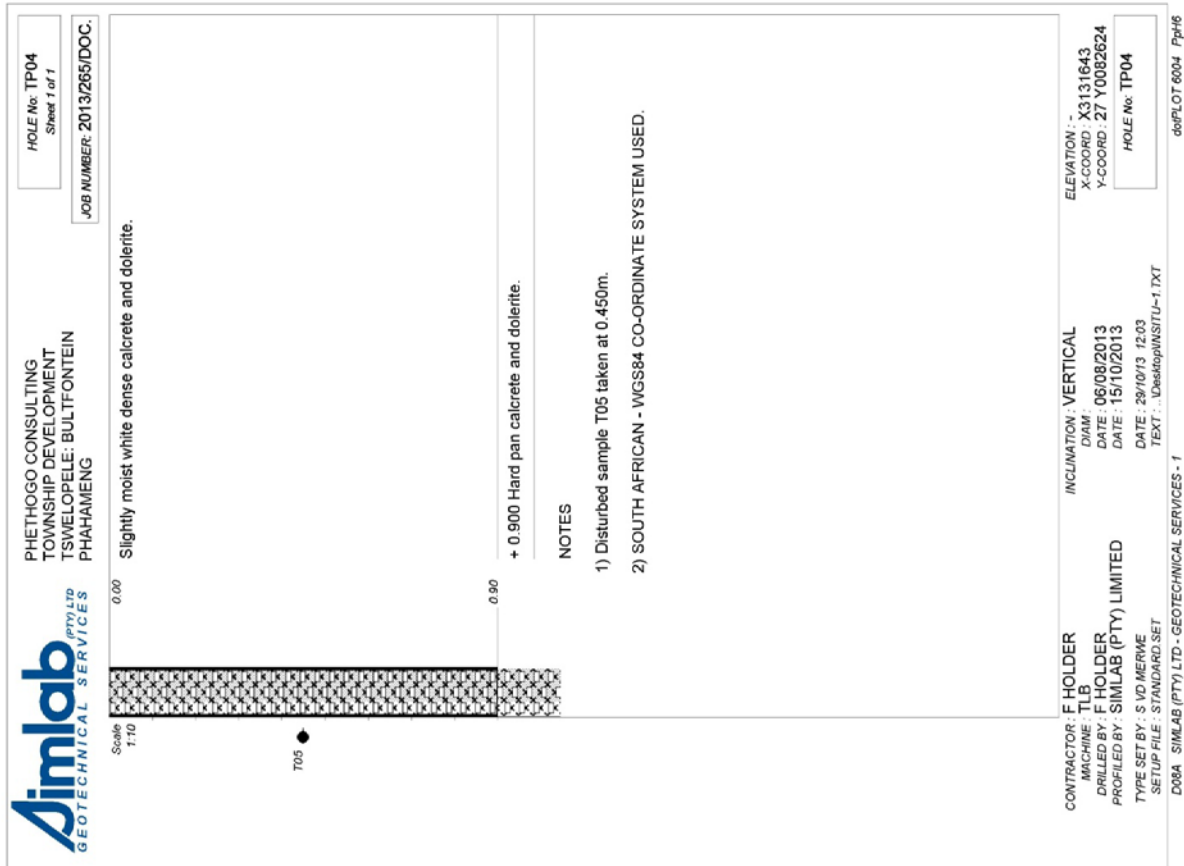
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TEST PIT No. : TP4



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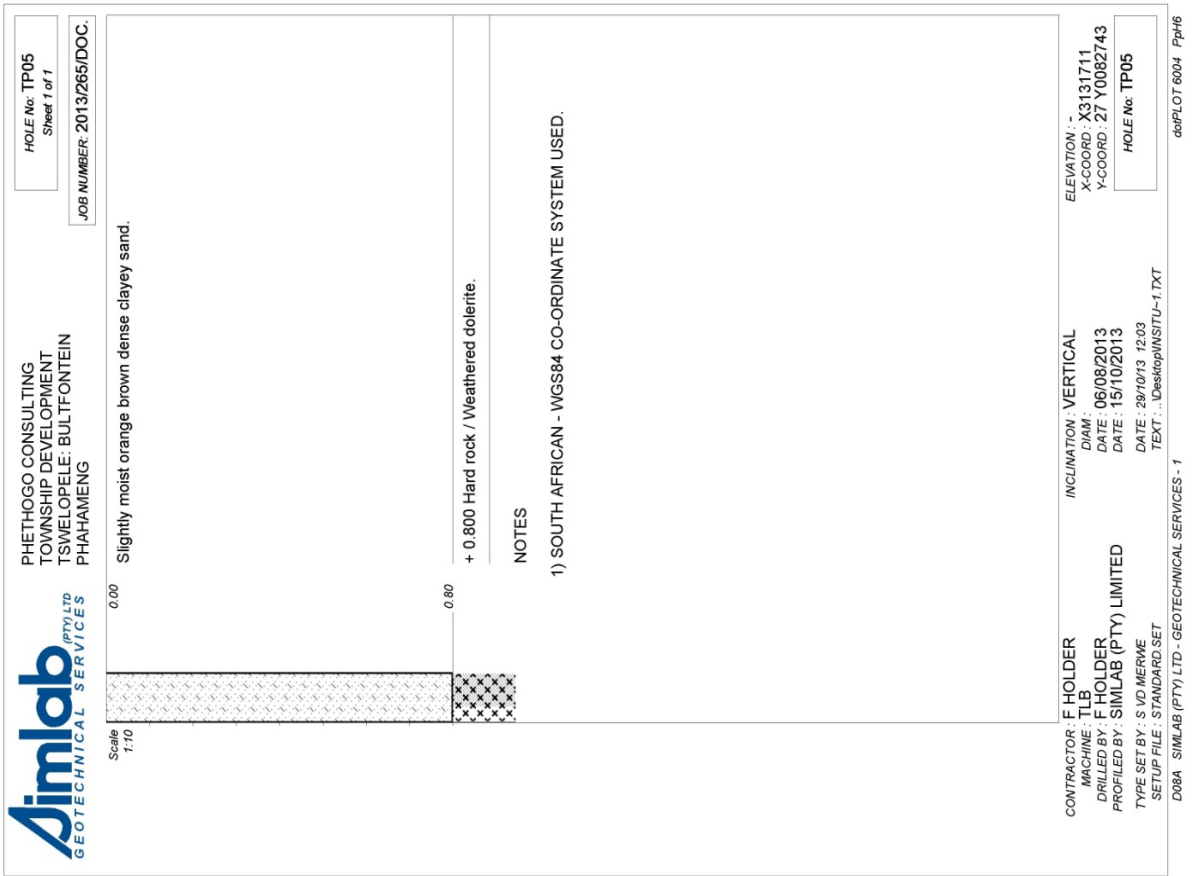
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TEST PIT No. : TP5



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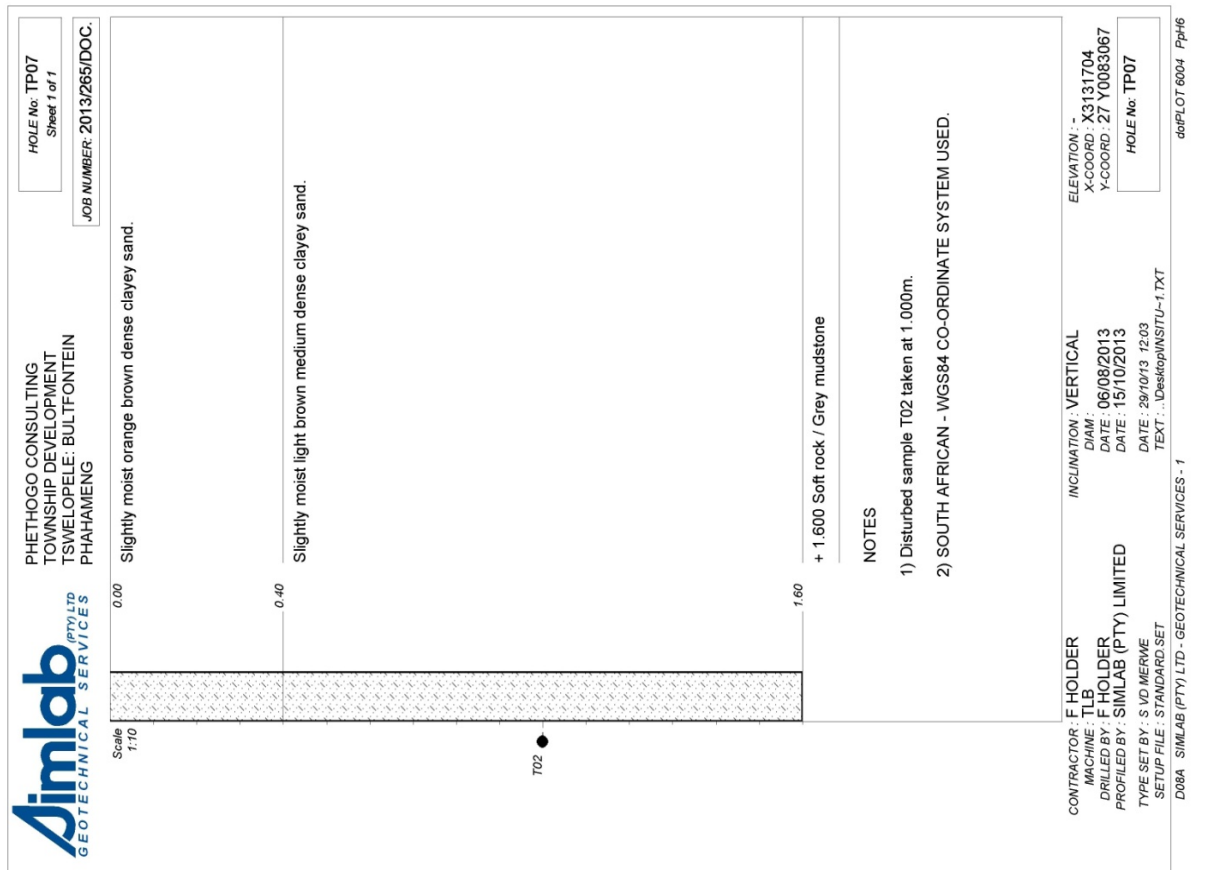
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TEST PIT No. : TP7



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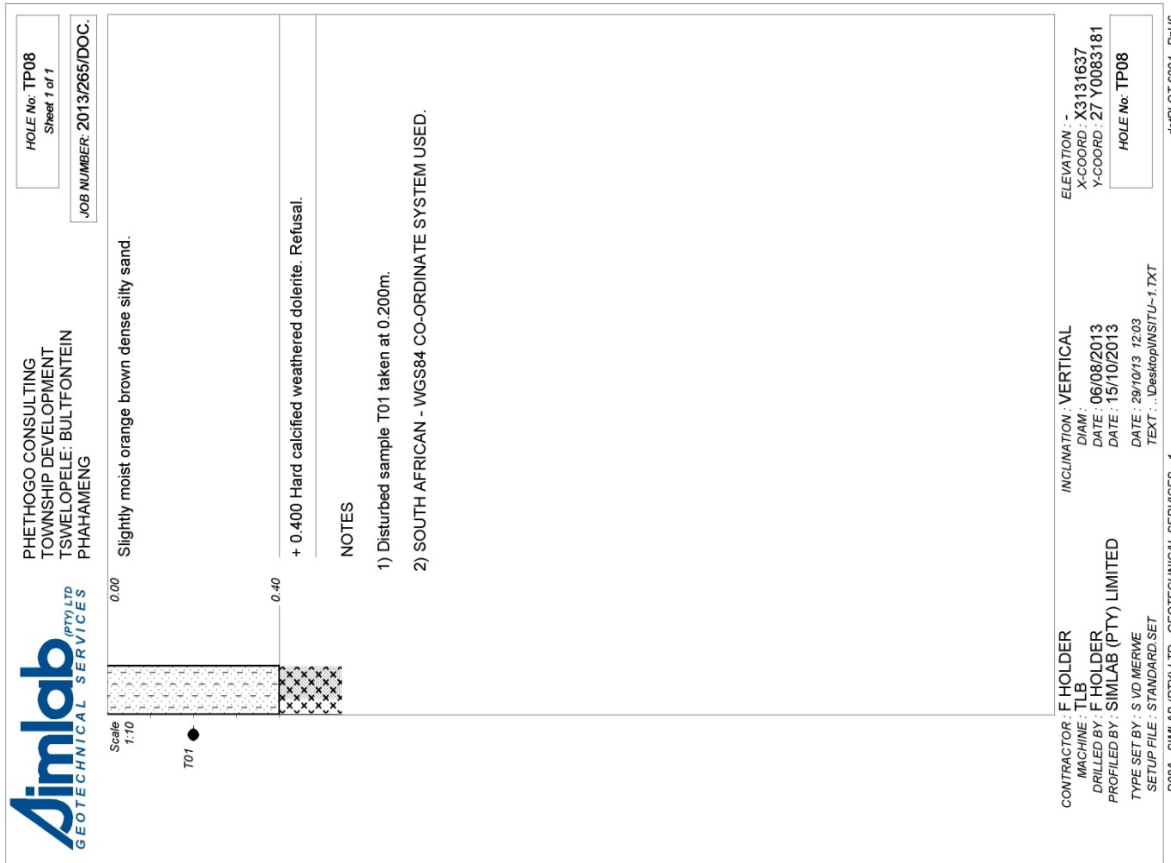
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TEST PIT No. : TP8



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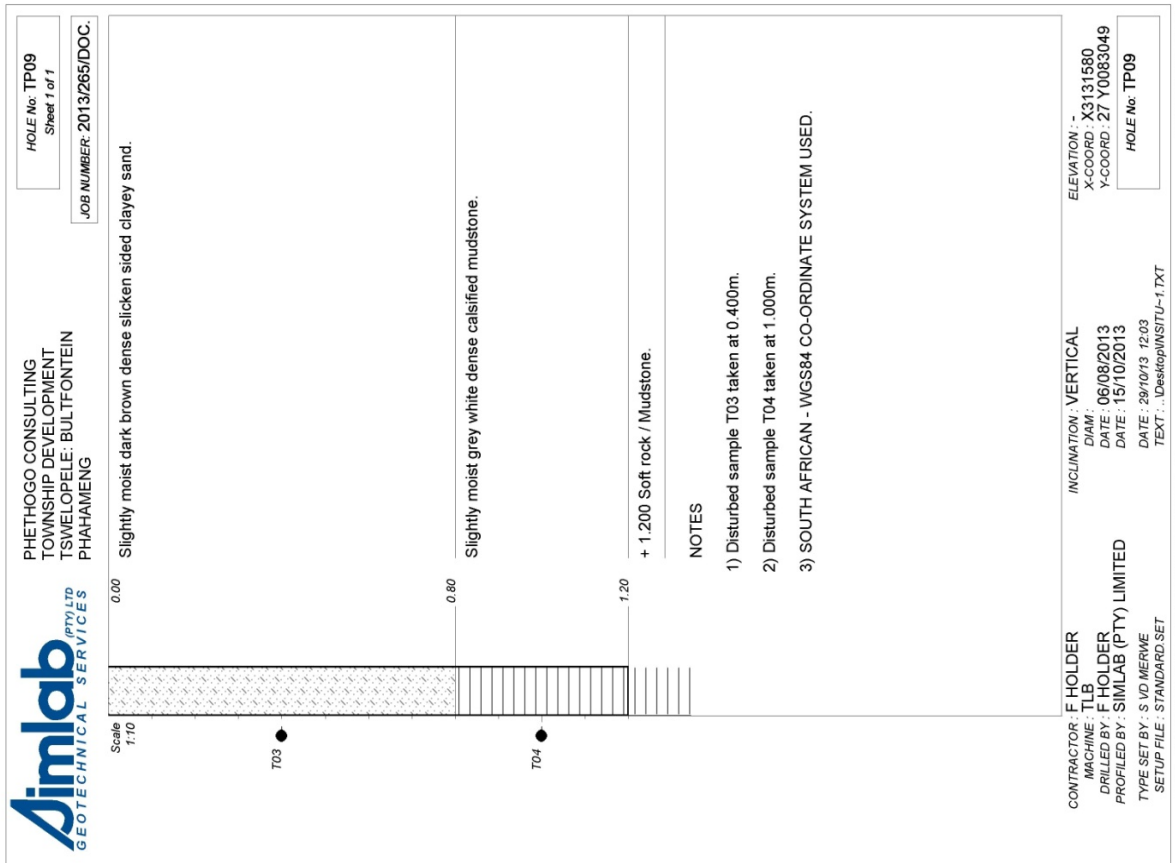
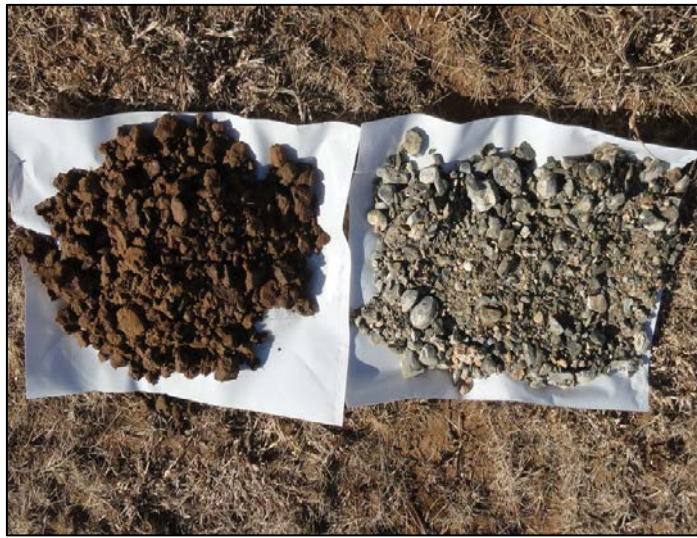
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TEST PIT No. : TP9



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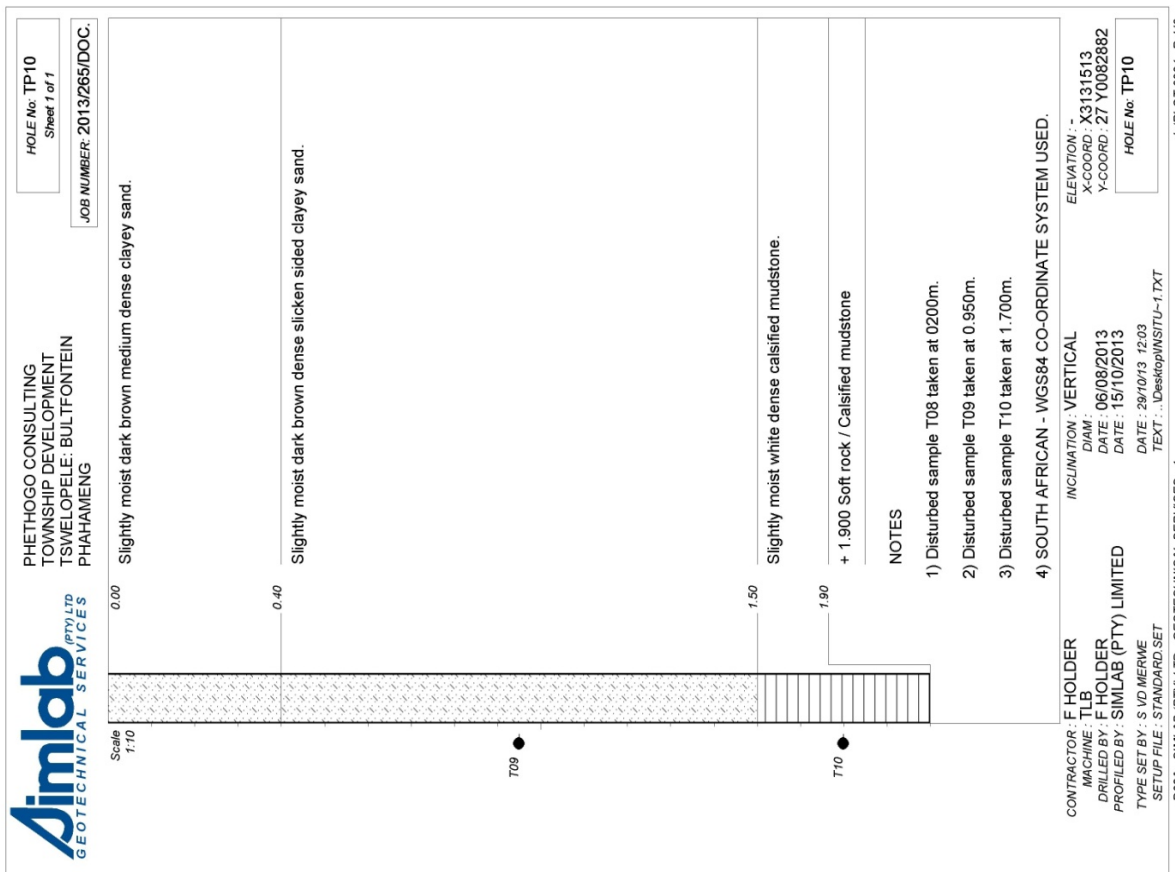
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TEST PIT No. : TP10



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<p>PHETHOGO CONSULTING TOWNSHIP DEVELOPMENT TSWELOPELE: BULTFONTEIN PHAHAMENG</p> <p>Simlab GEOTECHNICAL SERVICES</p>		<p>LEGEND Sheet 1 of 1</p> <p>JOB NUMBER: 2013/265/DOC.</p>
<p>SAND {SA04}</p> <p>SILTY {SA07}</p> <p>CLAY {SA08}</p> <p>CLAYEY {SA09}</p> <p>MUDSTONE {SA12}</p> <p>DOLERITE {SA18}{SA42}</p> <p>DENSE CALCRETE {SA26}{SA29}</p> <p>CALCRETE {SA26}</p> <p>DISTURBED SAMPLE {SA38}</p>	<p>CONTRACTOR: MACHINE: DRILLED BY: PROFILED BY: TYPE SET BY: SVD MERVE SETUP FILE: STANDARD.SET DOB: SIMLAB (PTY) LTD - GEOTECHNICAL SERVICES - 1</p> <p>INCLINATION: DIAM: DATE: DATE: DATE: 29/10/13 12:03 TEXT: ..\Desktop\INSITU-1.TXT</p> <p>ELEVATION: X-COORD: Y-COORD:</p> <p>LEGEND SUMMARY OF SYMBOLS</p> <p>doiPLOT 6004 Pph6</p>	<p>Name ●</p>

SUMMARY

APPENDIX C

LABORATORY TEST RESULTS



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MATERIAL ANALYSIS

HOLE No. / KM		TP1		
MATERIAL DEPTH (mm)		0 - 400	400 - 2100	2100+
SAMPLE / LAB. No.		T12 013/3075	T13 013/3076	NS
MATERIAL DESCRIPTION		Slightly moist dark brown dense slicken sided clayey sand	Slightly moist white grey dense calcsified mudstone	Soft rock / Calcified mudstone
* IN SITU FIELD MOISTURE (%)		10.0	9.9	
AASHTO CLASSIFICATION				
* UNIFIED SOIL CLASSIFICATION		SC	SC	
TRH14 / * COLTO CLASSIFICATION				
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES				
SIEVE ANALYSIS	63.0 mm			
	53.0 mm			
	37.5 mm			
	26.5 mm			
	19.0 mm			
	13.2 mm		100	
	4.75 mm		98	
	2.00 mm	100	93	
	0.425 mm	99	77	
	0.075 mm	42	26	
	* 0.002 mm	24	13	
SOIL MORTAR	COARSE SAND	1	17	
	FINE SAND	21 / 19 / 18	5 / 23 / 28	
	MATERIAL < 0.075 mm	42	27	
GRADING MODULUS (GM)		0.60	1.04	
* pH / CONDUCTIVITY Sm ⁻¹		8.24 / 0.302	8.89 / 0.233	
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)				
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L	38	47	
	P.I. / L.S.	16 / 8.0	20 / 9.5	
* POTENTIAL EXPANSIVENESS (mm)		Medium / 7.0mm	Medium / 20.0mm	
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)				
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)				
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)		
		OPT MOISTURE (%)		
		COMP MOISTURE (%)		
		DRY DENSITY (kg/m ³)		
		CBR (%) / * UCS / ITS (KPa)		
		SWELL (%)		
	NRB	DRY DENSITY (kg/m ³)		
		CBR (%)		
		PROCTOR	MAX DRY DENSITY (kg/m ³)	
	OPT MOISTURE (%)			
	CBR (%)			
CBR / * UCS / ITS	100%			
	98%			
	95%			
	93%			
	90%			



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MATERIAL ANALYSIS

HOLE No. / KM		TP2		
MATERIAL DEPTH (mm)		0 - 200	200 - 1800	1800+
SAMPLE / LAB. No.		NS	T11 013/2996	NS
MATERIAL DESCRIPTION		Slightly moist dark brown stiff slicken sided clay	Slightly moist white grey dense calcsified mudstone	Soft rock / Calcified mudstone
* IN SITU FIELD MOISTURE (%)			14.6	
AASHTO CLASSIFICATION				
* UNIFIED SOIL CLASSIFICATION			SM	
TRH14 / * COLTO CLASSIFICATION			No Classification	
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES				
SIEVE ANALYSIS	63.0 mm			
	53.0 mm			
	37.5 mm			
	26.5 mm			
	19.0 mm			
	13.2 mm		100	
	4.75 mm		95	
	2.00 mm		79	
	0.425 mm		58	
	0.075 mm		21	
	* 0.002 mm		12	
SOIL MORTAR	COARSE SAND		26	
	FINE SAND		29 / 11 / 8	
	MATERIAL<0.075 mm		26	
GRADING MODULUS (GM)			1.42	
* pH / CONDUCTIVITY Sm ⁻¹			8.60 / 0.214	
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)				
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L		49	
	P.I. / L.S.		18 / 11.0	
* POTENTIAL EXPANSIVENESS (mm)		Medium / 4.0mm	Medium / 20.0mm	
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)				
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)				
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)	1842	
		OPT MOISTURE (%)	14.0	
		COMP MOISTURE (%)	14.0	
		DRY DENSITY (kg/m ³)	1824	
		CBR (%) / * UCS / ITS (KPa)	6	
		SWELL (%)	4.1	
	NRB	DRY DENSITY (kg/m ³)	1740	
		CBR (%)	4	
	PROCTOR	MAX DRY DENSITY (kg/m ³)	1659	
		OPT MOISTURE (%)	-	
		CBR (%)	3	
CBR / * UCS / ITS	100%		6	
	98%		5	
	95%		4	
	93%		4	
	90%		3	



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MATERIAL ANALYSIS

HOLE No. / KM		TP3				
MATERIAL DEPTH (mm)		0 - 600	600 - 1100	1100+		
SAMPLE / LAB. No.		T6 013/3070	T7 013/3071	NS		
MATERIAL DESCRIPTION		Slightly moist orange brown dense clayey sand	Slightly moist grey white dense calcsified mudstone	Soft Rock / Mudstone		
* IN SITU FIELD MOISTURE (%)		10.8	5.4			
AASHTO CLASSIFICATION						
* UNIFIED SOIL CLASSIFICATION		SC	SM			
TRH14 / * COLTO CLASSIFICATION						
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES						
SIEVE ANALYSIS	63.0 mm					
	53.0 mm					
	37.5 mm					
	26.5 mm					
	19.0 mm					
	13.2 mm		100			
	4.75 mm	100	96			
	2.00 mm	99	79			
	0.425 mm	96	41			
	0.075 mm	34	28			
	* 0.002 mm	21	5			
SOIL MORTAR	COARSE SAND	4	48			
	FINE SAND	8 / 29 / 26	5 / 5 / 6			
	MATERIAL < 0.075 mm	34	36			
GRADING MODULUS (GM)		0.71	1.62			
* pH / CONDUCTIVITY Sm ⁻¹			8.49 / 0.331			
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)						
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L	36	41			
	P.I. / L.S.	16 / 8.2	15 / 8.7			
* POTENTIAL EXPANSIVENESS (mm)		Medium / 9.5mm	Low			
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)						
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)						
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)				
		OPT MOISTURE (%)				
		COMP MOISTURE (%)				
		DRY DENSITY (kg/m ³)				
		CBR (%) / * UCS / ITS (KPa)				
		SWELL (%)				
	NRB	DRY DENSITY (kg/m ³)				
		CBR (%)				
	PROCTOR	MAX DRY DENSITY (kg/m ³)				
		OPT MOISTURE (%)				
CBR (%)						
CBR / * UCS / ITS	100%					
	98%					
	95%					
	93%					
	90%					

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MATERIAL ANALYSIS

HOLE No. / KM		TP4		
MATERIAL DEPTH (mm)		0 - 900	900+	
SAMPLE / LAB. No.		T5 013/3069	NS	
MATERIAL DESCRIPTION		Slightly moist white dense calcrete and dolerite	Hard pan calcrete and dolerite	
* IN SITU FIELD MOISTURE (%)		5.5		
AASHTO CLASSIFICATION				
* UNIFIED SOIL CLASSIFICATION		GP - GM		
TRH14 / * COLTO CLASSIFICATION				
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES				
SIEVE ANALYSIS	63.0 mm			
	53.0 mm	100		
	37.5 mm	64		
	26.5 mm	60		
	19.0 mm	49		
	13.2 mm	42		
	4.75 mm	33		
	2.00 mm	27		
	0.425 mm	19		
	0.075 mm	11		
	* 0.002 mm	1		
SOIL MORTAR	COARSE SAND	31		
	FINE SAND	7 / 10 / 12		
	MATERIAL < 0.075 mm	39		
GRADING MODULUS (GM)		2.44		
* pH / CONDUCTIVITY Sm ⁻¹		8.30 / 0.409		
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)				
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L	39		
	P.I. / L.S.	9 / 3.9		
* POTENTIAL EXPANSIVENESS (mm)		Low		
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)				
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)				
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)		
		OPT MOISTURE (%)		
		COMP MOISTURE (%)		
		DRY DENSITY (kg/m ³)		
		CBR (%) / * UCS / ITS (KPa)		
		SWELL (%)		
	NRB	DRY DENSITY (kg/m ³)		
		CBR (%)		
	PROCTOR	MAX DRY DENSITY (kg/m ³)		
		OPT MOISTURE (%)		
		CBR (%)		
CBR / * UCS / ITS	100%			
	98%			
	95%			
	93%			
	90%			



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MATERIAL ANALYSIS

HOLE No. / KM		TP5		
MATERIAL DEPTH (mm)		0 - 800	800+	
SAMPLE / LAB. No.		NS	NS	
MATERIAL DESCRIPTION		Slightly moist orange brown dense clayey sand	Hard rock / Weathered dolerite	
* IN SITU FIELD MOISTURE (%)				
AASHTO CLASSIFICATION				
* UNIFIED SOIL CLASSIFICATION				
TRH14 / * COLTO CLASSIFICATION				
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES				
SIEVE ANALYSIS	63.0 mm			
	53.0 mm			
	37.5 mm			
	26.5 mm			
	19.0 mm			
	13.2 mm			
	4.75 mm			
	2.00 mm			
	0.425 mm			
	0.075 mm			
	* 0.002 mm			
SOIL MORTAR	COARSE SAND			
	FINE SAND			
	MATERIAL < 0.075 mm			
GRADING MODULUS (GM)				
* pH / CONDUCTIVITY Sm ⁻¹				
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)				
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L			
	P.I. / L.S.			
* POTENTIAL EXPANSIVENESS (mm)		Medium / 13.0mm		
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)				
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)				
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)		
		OPT MOISTURE (%)		
		COMP MOISTURE (%)		
		DRY DENSITY (kg/m ³)		
		CBR (%) / * UCS / ITS (KPa)		
		SWELL (%)		
	NRB	DRY DENSITY (kg/m ³)		
		CBR (%)		
	PROCTOR	MAX DRY DENSITY (kg/m ³)		
		OPT MOISTURE (%)		
		CBR (%)		
CBR / * UCS / ITS	100%			
	98%			
	95%			
	93%			
	90%			



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MATERIAL ANALYSIS

HOLE No. / KM		TP6	TP7		
MATERIAL DEPTH (mm)		-	0 - 400	400 - 1600	1600+
SAMPLE / LAB. No.		NS	NS	T2 013/3066	NS
MATERIAL DESCRIPTION		Falls inside borrow pit	Slightly moist orange brown dense clayey sand	Slightly moist light brown medium dense clayey sand	Soft rock / Grey mudstone
* IN SITU FIELD MOISTURE (%)				10.8	
AASHTO CLASSIFICATION					
* UNIFIED SOIL CLASSIFICATION				SC	
TRH14 / * COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm				
	13.2 mm				
	4.75 mm			100	
	2.00 mm			99	
	0.425 mm			96	
	0.075 mm			32	
* 0.002 mm			23		
SOIL MORTAR	COARSE SAND			3	
	FINE SAND			4 / 26 / 34	
	MATERIAL < 0.075 mm			33	
GRADING MODULUS (GM)				0.73	
* pH / CONDUCTIVITY Sm ⁻¹				8.38 / 0.323	
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L			35	
	P.I. / L.S.			15 / 7.2	
* POTENTIAL EXPANSIVENESS (mm)			Medium / 7.0mm	Medium / 15.0mm	
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)					
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / * UCS / ITS (KPa)			
		SWELL (%)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%)			
	PROCTOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
CBR (%)					
CBR / * UCS / ITS	100%				
	98%				
	95%				
	93%				
	90%				



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MATERIAL ANALYSIS

HOLE No. / KM		TP8		
MATERIAL DEPTH (mm)		0 - 400	+400	
SAMPLE / LAB. No.		T1 013/2995	NS	
MATERIAL DESCRIPTION		Slightly moist orange brown dense silty sand	Hard calcified weathered dolerite. Refusal	
* IN SITU FIELD MOISTURE (%)		6.6		
AASHTO CLASSIFICATION				
* UNIFIED SOIL CLASSIFICATION		SM		
TRH14 / * COLTO CLASSIFICATION		G7		
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES				
SIEVE ANALYSIS	63.0 mm			
	53.0 mm			
	37.5 mm			
	26.5 mm			
	19.0 mm			
	13.2 mm			
	4.75 mm	100		
	2.00 mm	99		
	0.425 mm	96		
	0.075 mm	24		
	* 0.002 mm	8		
SOIL MORTAR	COARSE SAND	3		
	FINE SAND	5 / 25 / 42		
	MATERIAL < 0.075 mm	24		
GRADING MODULUS (GM)		0.80		
* pH / CONDUCTIVITY Sm ⁻¹		7.72 / 0.214		
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)				
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L			
	P.I. / L.S.	S.P. / 1.4		
* POTENTIAL EXPANSIVENESS (mm)		Low		
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)				
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)				
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)	1935	
		OPT MOISTURE (%)	12.1	
		COMP MOISTURE (%)	12.0	
		DRY DENSITY (kg/m ³)	1935	
		CBR (%) / * UCS / ITS (KPa)	30	
		SWELL (%)	0.3	
	NRB	DRY DENSITY (kg/m ³)	1846	
		CBR (%)	27	
	PROCTOR	MAX DRY DENSITY (kg/m ³)	1778	
		OPT MOISTURE (%)	-	
		CBR (%)	11	
CBR / * UCS / ITS	100%	30		
	98%	26		
	95%	21		
	93%	18		
	90%	14		



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MATERIAL ANALYSIS

HOLE No. / KM		TP9			
MATERIAL DEPTH (mm)		0 - 800	800 - 1200	1200+	
SAMPLE / LAB. No.		T3 013/3067	T4 013/3068	NS	
MATERIAL DESCRIPTION		Slightly moist dark brown dense slicken sided clayey sand	Slightly moist grey white dense calcsified mudstone	Soft rock / Mudstone	
* IN SITU FIELD MOISTURE (%)		13.4	8.7		
AASHTO CLASSIFICATION					
* UNIFIED SOIL CLASSIFICATION		SC	SW - SM		
TRH14 / * COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm				
	13.2 mm				
	4.75 mm	100	100		
	2.00 mm	99	74		
	0.425 mm	96	36		
	0.075 mm	45	11		
	* 0.002 mm	27	4		
SOIL MORTAR	COARSE SAND	3	52		
	FINE SAND	5 / 26 / 22	17 / 9 / 7		
	MATERIAL < 0.075 mm	45	15		
GRADING MODULUS (GM)		0.60	1.79		
* pH / CONDUCTIVITY Sm ⁻¹		8.11 / 0.389	8.56 / 0.370		
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L	39	42		
	P.I. / L.S.	18 / 8.7	14 / 7.0		
* POTENTIAL EXPANSIVENESS (mm)		Medium / 12.0mm	Low		
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)					
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / * UCS / ITS (KPa)			
		SWELL (%)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%)			
	PROCTOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		CBR (%)			
CBR / * UCS / ITS	100%				
	98%				
	95%				
	93%				
	90%				



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MATERIAL ANALYSIS

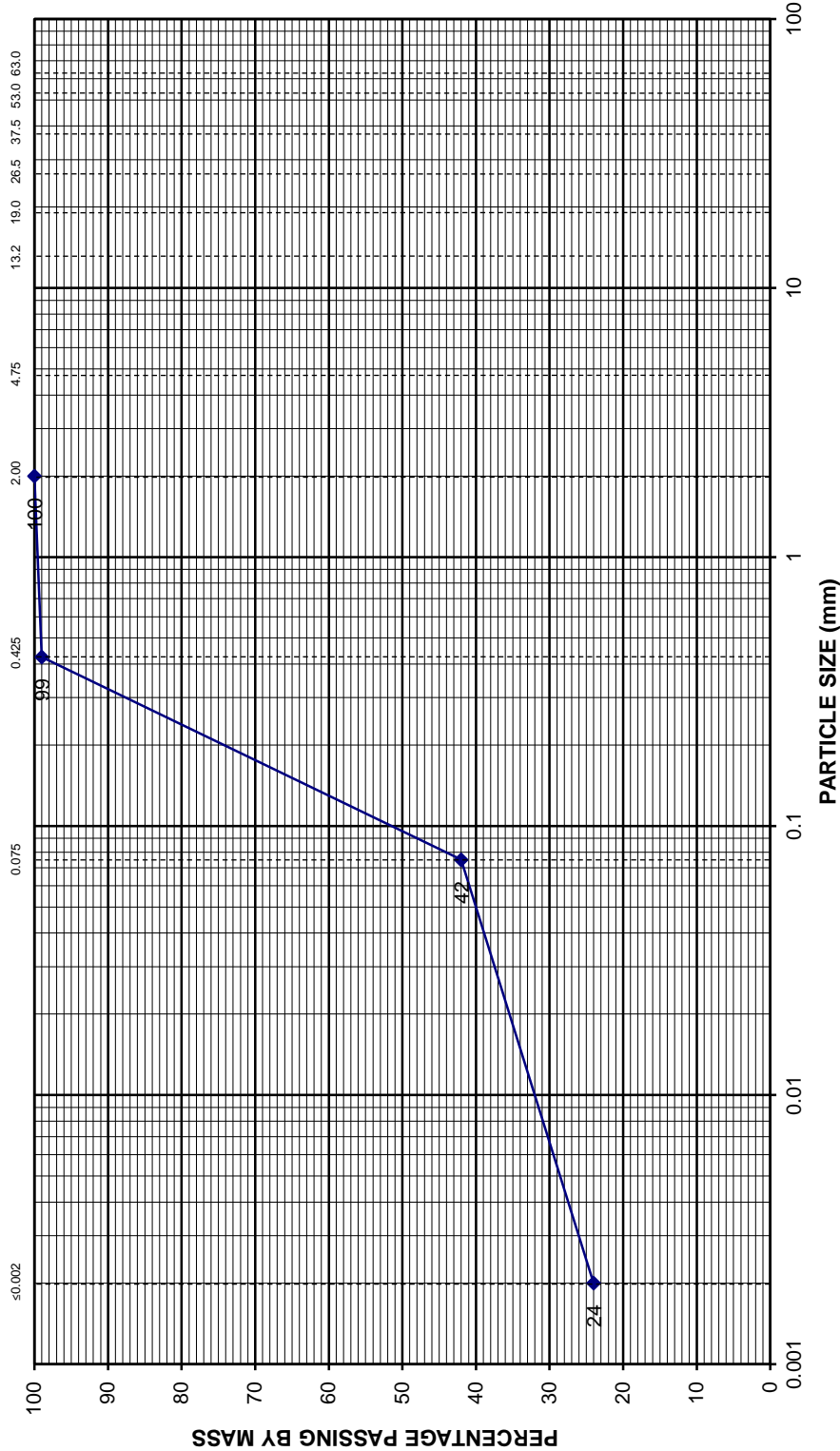
HOLE No. / KM	TP10				
MATERIAL DEPTH (mm)	0 - 400	400 - 1500	1500 - 1900	1900+	
SAMPLE / LAB. No.	T8 013/3072	NS	T10 013/3074	NS	
MATERIAL DESCRIPTION	Slightly moist dark brown dense clayey sand	Slightly moist dark brown dense slicken sided clayey sand	Slightly moist white dense calcsified mudstone	Soft rock / Calcsified mudstone	
* IN SITU FIELD MOISTURE (%)	6.1		10.9		
AASHTO CLASSIFICATION					
* UNIFIED SOIL CLASSIFICATION	SC	SC	SC		
TRH14 / * COLTO CLASSIFICATION					
SIEVE ANALYSIS, PERCENTAGE OF MATERIAL PASSING 0.075 mm SIEVE (TMH 1, Method A1 (a), A5) - % PASSING SIEVES					
SIEVE ANALYSIS	63.0 mm				
	53.0 mm				
	37.5 mm				
	26.5 mm				
	19.0 mm				
	13.2 mm			100	
	4.75 mm			96	
	2.00 mm	100	100	85	
	0.425 mm	99	98	61	
	0.075 mm	21	16	24	
	* 0.002 mm	8	14	17	
SOIL MORTAR	COARSE SAND	1	2	28	
	FINE SAND	17 / 30 / 31	39 / 32 / 10	14 / 16 / 14	
	MATERIAL<0.075 mm	21	16	28	
GRADING MODULUS (GM)	0.80	0.86	1.30		
* pH / CONDUCTIVITY Sm ⁻¹	8.11 / 0.233	8.13 / 0.321			
ATTERBERG LIMITS ANALYSIS (TMH 1, Method A2, A3, & A4)					
ATTERBERG LIMITS PASSING SIEVE (mm) >0.425	L.L	23	31	47	
	P.I. / L.S.	8 / 4.0	14 / 6.5	21 / 10.1	
* POTENTIAL EXPANSIVENESS (mm)	Low	Medium / 14.0mm	Medium / 4.2mm		
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT, CALIFORNIA BEARING RATIO ANALYSIS (TMH 1, Method A7 & A8)					
UNCONFINED COMPRESSIVE STRENGTH & INDIRECT TENSILE STRENGTH OF STABILISED MATERIAL (TMH 1, Method A14 & A16T)					
CBR / * UCS / ITS DETERMINATION	MOD AASHTO	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		COMP MOISTURE (%)			
		DRY DENSITY (kg/m ³)			
		CBR (%) / * UCS / ITS (KPa)			
		SWELL (%)			
	NRB	DRY DENSITY (kg/m ³)			
		CBR (%)			
	PROCTOR	MAX DRY DENSITY (kg/m ³)			
		OPT MOISTURE (%)			
		CBR (%)			
CBR / * UCS / ITS	100%				
	98%				
	95%				
	93%				
	90%				

APPENDIX D

PARTICLE SIZE DISTRIBUTION



***PARTICLE SIZE DISTRIBUTION**

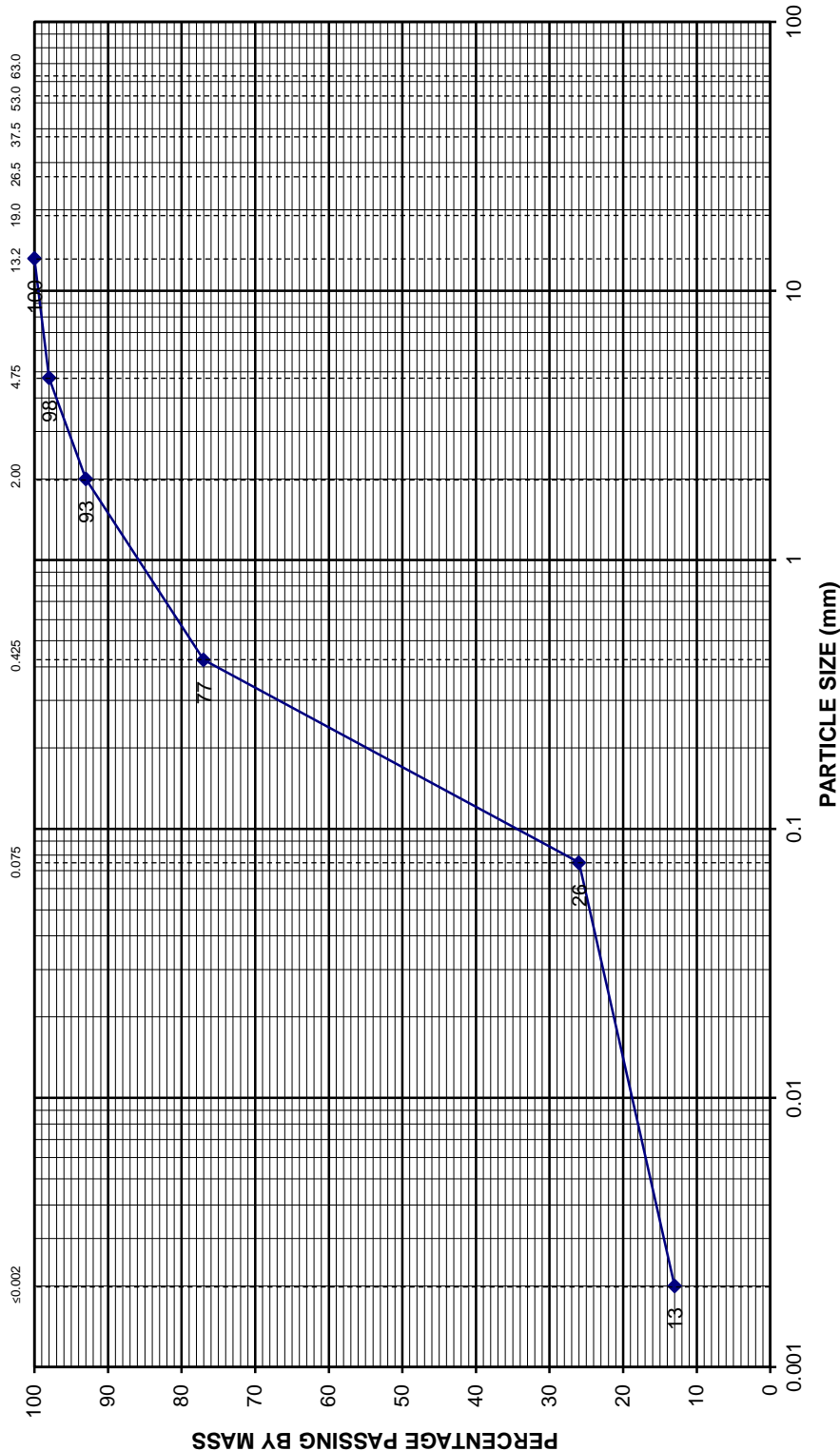


Particle Size Range (mm)	Classification	Percentage
(≤ 0.002)	CLAY	24%
(0.002 - 0.006)	FINE	SILT 18%
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	SAND 58%
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	GRAVEL 0%
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	

HOLE No. : Test Pit 01	DEPTH : 0 - 400mm	SAMPLE No. : T12, 013/3075
MATERIAL DESCRIPTION : Slightly moist dark brown dense slicken sided clayey sand		
ATTERBERG LIMITS : 38 / 16 / 8.0	POTENTIAL EXPANSIVENESS : Medium - 7.0mm	PAGE No. : 1 of 13



***PARTICLE SIZE DISTRIBUTION**



Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	FINE CLAY	13%
(0.006 - 0.006)	FINE CLAY	13%
(0.006 - 0.020)	MEDIUM SILT	13%
(0.020 - 0.060)	COARSE SILT	13%
(0.060 - 0.200)	FINE SAND	67%
(0.200 - 0.600)	MEDIUM SAND	67%
(0.600 - 2.000)	COARSE SAND	67%
(2.0 - 6.0)	FINE GRAVEL	7%
(6.0 - 20.0)	MEDIUM GRAVEL	7%
(20.0 - 60.0)	COARSE GRAVEL	7%
(60.0 - 200.0)	COBBLE	7%

HOLE No.:	Test Pit 01	DEPTH:	400 - 2100mm	SAMPLE No.:	T13, 013/3076
MATERIAL DESCRIPTION: Slightly moist white grey dense calcified mudstone					
ATTERBERG LIMITS:	47 / 20 / 9.5	POTENTIAL EXPANSIVENESS:	Medium - 20.0mm	PAGE No.:	2 of 13



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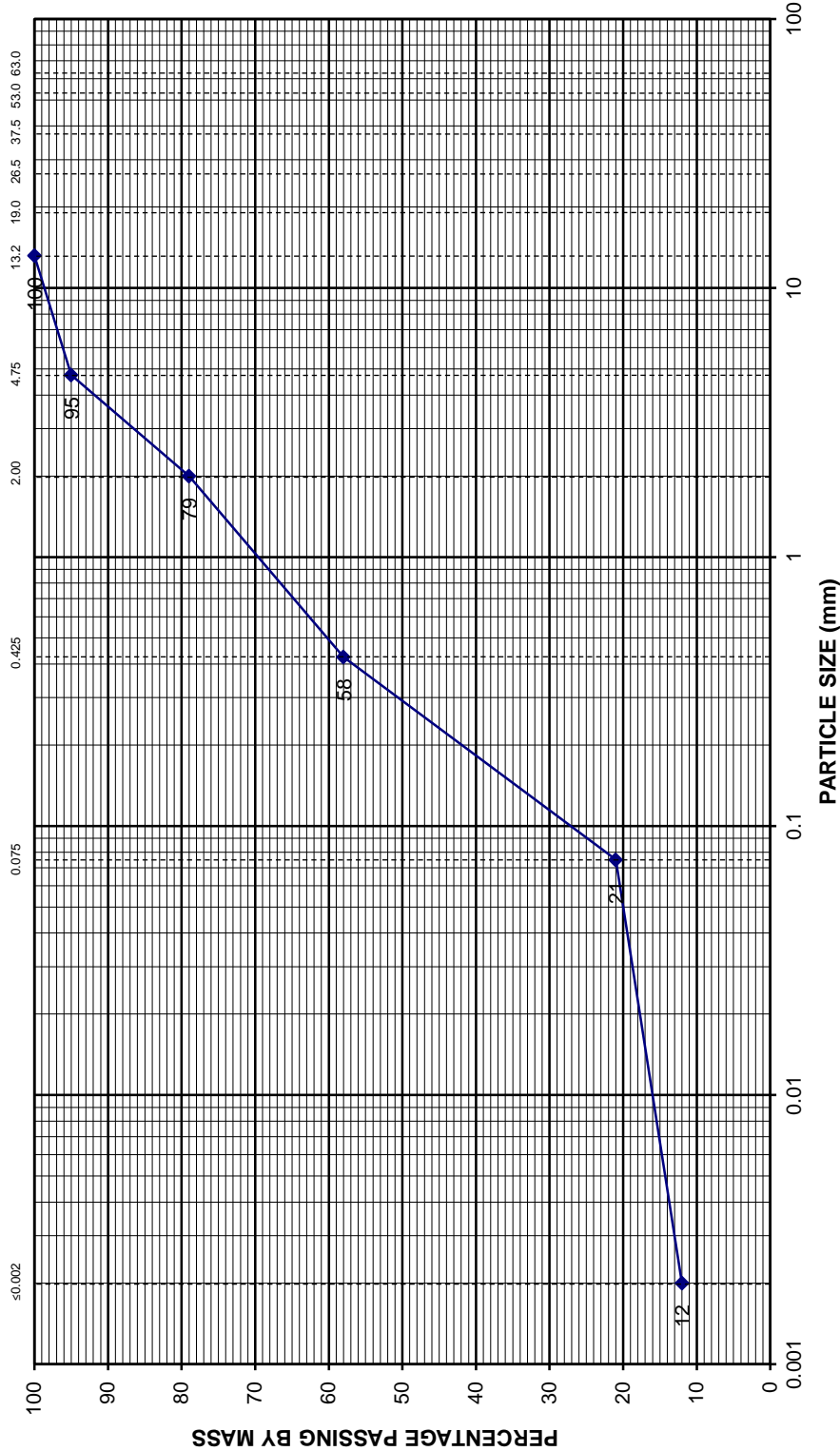
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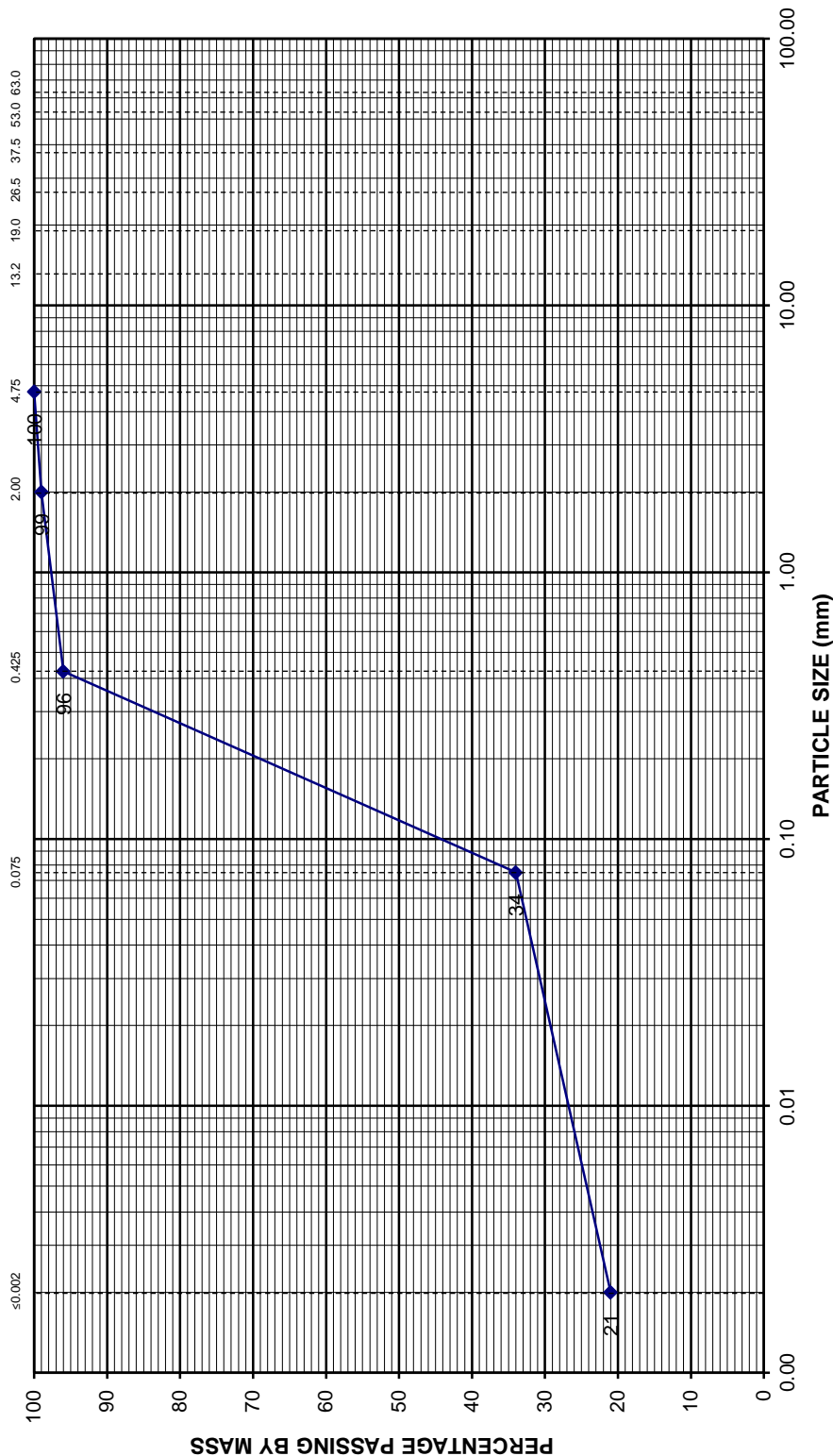


Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	CLAY	12%
(0.002 - 0.006)	FINE	9%
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	58%
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	21%
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	

HOLE No.:	Test Pit 02	DEPTH:	200 - 1800mm	SAMPLE No.:	T11, 013/2996
MATERIAL DESCRIPTION: Slightly moist white grey dense calcified mudstone					
ATTERBERG LIMITS:	49 / 18 / 11.0	POTENTIAL EXPANSIVENESS:	Medium - 20.0mm	PAGE No.:	3 of 13



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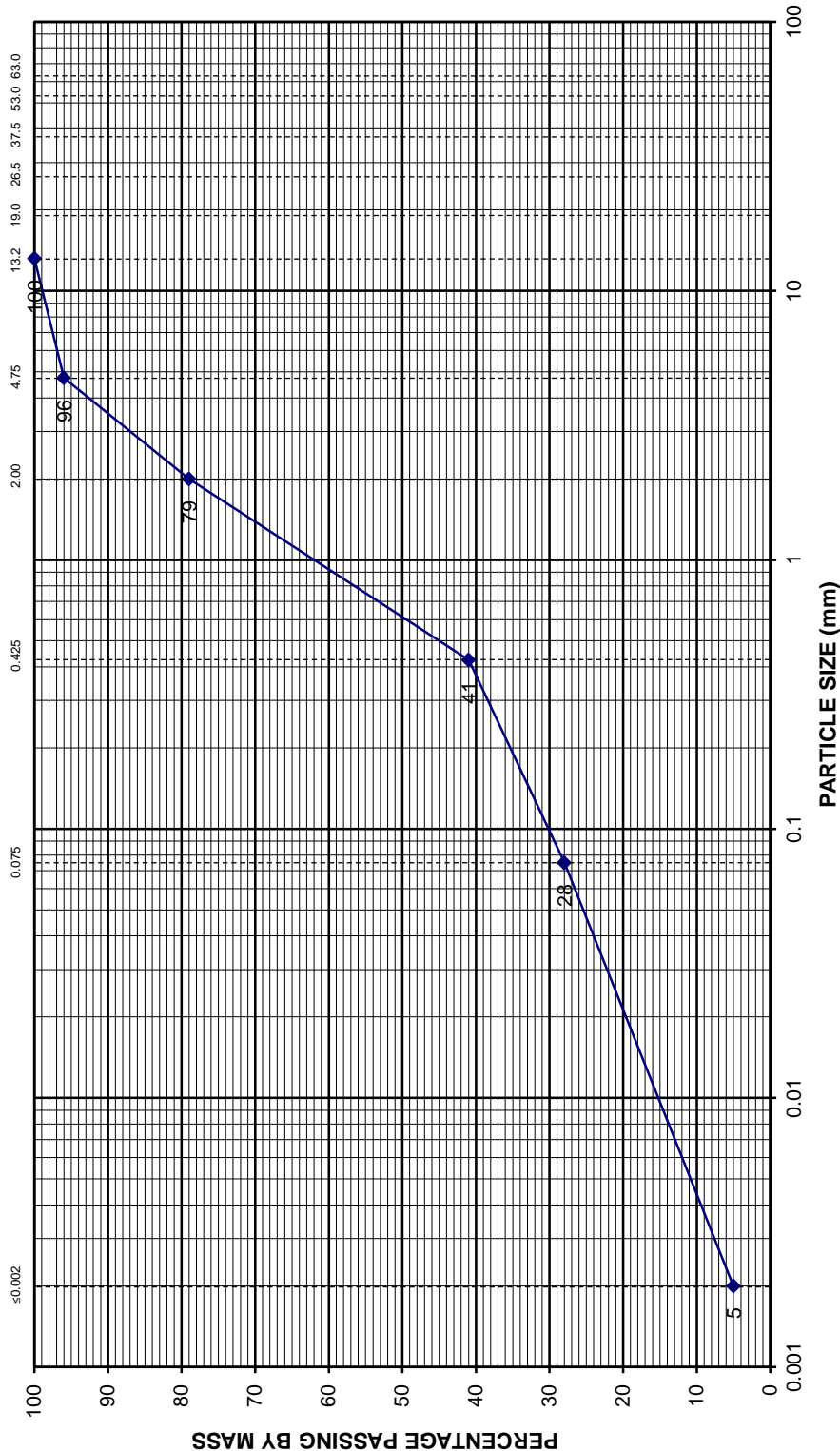


Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	FINE CLAY	21%
(0.002 - 0.006)	FINE CLAY	
(0.006 - 0.020)	MEDIUM SILT	13%
(0.020 - 0.060)	COARSE SILT	
(0.060 - 0.200)	FINE SILT	
(0.200 - 0.600)	MEDIUM SAND	65%
(0.600 - 2.000)	COARSE SAND	
(2.0 - 6.0)	FINE GRAVEL	
(6.0 - 20.0)	MEDIUM GRAVEL	1%
(20.0 - 60.0)	COARSE GRAVEL	
(60.0 - 200.0)	COBBLE	

HOLE No.:	Test Pit 03	DEPTH:	0 - 600mm	SAMPLE No.:	T6, 013/3070
MATERIAL DESCRIPTION: Slightly moist orange brown dense clayey sand					
ATTERBERG LIMITS:	36 / 16 / 8.2	POTENTIAL EXPANSIVENESS:	Medium - 9.5mm	PAGE No.:	4 of 13



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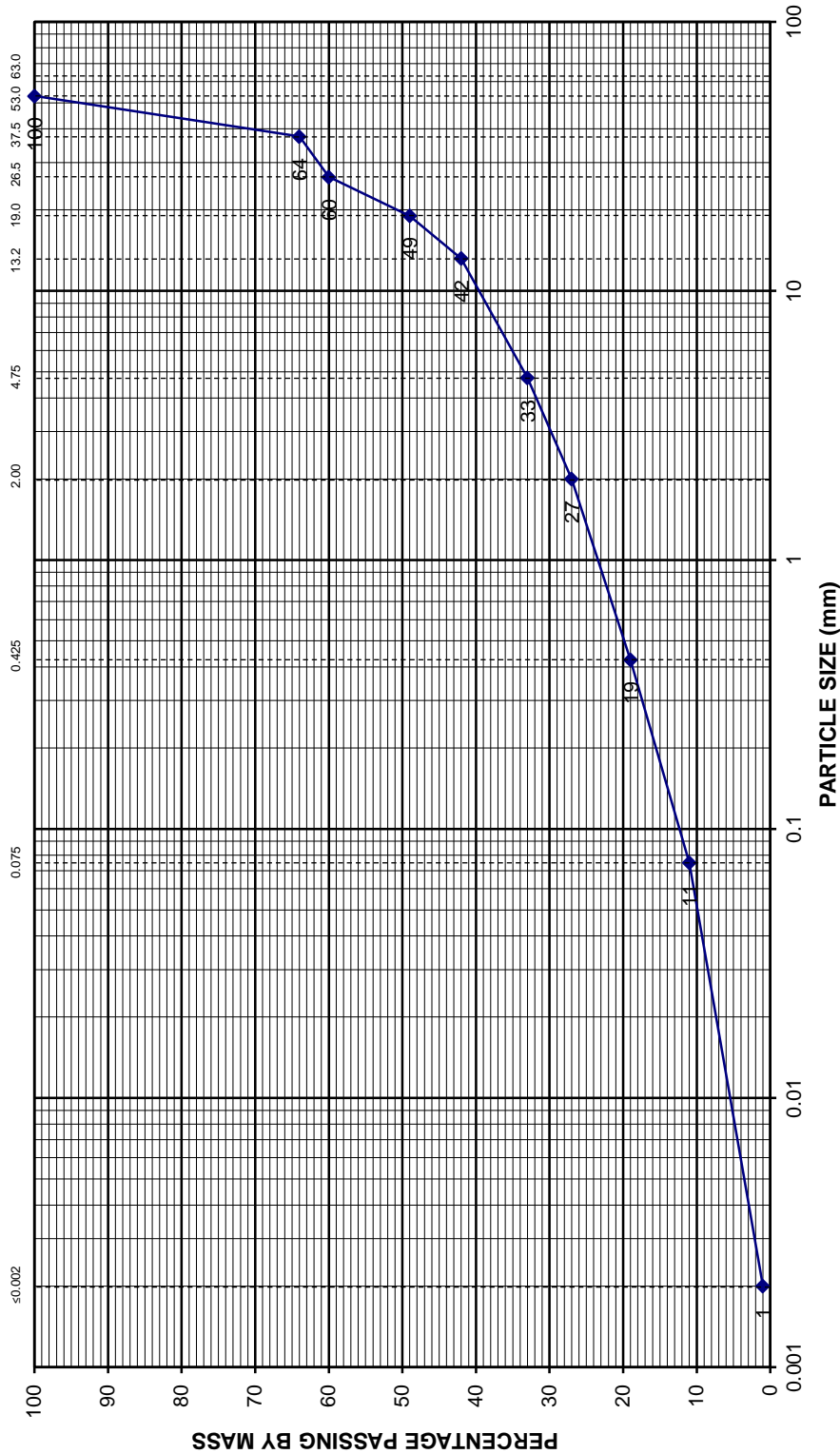


Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	CLAY	5%
(0.002 - 0.006)	FINE	
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	
SILT		23%
SAND		51%
GRAVEL		21%

HOLE No.: Test Pit 03	DEPTH: 600 - 1100mm	SAMPLE No.: T7, 013/3071
MATERIAL DESCRIPTION: Slightly moist grey white dense calcified mudstone		
ATTERBERG LIMITS: 41 / 15 / 8.7	POTENTIAL EXPANSIVENESS: Low	PAGE No.: 5 of 13



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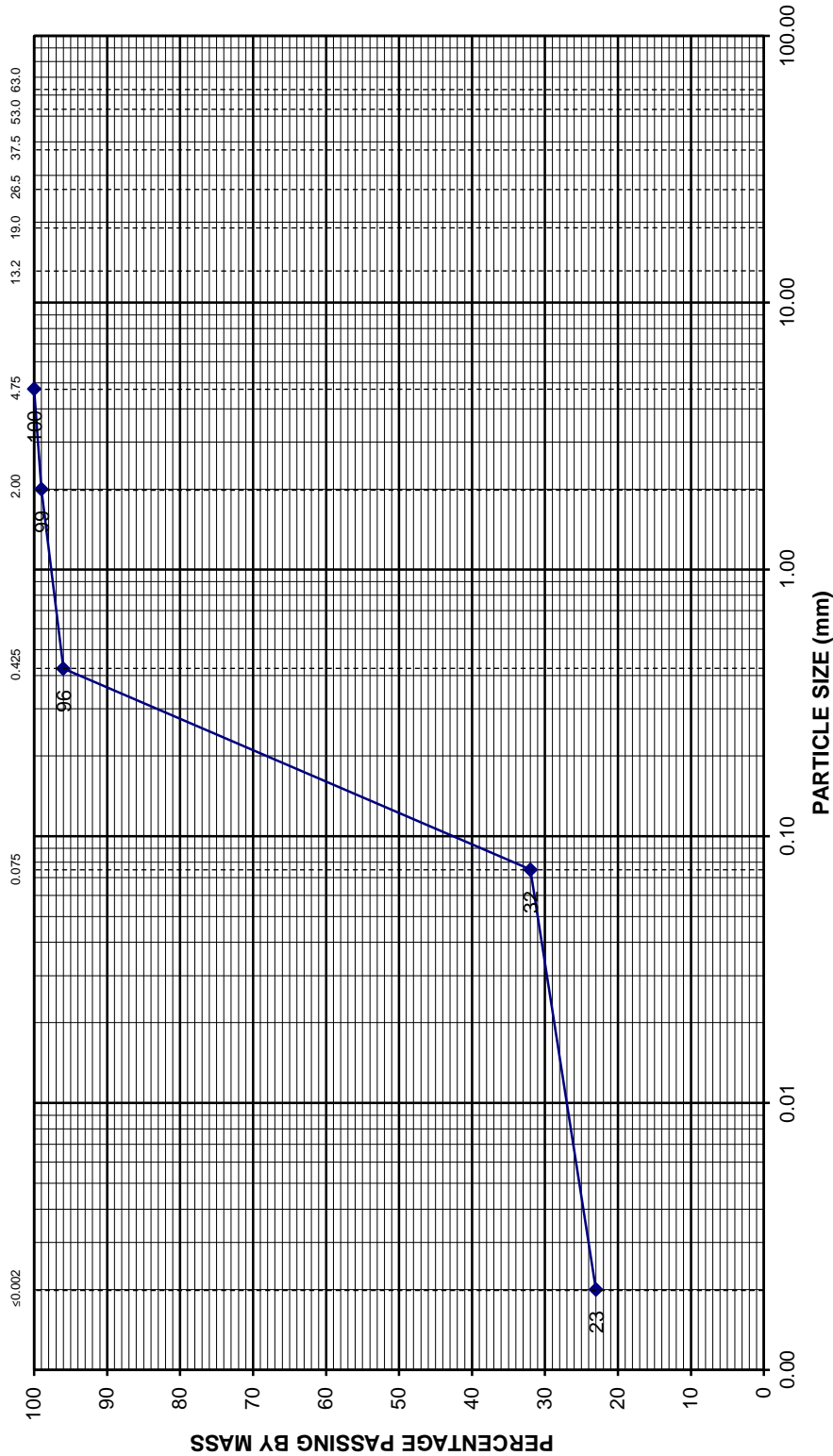


Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	CLAY	1%
(0.002 - 0.006)	FINE	
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	
SILT		10%
SAND		16%
GRAVEL		73%

HOLE No.: Test Pit 04	DEPTH: 0 - 900mm	SAMPLE No.: T5, 013/3069
MATERIAL DESCRIPTION: Slightly moist white dense calcrete and dolerite		
ATTERBERG LIMITS: 39 / 9 / 3.9	POTENTIAL EXPANSIVENESS: Low	PAGE No.: 6 of 13



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Particle Size Range (mm)	Soil Classification	Percentage
(≤0.002)	CLAY	23%
(0.002 - 0.006)	FINE	
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	
GRAVEL		1%
SAND		67%

HOLE No.: Test Pit 07	DEPTH: 400 - 1600mm	SAMPLE No.: T2, 013/3066
MATERIAL DESCRIPTION: Slightly moist light brown medium dense clayey sand		
ATTERBERG LIMITS: 35 / 15 / 7.2	POTENTIAL EXPANSIVENESS: Medium - 15.0mm	PAGE No.: 7 of 13



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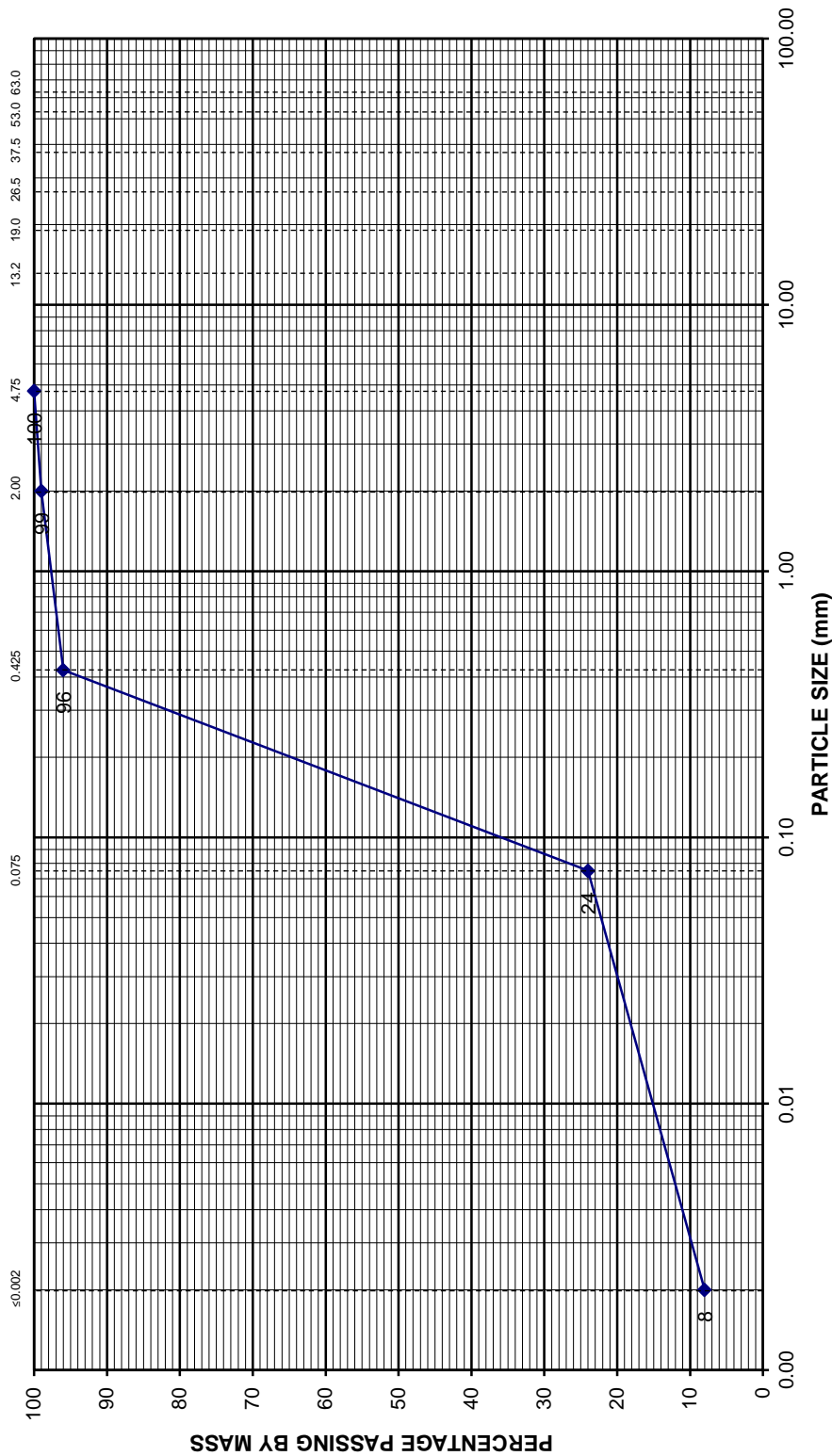
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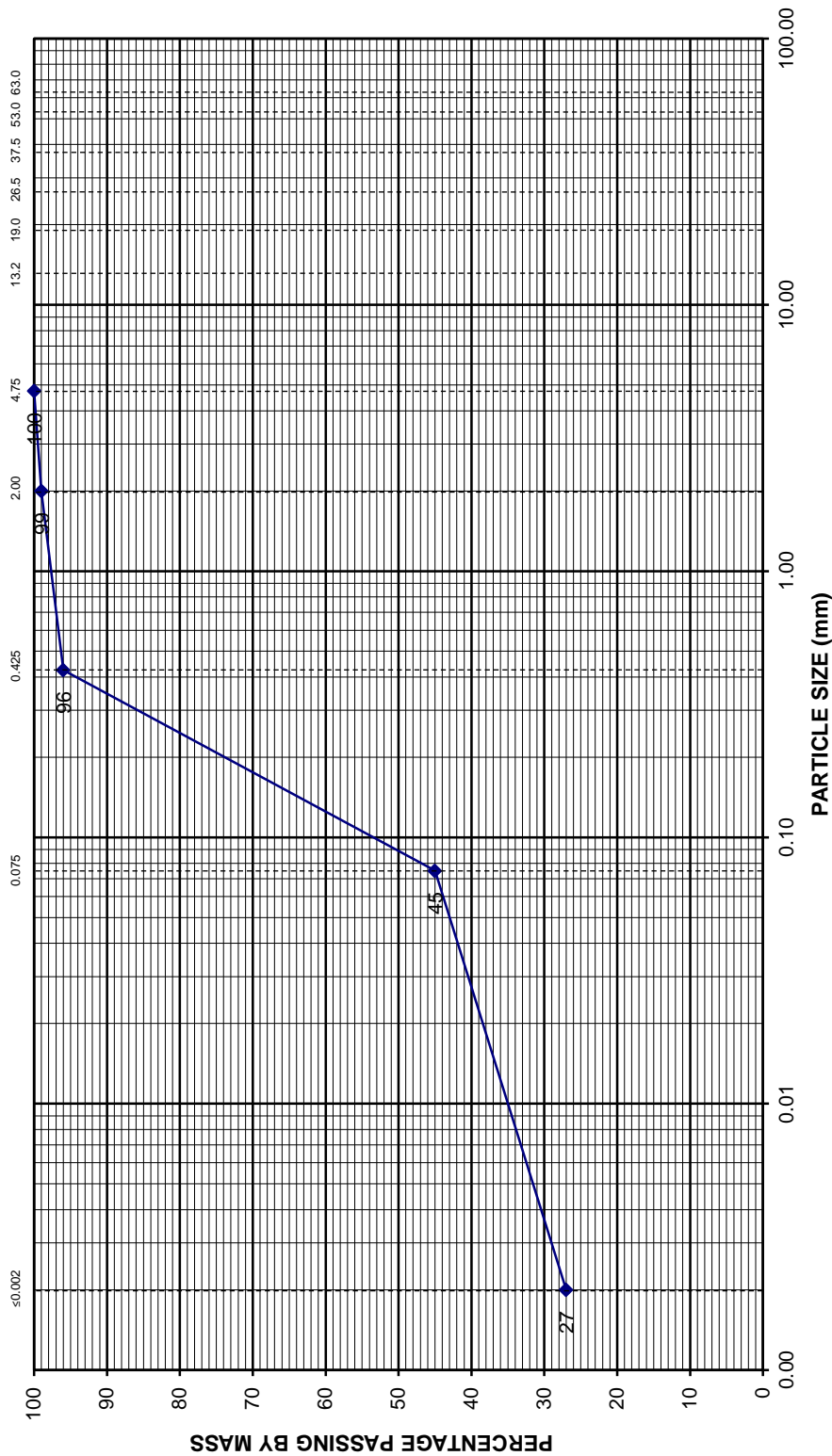


Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	FINE CLAY	8%
(0.002 - 0.006)	FINE CLAY	
(0.006 - 0.020)	MEDIUM SILT	16%
(0.020 - 0.060)	COARSE SILT	
(0.060 - 0.200)	FINE SILT	
(0.200 - 0.600)	MEDIUM SAND	75%
(0.600 - 2.000)	COARSE SAND	
(2.0 - 6.0)	FINE GRAVEL	
(6.0 - 20.0)	MEDIUM GRAVEL	1%
(20.0 - 60.0)	COARSE GRAVEL	
(60.0 - 200.0)	COBBLE	

HOLE No.:	Test Pit 08	DEPTH:	0 - 400 mm	SAMPLE No.:	T1, 013/2995
MATERIAL DESCRIPTION: Slightly moist orange brown dense silty sand					
ATTERBERG LIMITS:	/ S.P. / 1.4	POTENTIAL EXPANSIVENESS:	Low	PAGE No.:	8 of 13



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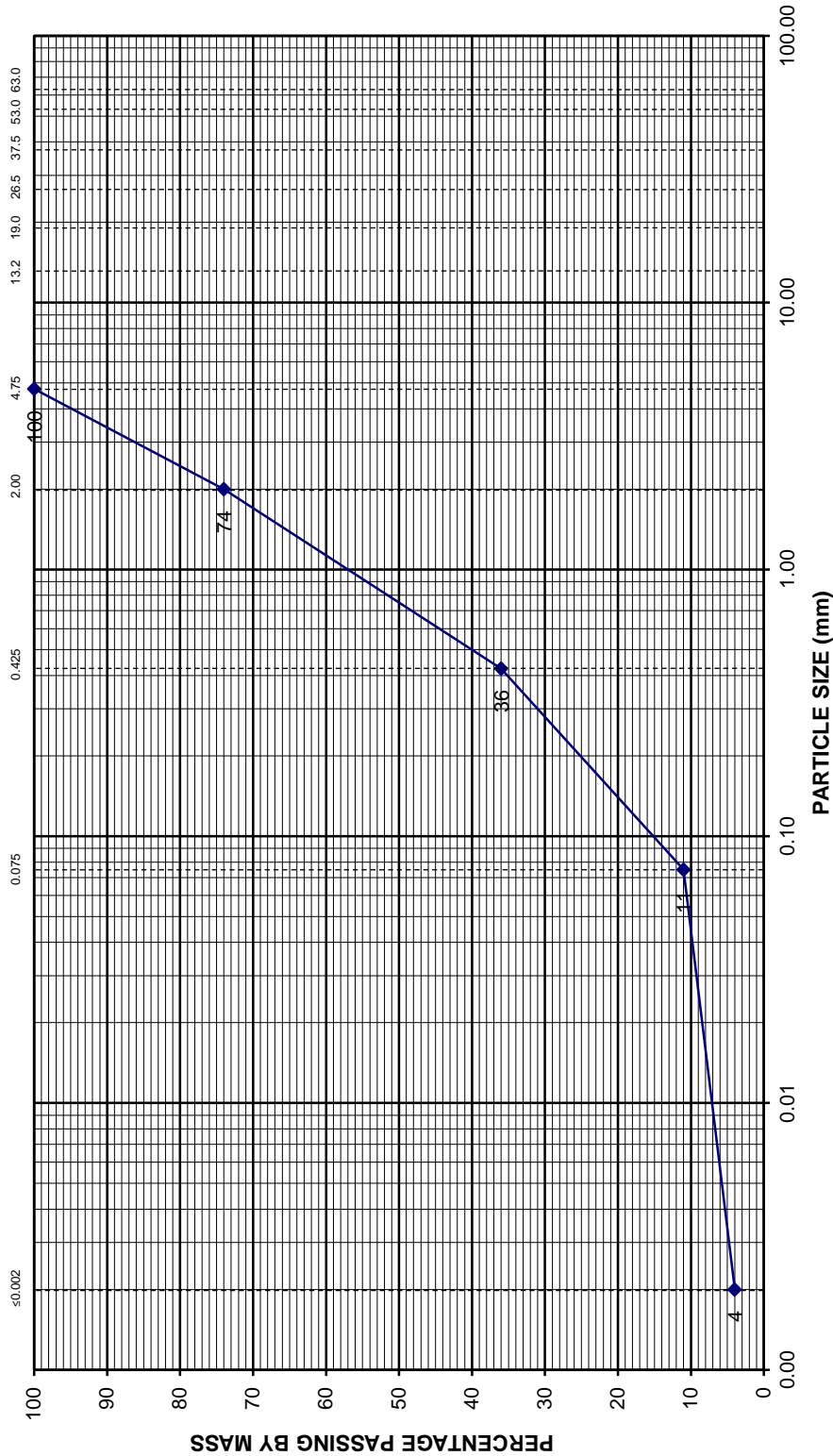


Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	CLAY	27%
(0.002 - 0.006)	FINE	
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	
SAND		54%
SILT		18%
GRAVEL		1%

HOLE No.: Test Pit 09	DEPTH: 0 - 800 mm	SAMPLE No.: T3, 013/3067
MATERIAL DESCRIPTION: Slightly moist dark brown dense slicken sided clayey sand		
ATTERBERG LIMITS: 39 / 18 / 8.7	POTENTIAL EXPANSIVENESS: Medium - 12.0mm	PAGE No.: 9 of 13



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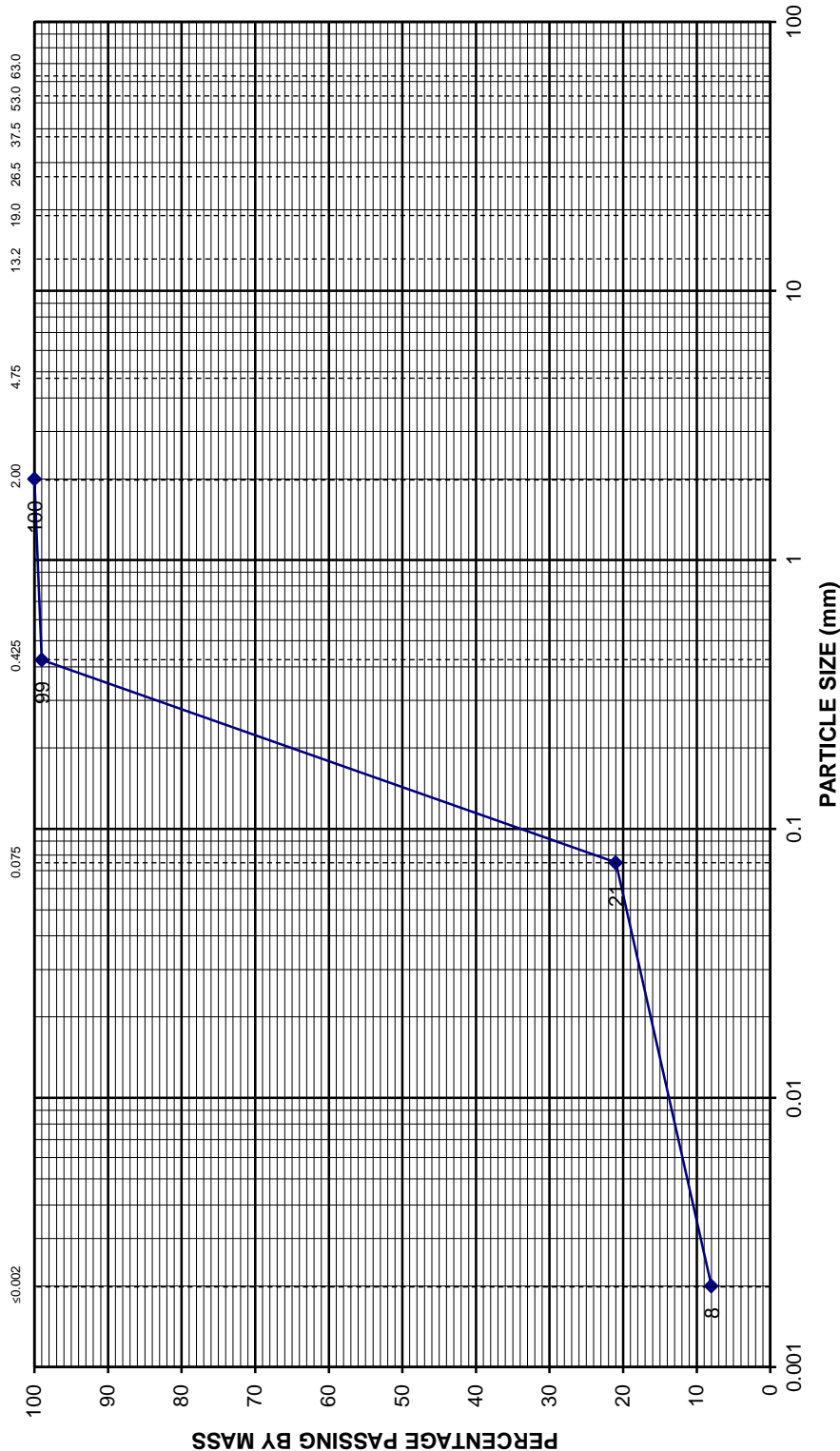


Particle Size Range (mm)	Classification	Percentage
(≤ 0.002)	CLAY	4%
(0.002 - 0.006)	FINE	7%
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	63%
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	26%
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	

HOLE No.:	Test Pit 09	DEPTH:	800 - 1200 mm	SAMPLE No.:	T4, 013/3068
MATERIAL DESCRIPTION: Slightly moist grey white dense calcified mudstone					
ATTERBERG LIMITS:	42 / 14 / 7.0	POTENTIAL EXPANSIVENESS:	Low	PAGE No.:	10 of 13



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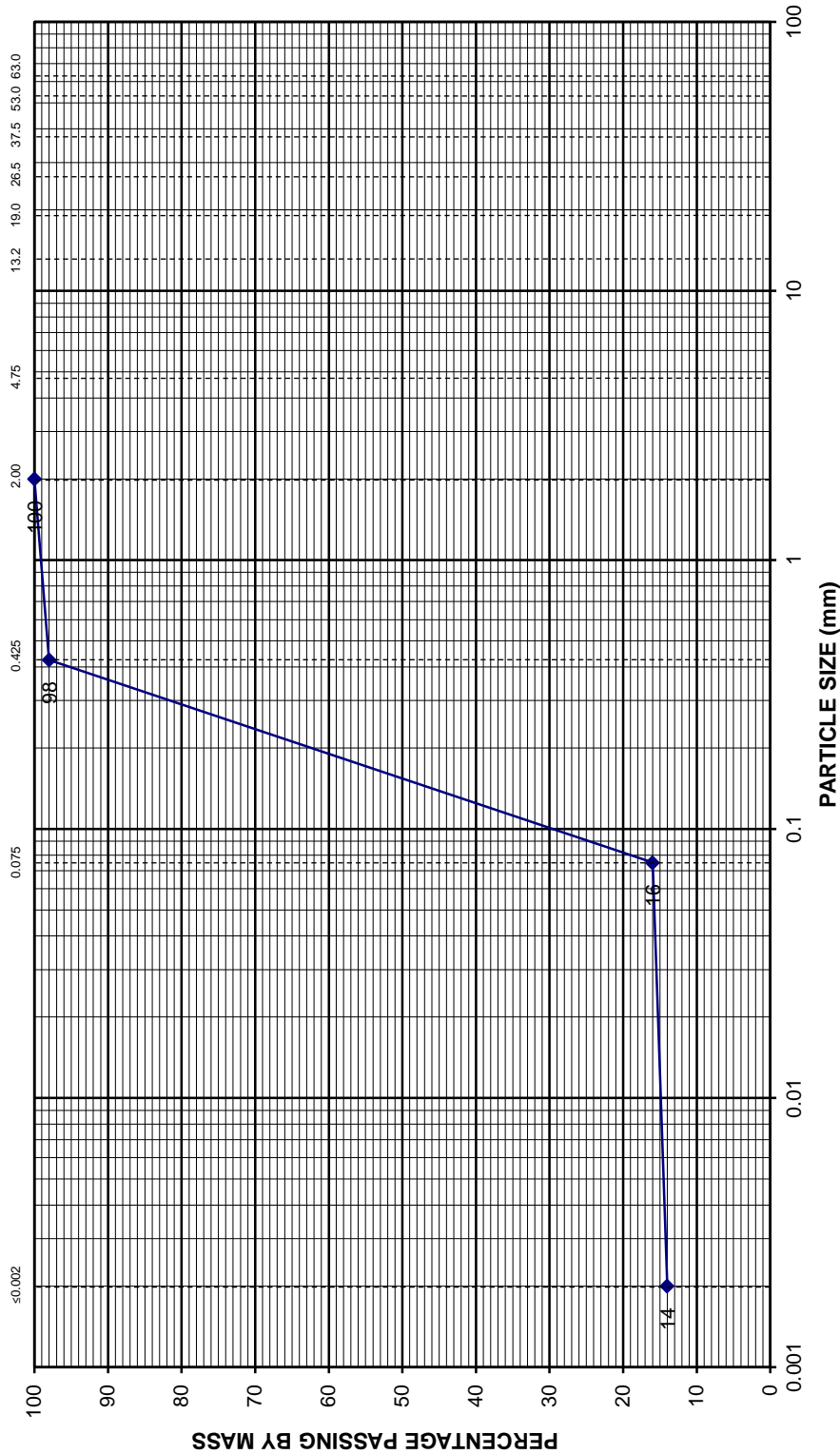


Particle Size Range (mm)	Soil Type	Percentage
(≤ 0.002)	CLAY	8%
(0.002 - 0.006)	FINE	
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	
SILT		13%
SAND		79%
GRAVEL		0%

HOLE No.: Test Pit 10	DEPTH: 0 - 400 mm	SAMPLE No.: T8, 013/3072
MATERIAL DESCRIPTION: Slightly moist dark brown dense clayey sand		
ATTERBERG LIMITS: 23 / 8 / 4.0	POTENTIAL EXPANSIVENESS: Low	PAGE No.: 11 of 13



***PARTICLE SIZE DISTRIBUTION**

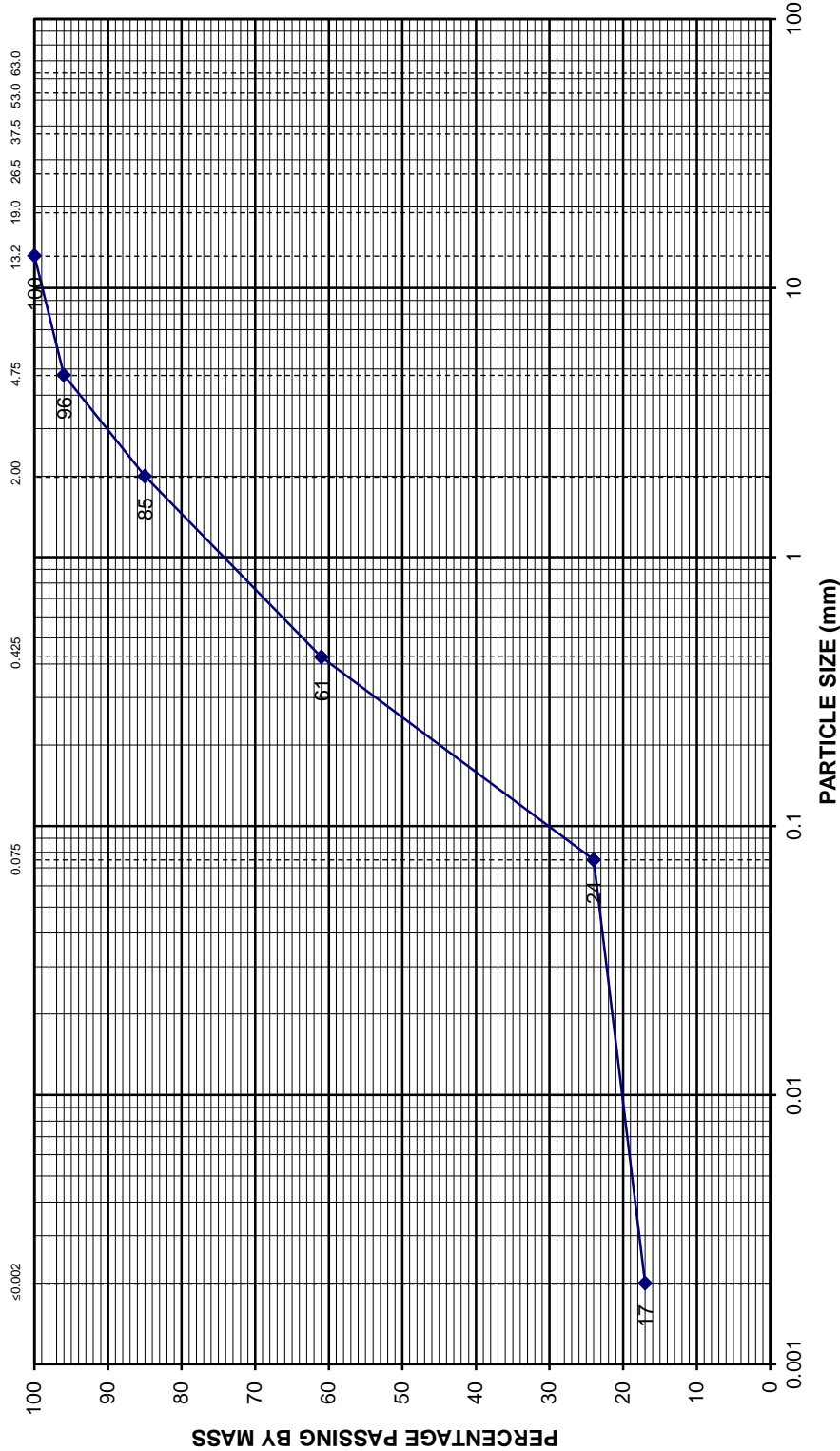


Particle Size Range (mm)	Soil Classification	Percentage
(≤0.002)	CLAY	14%
(0.002 - 0.006)	FINE	
(0.006 - 0.020)	MEDIUM	
(0.020 - 0.060)	COARSE	
(0.060 - 0.200)	FINE	
(0.200 - 0.600)	MEDIUM	
(0.600 - 2.000)	COARSE	
(2.0 - 6.0)	FINE	
(6.0 - 20.0)	MEDIUM	
(20.0 - 60.0)	COARSE	
(60.0 - 200.0)	COBBLE	
Total	SAND	84%
Total	SILT	2%
Total	GRAVEL	0%

HOLE No.: Test Pit 10	DEPTH: 400 - 1500 mm	SAMPLE No.: T9, 013/3073
MATERIAL DESCRIPTION: Slightly moist dark brown dense slicken sided clayey sand		
ATTERBERG LIMITS: 31 / 14 / 6.5	POTENTIAL EXPANSIVENESS: Medium - 14.0mm	PAGE No.: 12 of 13



***PARTICLE SIZE DISTRIBUTION**



Particle Size Range (mm)	Soil Classification	Percentage
(≤ 0.002)	FINE CLAY	17%
(0.006 - 0.006)	FINE CLAY	17%
(0.006 - 0.020)	MEDIUM SILT	7%
(0.020 - 0.060)	COARSE SILT	7%
(0.060 - 0.200)	FINE SAND	61%
(0.200 - 0.600)	MEDIUM SAND	61%
(0.600 - 2.000)	COARSE SAND	61%
(2.0 - 6.0)	FINE GRAVEL	15%
(6.0 - 20.0)	MEDIUM GRAVEL	15%
(20.0 - 60.0)	COARSE GRAVEL	15%
(60.0 - 200.0)	COBBLE	15%

HOLE No.: Test Pit 10	DEPTH: 1500 - 1900 mm	SAMPLE No.: T10, 013/3074
MATERIAL DESCRIPTION: Slightly moist white dense calcified mudstone		
ATTERBERG LIMITS: 47 / 21 / 10.1	POTENTIAL EXPANSIVENESS: Medium - 4.2mm	PAGE No.: 13 of 13

APPENDIX E TEST PIT PHOTOS



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TEST PIT PHOTOS



TEST PIT 1



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TEST PIT PHOTOS



TEST PIT 2



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TEST PIT PHOTOS



TEST PIT 3



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TEST PIT PHOTOS



TEST PIT 4



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TEST PIT PHOTOS



TEST PIT 5



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TEST PIT PHOTOS



TEST PIT 7



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TEST PIT PHOTOS



TEST PIT 8



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TEST PIT PHOTOS



TEST PIT 9



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TEST PIT PHOTOS



TEST PIT 10

APPENDIX F SITE PHOTOS



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SITE PHOTOS



Vicinity of Test Pit 7



Direction : South West



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SITE PHOTOS



Direction : East



Direction : South

APPENDIX G LAYOUT PLAN



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LAYOUT PLAN



GPS CO-ORDINATES

TP1	27 Y0082683	X3131275
TP2	27 Y0082698	X3131432
TP3	27 Y0082735	X3131582
TP4	27 Y0082624	X3131643
TP5	27 Y0082743	X3131711
TP6	27 Y0082908	X3131708
TP7	27 Y0083067	X3131704
TP8	27 Y0083181	X3131637
TP9	27 Y0083049	X3131580
TP10	27 Y0082882	X3131513

WGS 84 South African LO 27